 NASA SP-7037 (20)

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 20

JULY 1972

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PREVIOUS BIBLIOGRAPHIES IN THIS SERIES

Document	*Date*	*Coverage*
NASA SP-7037	September 1970	Jan.–Aug. 1970
NASA SP-7037 (01)	January 1971	Sept.–Dec. 1970
NASA SP-7037 (02)	February 1971	January 1971
NASA SP-7037 (03)	March 1971	February 1971
NASA SP-7037 (04)	April 1971	March 1971
NASA SP-7037 (05)	May 1971	April 1971
NASA SP-7037 (06)	June 1971	May 1971
NASA SP-7037 (07)	July 1971	June 1971
NASA SP-7037 (08)	August 1971	July 1971
NASA SP-7037 (09)	September 1971	August 1971
NASA SP-7037 (10)	October 1971	September 1971
NASA SP-7037 (11)	November 1971	October 1971
NASA SP-7037 (12)	December 1971	November 1971
NASA SP-7037 (13)	January 1972	December 1971
NASA SP-7037 (14)	January 1972	Annual Indexes 1971
NASA SP-7037 (15)	February 1972	January 1972
NASA SP-7037 (16)	March 1972	February 1972
NASA SP-7037 (17)	April 1972	March 1972
NASA SP-7037 (18)	May 1972	April 1972
NASA SP-7037 (19)	June 1972	May 1972

This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Tisco, Inc.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget June 23, 1971.

NASA SP-7037 (20)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 20

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in June 1972 in

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

Scientific and Technical Information Office
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JULY 1972
Washington D C

This Supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22151 for $3 00. For copies mailed to addresses outside the United States, add $2.50 per copy for handling and postage.

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.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 437 reports, journal articles, and other documents originally announced in June 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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 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 are reproduced exactly as they appeared originally in *IAA* or *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.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A72-10000 Series)

All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc, (AIAA), as follows Paper copies are available at $5 00 per document up to a maximum of 20 pages The charge for each additional page is 25 cents Microfiche [1] are available at the rate of $1 00 per microfiche for documents identified by the # symbol following the accession number A number of publications, because of their special characteristics, are available only for reference in the AIAA Technical Information Service Library Minimum airmail postage to foreign countries is $1.00 Please refer to the accession number, e g , A72-10969, when requesting publications

STAR ENTRIES (N72-10000 Series)

A source from which a publication abstracted in this Section is available to the public is ordinarily given on the last line of the citation, e g , Avail NTIS The following are the most commonly indicated sources (full addresses of these organizations are listed at the end of this introduction)

Avail NTIS Sold by the National Technical Information Service at a standard price of $3 00 for hard copy (printed, facsimile, or reproduced from microcopy) of 300 pages or less Documents in the 301 to 600 page range are sold for $6 00 in hard copy, and those in the 601 to 900 page range are sold at $9 00 Documents exceeding 900 pages are priced by NTIS on an individual basis These prices apply retroactively to all documents in the NTIS collection, but in addition, documents of 300 pages or less that are over two years old (from date of announcement in *Government Reports Announcements*, or *STAR* for those items announced only in *STAR*) will have a surcharge of $3 00 added for a total price of $6 00 No additional surcharge will be added for documents over 300 pages For copies mailed to addresses outside the United States add $2 50 each for handling and postage. Microfiche is available from NTIS at a standard price of 95 cents (regardless of age) for those documents identified by the # sign following the accession number (e g , N72-11045#) and having an NTIS availability shown in the citation For copies mailed to addresses outside the United States add $1 50 per document for handling and postage Standing orders for microfiche of (1) the full collection of NTIS-available documents announced in *STAR* with the # symbol, (2) NASA reports only (identified by an asterisk (*)), (3) NASA-accessioned non-NASA reports only (for those who wish to maintain an integrated microfiche file of aerospace documents by the "N" accession number), or (4) any of these classes within one or more *STAR* categories, also may be placed with NTIS at greatly reduced prices per title (e g., 35 cents) over individual requests For subscribers outside the United States, add 15 cents for each title shipped Inquiries concerning NTIS Selective Categories in Microfiche should be addressed to the Subscription Unit, National Technical Information Service
Prices for NTIS products and services are subject to change without notice

Avail SOD (or GPO) Sold by the Superintendent of Documents, U S Government Printing Office, in hard copy The price is given following the availability line (An order received by NTIS for one of these documents will be filled at the SOD price if hard copy is requested NTIS will also fill microfiche requests, at the standard 95 cent price, for those documents identified by a # symbol)

(1) A microfiche is a transparent sheet of film, 105 x 148 mm in size containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 24 1 reduction)

Avail NASA Scientific and Technical Information Office Documents with this availability are usually news releases or informational brochures available without charge in paper copy

Avail AEC Depository Libraries Organizations in U S cities and abroad that maintain collections of U S Atomic Energy Commission reports, usually in microfiche form, are listed in *Nuclear Science Abstracts* Services available from the USAEC and its depositories are described in a booklet, *Science Information Available from the Atomic Energy Commission* (TID-4550), which may be obtained without charge from the USAEC Division of Technical Information

Avail Univ Microfilms Documents so indicated are dissertations selected from *Dissertation Abstracts,* and are sold by University Microfilms as xerographic copy (HC) at $10 00 each and microfilm at $4 00 each, regardless of the length of the manuscript Handling and shipping charges are additional All requests should cite the author and the Order Number as they appear in the citation

Avail HMSO Publications of Her Majesty's Stationery Office are sold in the U S by Pendragon House, Inc , (PHI), Redwood City, California The U S price (including a service charge) is given, or a conversion table may be obtained from PHI

Avail National Lending Library, Boston Spa, England Sold by this organization at the price shown (If none is given, an inquiry should be addressed to NLL)

Avail ZLDI Sold by the Zentralstelle fur Luftfahrtdokumentation und -Information, Munich, Federal Republic of Germany, at the price shown in deutschmarks (DM)

Avail Issuing Activity, or Corporate Author, or no indication of availability Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document

Avail U S Patent Office Sold by Commissioner of Patents, U S Patent Office, at the standard price of $ 50 each, postage free

Other availabilities If the publication is available from a source other than the above, the publisher and his address will be displayed entirely on the availability line or in combination with the corporate author line

GENERAL AVAILABILITY

All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA A listing of public collections of NASA documents is included on the inside back cover

SUBSCRIPTION AVAILABILITY

This publication is available on subscription from the National Technical Information Service (NTIS) The annual subscription rate for the monthly supplements, excluding the annual cumulative index, is $18 00 All questions relating to subscriptions should be referred to the NTIS

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics
and Astronautics
Technical Information Service
750 Third Ave
New York, N Y 10017

Commissioner of Patents
U S Patent Office
Washington, D C 20231

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av Charles de Gaulle
92-Neuilly-sur-Seine, France

Her Majesty's Stationery Office
P O Box 569, S E 1
London, England

NASA Scientific and Technical Information
Facility
P O Box 33
College Park, Maryland 20740

National Aeronautics and Space
Administration
Scientific and Technical Information
Office (KSI)
Washington, D C 20546

National Lending Library for Science
and Technology
Boston Spa, Yorkshire, England

National Technical Information Service
Springfield, Virginia 22151

Pendragon House, Inc
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U S Government Printing Office
Washington, D C 20402

University Microfilms, Inc
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

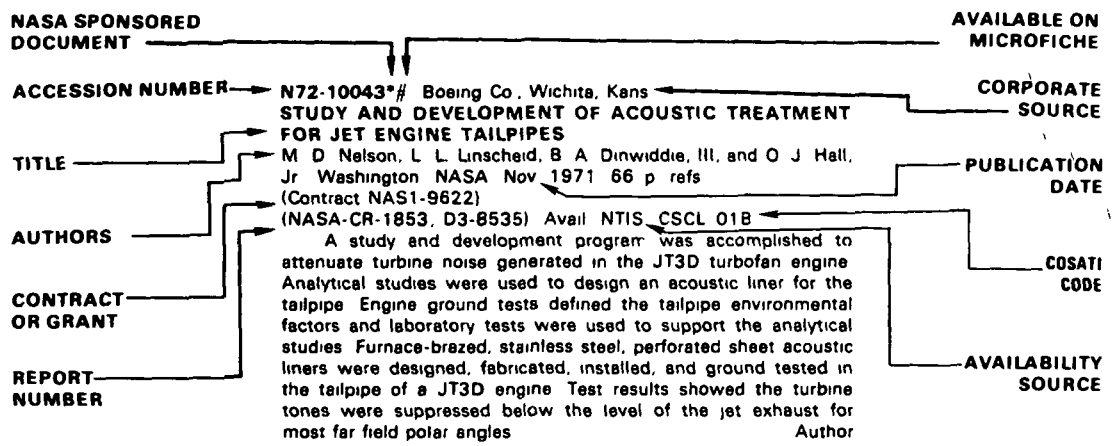
University Microfilms, Inc
Tylers Green
London, England

U S Atomic Energy Commission
Technical Information Center
P O Box 62
Oak Ridge, Tennessee 37830

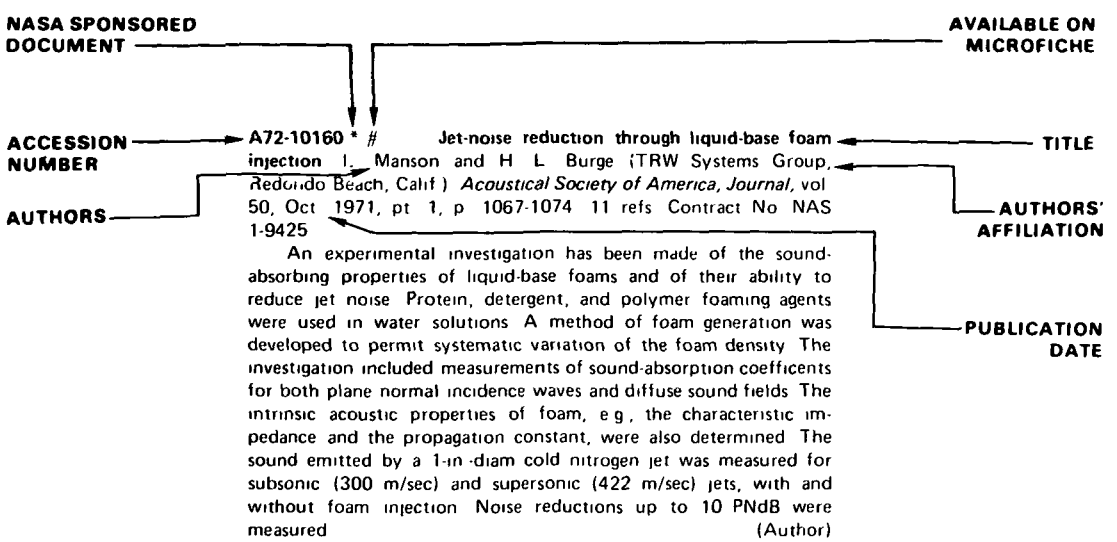
Zentralstelle fur Luftfahrtdoku-
mentation und-Information
8 Munchen 86
Postfach 880
Federal Republic of Germany

TABLE OF CONTENTS

TYPICAL CITATION AND ABSTRACT FROM *STAR*



TYPICAL CITATION AND ABSTRACT FROM *IAA*



AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 20) JULY 1972

IAA ENTRIES

A72-25247 # **Surface patterns - Comparison of experiment with theory.** C O White and R M Grabow (Philco-Ford Corp., Aeronutronic Div., Newport Beach, Calif) *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 7th, San Antonio, Tex., Apr. 10-12, 1972, Paper 72-313* 12 p 31 refs Members, $1 50, nonmembers, $2 00 Contract No. F04701-71-C-0014.

Experimental surface patterns from ablating, melting, and flowing materials in supersonic flow are compared with theory Results from wind tunnel, rocket motor, and flight test environments are shown to have common characteristics and to correlate in terms of relatively simple parameters The theories considered include differential ablation, inelastic deformation, and liquid layer instability mechanisms All theories yield the same functional dependence of pattern wave angle, but the predicted variations of pattern wavelength and onset condition are found to be different for each of the mechanisms The experimental data are best correlated by a theoretical model which encompasses both the inelastic deformation and liquid layer mechanisms. (Author)

A72-25255 # **Coordinating the coming STOL aircraft system.** J. T. Pyle and H. H. Howell. *Astronautics and Aeronautics*, vol 10, Apr 1972, p. 43, 80.

Discussion of a coordinated STOL aircraft system development program designed to hasten the operational maturity and start of such a system. Four examined key elements of this program include the vehicle, the airport facility and related ground environment, the modal interface, and airspace management and coordination M.V.E

A72-25284 # **Hydraulic starter systems for aircraft turbine engines II (Hydrauliczne uklady rozruchu lotniczych silnikow turbinowych. II).** B Bolinski *Technika Lotnicza i Astronautyczna,* vol 27, Feb 1972, p 10-13 In Polish

The dynamics of a hydraulic starter system for a turbine engine are examined in terms of loads arising in the system under operation, and design requirements for ensuring adequate fluid supply and satisfactory fluid pressure are outlined A method is described for solving the equation of motion of a hydraulic motor with torque loading and variable pressure of the working fluid T M

A72-25285 # **Critical lift of a helicopter rotor. I (Krytyczna nosnosc wirnika smiglowca. I).** K Szumanski *Technika Lotnicza i Astronautyczna,* vol. 27, Feb 1972, p 14-17 10 refs In Polish

Flow separation on helicopter rotor blades is examined as a function of flight speed, rotor disk loading, blade tip speed, air density, rotor geometry, blade elasticity, and flow velocity distribution across the rotor. Separation-induced effects are analyzed, including (1) ceiling, speed, and lift reductions, (2) increased noise and vibration, (3) loss of stability and maneuverability, (4) rise in power consumption, and (4) increased dynamic loading Design methods of evaluating the critical lift of rotors are compared T.M

A72-25286 # **New alloys used in the aircraft industry (Nowe stopy stosowane w przemysle lotniczym).** J Sadaj *Technika Lotnicza i Astronautyczna,* vol 27, Feb 1972, p 18-21 5 refs In Polish

The chemical compositions of titanium, aluminum, and steel alloys employed in the aircraft industry are described along with typical heat treatment operations Tables show the elastic modulus, yield limit, strength, and other properties of both alloys and welds Typical applications and operational specifications are outlined T M

A72-25287 # **Aircraft wheel mechanics. II (Mechanika kola samolotu II).** M. Mielniczak *Technika Lotnicza i Astronautyczna,* vol 27, Feb. 1972, p 22-25 In Polish.

Forces acting on freely turning and braked wheels are described, and the operation of antiskid braking systems for aircraft landing gear mechanisms is explained. Cross-wind effects on the braking process are examined, and attention is given to factors producing lateral drift of tires on the runway A comprehensive breakdown of forces acting on the entire gear mechanism during taxiing is included T M

A72-25329 **Properties of the extremal field in an optimal control problem.** V F Illarionov and V T Pashintsev (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) *(Akademiia Nauk SSSR, Doklady,* vol 200, Oct. 21, 1971, p 1291-1293) *Soviet Physics - Doklady,* vol 16, Apr 1972, p. 820-822 Translation.

The parameters of optimal aircraft flight over an assigned distance with a minimum fuel consumption are discussed Pontriagin's maximum principle is applied to obtain the optimal control requirements for determining the properties of a family of extremals in the plane of the specific mechanical energy and altitude (h) of flight The properties are realizable in the open region of a set of permissible values of the engine thrust and h V Z

A72-25366 * # **A mixed optimization method for automated design of fuselage structures** J Sobieszczanski (NASA, Langley Research Center, Hampton, Va) and D. Loendorf (NASA, Langley Research Center, Hampton, Va , U S Army, Washington, D C). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr 10-12, 1972, AIAA Paper 72-330.* 12 p 16 refs Members, $1.50, nonmembers, $2 00.

A procedure for automating the design of transport aircraft fuselage structures has been developed and implemented in the form of an operational program The structure is designed in two stages First, an overall distribution of structural material is obtained by means of optimality criteria to meet strength and displacement constraints Subsequently, the detailed design of selected rings and panels consisting of skin and stringers is performed by mathematical optimization accounting for a set of realistic design constraints The practicality and computer efficiency of the procedure is demonstrated on cylindrical and area-ruled large transport fuselages (Author)

A72-25367 * # **Automated procedures for sizing aerospace vehicle structures (SAVES)** G L Giles, C L Blackburn, and S C. Dixon (NASA, Langley Research Center, Hampton, Va). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr 10-12, 1972, AIAA Paper 72-332* 13 p 25 refs Members, $1 50, nonmembers, $2 00

Results from a continuing effort to develop automated methods for structural design are described A system of computer programs presently under development called SAVES is intended to automate the preliminary structural design of a complete aerospace vehicle. Each step in the automated design process of the SAVES system of programs is discussed, with emphasis placed on use of automated

routines for generation of finite-element models The versatility of these routines is demonstrated by structural models generated for a space shuttle orbiter, an advanced technology transport, and a hydrogen fueled Mach 3 transport. Illustrative numerical results are presented for the Mach 3 transport wing (Author)

A72-25368 * # **Automated design optimization of supersonic airplane wing structures under dynamic constraints.** R L Fox (Case-Western-Reserve University, Cleveland, Ohio), H Miura (Technical University of Norway, Trondheim, Norway), and S S Rao (Indian Institute of Technology, Kanpur, India) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr 10-12, 1972, AIAA Paper 72-333.* 17 p 24 refs Members, $1.50, nonmembers, $2 00 Grant No NGR-36-003-002

The problems of the preliminary and first level detail design of supersonic aircraft wings are stated as mathematical programs and solved using automated optimum design techniques The problem is approached in two phases the first is a simplified equivalent plate model in which the envelope, plan form and structural parameters are varied to produce a design, the second is a finite element model with fixed configuration in which the material distribution is varied Constraints include flutter, aeroelastically computed stresses and deflections, natural frequency and a variety of geometric limitations The Phase I objective is a combination of weight and drag while Phase II is a weight minimization (Author)

A72-25369 * # **Design of a convective cooling system for a Mach 6 hypersonic transport airframe** F M Anthony and R G. Helenbrook (Bell Aerospace Co., Buffalo, N.Y) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr 10-12, 1972, AIAA Paper 72-334.* 16 p 6 refs Members, $1 50, nonmembers, $2.00 Contract No NAS1-7468

The design of a convective cooling system for an aluminum alloy airframe was established to verify preliminary weight estimates and to define future development requirements A water glycol coolant was circulated through a closed loop network of supply and return lines to absorb incident aerodynamic heating from structural skin panels with integral passages and to transfer this heat input to a heat exchanger where it is rejected to the hydrogen fuel Partial shielding of the aluminum alloy structure reduced heat loads to levels compatible with engine fuel flow requirements (Author)

A72-25370 * # **Hail damage to typical aircraft surfaces.** R. J. Hayduk (NASA, Langley Research Center, Hampton, Va.) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-335* 7 p 9 refs Members, $1.50, nonmembers, $2 00

Severe structural damage can occur when aircraft collide with hailstones Consequently, methods of predicting hail damage to airplane surfaces are needed by the aircraft designer This paper describes an analytical method of predicting the dent depth and final deformed shape for simple structural components impacted by hailstones The solution was accomplished by adapting the DEPROSS computer program to the problem of normal impact of hail on flat metallic sheets and spherical metallic caps Experimental data and analytical predictions are presented for hail damage to typical aircraft surfaces along with a description of the hail gun and hail simulation technique used in the experimental study (Author)

A72-25374 * # **The effect of hypersonic nonlinear aerodynamic loading on panel flutter** S C McIntosh, Jr (Stanford University, Stanford, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-345.* 8 p. 8 refs. Members, $1.50, nonmembers, $2.00 Grant No NGR-05-020-102

The system considered is a two-dimensional isotropic panel, or plate-column, on hinged supports, with one end spring restrained in the plane of the panel. Panel geometric nonlinearities and piston-theory aerodynamic nonlinearities are included Results from an earlier preliminary study indicate that only two second-order nonlinear aerodynamic terms are important. The nonlinear aerodynamic terms introduce the possibility of an amplitude-sensitive instability, where the panel is unstable to disturbances of a certain magnitude but stable for smaller ones This type of instability is examined for various panel in-plane loads and initial conditions, with other parameters having values representative of current practice. A single new interaction parameter, representing the importance of the nonlinear aerodynamic terms in comparison with the panel geometric nonlinear terms, is introduced. A parameter survey is presented, involving this parameter and the static pressure difference across the panel. Finally, the practical impact of this type of instability is discussed. (Author)

A72-25387 * # **Compressive strength of titanium alloy skin-stringer panels selectively reinforced with boron-aluminum composite.** H. W Herring (NASA, Langley Research Center, Hampton, Va) and R. L Carri (Grumman Aerospace Corp , Bethpage, N.Y.) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr. 10-12, 1972, AIAA Paper 72-359.* 9 p 5 refs Members, $1.50, nonmembers, $2.00

Description of a method of selectively reinforcing conventional titanium airframe structure with unidirectional boron-aluminum composite attached by brazing which has been successfully demonstrated based on compression tests of short skin-stringer panels Improvements in structural performance exceeded 25% on an equivalent weight basis over the range from room temperature to 800 F, both in terms of initial buckling and maximum strengths Room-temperature performance was not affected by prior exposure at 600 F for 1000 hours in air, or by 400 cycles between -65 and 600 F The experimental results were generally predictable on the basis of existing analytical procedures. No evidence of failure was observed in the braze bond between the boron-aluminum composite and the titanium alloy (Author)

A72-25389 # **The graded thermal barrier - A new approach for turbine engine cooling.** J R Cavanagh, K. R Cross, R L Newman, and W. C. Spicer (General Motors Corp , Detroit Diesel Allison Div., Indianapolis, Ind.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr 10-12, 1972, AIAA Paper 72-361.* 16 p 13 refs Members, $1 50, nonmembers, $2.00.

A cooling scheme, based on the use of a low-conductivity insulating coating (thermal barrier), for high-pressure-ratio high-inlet-temperature gas turbine engines is examined An attractive feature common to such schemes is the substantial savings in cooling air The relative merits of thin graded plasma-sprayed coatings and thicker reinforced coatings are discussed, and the results of a test program which match engine conditions with the graded coatings are reviewed. (Author)

A72-25400 # **Dynamic modeling of high bypass ratio turbofan engines.** J C. Breaks (Lockheed-California Co , Burbank, Calif.) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr. 10-12, 1972, AIAA Paper 72-376.* 7 p Members, $1.50, nonmembers, $2 00

The models described in this paper were constructed and tested as part of the wind tunnel flutter test program for the Lockheed L-1011 tri-jet This paper is presented to show the methods used to simulate the complex structure of a large turbo-fan engine and to present data from the calibration of the models which will support

the conclusion that a successful simulation was accomplished Design of the models parallels that of the full scale Rolls Royce RB211 engine as closely as possible in order to permit the study of a wide range of failed and unfailed conditions. Several design compromises were necessary, however, and these and their solutions are noted. The resultant engine models proved to be very durable, undergoing over 200 hours of testing without a failure (Author)

A72-25401 # **Theoretical investigation of supersonic cascade flutter and related interference problems.** M F Platzer (U S. Naval Postgraduate School, Monterey, Calif) and H. G Chalkley (U S. Navy, Washington, D.C) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-377.* 9 p 14 refs. Members, $1 50, nonmembers, $2 00. Navy-supported research Navy Task A310310A/551A/1

Supersonic flow past oscillating flat plate cascades with supersonic leading-edge locus is analyzed using a linearized method of characteristics valid for arbitrary frequencies and an elementary analytical theory valid only for low frequencies of oscillation These two methods are extensions of previous work by Teipel and Sauer for the single airfoil in an unbounded supersonic flow to the case of airfoils oscillating in cascade Pressure distributions as well as torsional flutter boundaries are computed in dependence of some of the primary parameters, i e , Mach number, solidity, stagger angle, density ratio, structural damping and elastic axis position Also, results are presented for the related problem of supersonic wind tunnel interference (including the effect of tunnel porosity) and airfoil-airfoil interference (Author)

A72-25402 # **Unsteady aerodynamics of non-planar wings and wing-tail configurations of elastic flight vehicles in supersonic flight.** J Morito, II and W S. Rowe (Boeing Co., Seattle, Wash) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr. 10-12, 1972, AIAA Paper 72-378.* 16 p. 19 refs Members, $1 50, nonmembers, $2 00 Contract No. F33615-70-C-1126.

This paper presents a method for predicting the unsteady aerodynamic loadings of flexible aircraft with non-planar wings and wing-tail surfaces in supersonic flow. The aerodynamic interference between the wing and tail has been taken into account. The planforms of either surface are entirely general, being specified by linear boundaries between points The computation considers dihedral angles on both wing and tail, and longitudinal and vertical separations between them. The aerodynamic influence coefficients (AIC) associated with velocity potential, upwash, sidewash and longitudinal wash at the center of the arbitrarily oriented pulse-receiving panel are developed. The AIC's are manipulated to avoid numerical integration problems due to their singular natures at the Mach hyperbola The boundary conditions of the 'interfered' surfaces in the disturbed flow field are discussed Illustrative examples for the computed aerodynamic quantities and flutter stability boundaries are presented and correlated with empirical data. (Author)

A72-25404 * # **Stall flutter analysis.** L E. Ericsson and J P Reding (Lockheed Missiles and Space Co , Sunnyvale, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr 10-12, 1972, AIAA Paper 72-380* 16 p 56 refs Members, $1 50, nonmembers, $2.00 Contract No NAS1-9987

An analysis of unsteady airfoil stall and stall flutter is presented that is based on a series of approximations. Unsteady aerodynamic characteristics are related theoretically to static aerodynamic characteristics Preliminary results show good agreement with experimental dynamic stall data The analysis is applied to determine the boundaries for stall flutter, particularly for the straight wing of one candidate space-shuttle configuration As formulated, the analysis should provide a conservative estimate - i e., the predicted stall flutter region is slightly larger than the expected one, as demonstrated by comparison with experiments M V E

A72-25413 * # **Design, analysis, and test of a boron/epoxy reinforced airframe.** M J Rich and R T Welge (United Aircraft Corp., Sikorsky Aircraft Div , Stratford, Conn) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr. 10-12, 1972, AIAA Paper 72-392.* 7 p. Members, $1 50, nonmembers, $2 00. Contract No NAS1-10459.

The airframe of a large helicopter generally requires additional stiffening for dynamic tuning to prevent resonance with the rotor vibratory forces Investigations showed that aluminum stringers reinforced with boron/epoxy offered substantial weight saving for the CH54B Skycrane helicopter to achieve the required airframe stiffness As a result, a program has been conducted under a NASA contract to design, test, and evaluate the static and fatigue strength characteristics of the composite reinforcement The results of this phase of the effort will be reported in this paper (Author)

A72-25423 * # **Experimental evaluation of the aerodynamic damping of skin panels at low supersonic Mach numbers.** L Muhlstein, Jr. (NASA, Ames Research Center, Moffett Field, Calif). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-402.* 8 p 12 refs Members, $1 50, nonmembers, $2 00

The aerodynamic damping of the first three vibration modes of a rectangular panel exposed to an attached turbulent boundary layer has been measured over the Mach number range of 1 10 to 1 40 Data showing that aerodynamic damping is a strong function of Mach number, dynamic pressure, mode shape, and boundary layer thickness are presented. At low supersonic Mach numbers, aerodynamic damping was found to be 20 to 100 times as large as common values of structural damping Means of calculating aerodynamic damping, including effects of the boundary layer profile, are discussed Calculated aerodynamic damping is compared with experimental data (Author)

A72-25424 * # **On the calculation of panel flutter boundaries.** P A Gaspers, Jr (NASA, Ames Research Center, Moffett Field, Calif) *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex , Apr 10-12, 1972, AIAA Paper 72-403* 6 p Members, $1 50, nonmembers, $2 00

Methods are described for the complete automation of flutter boundary calculations when the aerodynamic forces are derived from linear three-dimensional unsteady potential flow theory The usual process of visual curve fairing in the mass ratio versus structural damping plane is replaced by numerical procedures for ordering the eigenvalues in such a way that the n-th eigenvalue is always associated with the same flutter boundary The mass ratio versus structural damping curves are interpolated via parametric cubic spline functions to produce the desired plots in the stiffness-parameter/mass-ratio plane The entire process is accomplished in a single computer run (Author)

A72-25453 **Design, analysis, and testing of an advanced composite F-111 fuselage.** J E Ashton, M L Burdorf, and F. Olson (General Dynamics Corp , Fort Worth, Tex) In Composite materials Testing and design, Proceedings of the Second Conference, Anaheim, Calif , April 20-22, 1971 . Philadelphia, American Society for Testing and Materials, 1972, p 3-27 Contract No F33615-69-C-1494

The paper describes the design, analysis, and testing of a full-scale section of an F-111 aft fuselage center body made from advanced composite materials A 160-in -long test component was fabricated and tested to destruction The composite material systems were graphite/epoxy, boron/epoxy, boron/aluminum, and glass/epoxy Maximum use of composites was maintained throughout the structure, with both skins and substructures being treated Design concepts for the various structural elements were developed through a program of testing of subelement specimens Test results were obtained on the strength of boron and graphite composites applied to sandwich panels, stiffened sheet panels, frames, bulkheads, and fittings A static test component was detail designed and fabricated Fourteen subassemblies of frames and panels were fabricated and assembled into a 920-lb component using 460 lb of composite material A weight saving of 18 per cent of the counterpart aluminum and steel structure was obtained (Author)

A72-25454 Design philosophy for boron/epoxy structures. R N Hadcock (Grumman Aerospace Corp , Bethpage, N Y) In *Composite materials Testing and design, Proceedings of the Second* Conference, Anaheim, Calif , April 20-22, 1971
Philadelphia, American Society for Testing and Materials, 1972, p 28-40 7 refs

The philosophy followed to satisfy design requirements for aircraft structures is discussed An approach is described which has been successfully used to generate boron/epoxy design allowables data on the basis of 90% probability of survival with a confidence of 95% This approach results in design strength data which include not only the variations in material properties but also any inadequacies in theoretical methods for strength prediction Results of tests on full scale components and subcomponents are compared with theoretical predictions using these design allowables data (Author)

A72-25476 The strength of bolted connections in graphite/epoxy composites reinforced by colaminated boron film G E. Padawer (National Research Corp , Cambridge, Mass) In Composite materials Testing and design, Proceedings of the Second Conference, Anaheim, Calif , Apr 20-22, 1971
Philadelphia, American Society for Testing and Materials, 1972, p 396-414 20 refs Contract No N000156-70-C-1100

Investigation of unidirectional (all 0 deg), bidirectional (plus or minus 45 deg), and tridirectional (0 deg, plus or minus 45 deg) graphite fiber/epoxy resin composites fabricated to form a series of double-lap bolted joint models These models were tested to measure the joint strength effectiveness of transversely isotropic boron film colaminated locally at 6 and 12 vol % levels Results show that the addition of film plies to the highly directional fiber laminae increases the joint strength and stiffness up to 200%, the chief contribution of the boron film being high bearing strength and resistance to shear distortion A novel test method for bolted lap joints was developed in which the bolt head pressure was maintained constant by means of preloaded springs, thus eliminating the ambiguity resulting from an inconstant contribution of the bolt clamping friction to the total joint strength The strength weight effectiveness of boron film reinforcement in this particular application is demonstrated (Author)

A72-25567 Spectrometric oil analysis - Use and interpretation of data D Lotan (SNECMA, Paris, France) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar. 15-17, 1972, Paper 720303.* 16 p Members, $1 25, nonmembers, $2 00

The paper describes a theory that can be used to explain a mathematical statement of the functioning of an oil system To arrive at this theory, the rates of contamination of the oil circuits of turbojet engines were investigated extensively, by way of spectrometric oil analyses The details of the phenomena involved are presented, along with the parameters governing the oil system A chart for interpreting spectrometric oil analysis data is developed, and the mathematical theory is worked out in detail (Author)

A72-25568 Civil certification of a normal category plastic airplane. C L Stoner (FAA, Washington, D C) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720304* 3 p Members, $1 25; nonmembers, $2 00

This paper covers structural requirements for certification of a normal category plastic airplane Due to the lack of service experience and published data, substantiation of the airframe requires special attention Means for showing compliance with applicable regulations covering proof of structure, fabrication methods, protection of structure, material strength properties and design values, special factors, fatigue strength, and lightning protection are explained. By current standards, a plastic airframe is novel However, plastics may be the answer to the corrosion and fatigue problems of metal aircraft. (Author)

A72-25569 An investigation of flight loads, counting methods, and effects on estimated fatigue life. R Sewell (National Aeronautical Establishment, Ottawa, Canada) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720305* 17 p 10 refs Members, $1 25, nonmembers, $2 00

This paper is concerned with the analysis of aircraft flight loads from counting accelerometer records of normal acceleration at the center of gravity The load-time histories so obtained may be used to set up applied loads sequences for component or full-scale fatigue tests, and the derived stress-time histories may be used in the estimation of the fatigue life of the wing structure Accelerometer design is discussed, and three counting methods used (peak-count, variable reset, and level crossings) are compared Damage calculations are presented, based on the Miner-Palmgren hypothesis of cumulative damage and the stress-endurance data published by the Royal Aeronautical Society An alternative to the more-usual method of estimating fatigue damage is given which considerably reduces the labor involved and provides more accurate results (Author)

A72-25570 New concepts in developing flight airworthiness requirements. D A Tuck (FAA, Washington, D C) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720306* 6 p 7 refs Members, $1 25, nonmembers, $2 00

The FAA Flight Test Branch is now actively engaged in several regulatory development programs using resources made available by NASA, FAA, USAF, and others in industry These resources include advanced flight simulators, variable stability aircraft, and current aircraft These tools are in use now to develop standard proposals for supersonic transports, V/STOL, transports, and general aviation aircraft Critical control and stability parameters may now be explored by FAA flight standards pilots in concert with other government and industry experts to the extent and with fidelity never before possible G.R

A72-25571 TSO is the way to go. H. E Waterman (FAA, Washington, D C). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720307* 4 p. Members, $1 25, nonmembers, $2.00

General aviation equipment standards are discussed in the light of the needs of safety in the immediate future air traffic system. Particular attention is given to the Technical Standard Order (TSO) system Various objections to TSO are enumerated and examined, as are the advantages of the system and suggestions for its improvement O H

A72-25572 **Aspects of structural safety in general aviation airplanes.** R Allen and W. Roberts (FAA, Washington, D C). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720308* 9 p Members, $1.25, nonmembers, $2 00

A study of 1547 accidents in general aviation was conducted to determine whether structural failure was responsible for a significant portion of these accidents IFR and turbulent weather conditions existed in more than half of these accidents This result was also apparent for fleets with the greatest structural strength Certain general aviation models were relatively free of one or the other of the two major in-flight failure modes (ground contact and stall) The inability to negotiate severe weather suggests that aerodynamic improvement may deserve special emphasis T M

A72-25573 **Some special investigation areas in light aircraft flutter.** C C Pate, M K Punatar, and R W Winn (Cessna Aircraft Co , Wichita, Kan) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar. 15-17, 1972, Paper 720309* 8 p Members, $1 25, nonmembers, $2 00

A brief description is given of one approach taken by a manufacturer of light business and personal aircraft to the flutter analysis of propeller whirl flutter, twin-boom aircraft, T-tail configuration, servo tabs, and all-moving tail Effects of structural variations that may occur in the service life of an aircraft are presented, and the effect of ice formation on control surfaces is discussed (Author)

A72-25574 **Inspectability criteria for airframes designed to fatigue/fail-safe requirements.** R T Weaver (FAA, Washington, D C) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720310* 5 p. 6 refs Members, $1 25, nonmembers, $2 00

Inspection programs which will become a part of small airplane certification and operation as a result of Amendment 7 to Federal Aviation Regulation 23 are discussed This Amendment adds fail-safe strength evaluation to wings and associated structures of small aircraft, which allows compliance with the regulations without long fatigue analyses O H.

A72-25575 **Fatigue certification of general aviation aircraft in Australia.** K O'Brien, C Torkington, M Benoy, and R Douglas (Department of Civil Aviation, Melbourne, Australia) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720311.* 15 p 17 refs Members, $1 25, nonmembers, $2 00

This paper deals broadly with three aspects of the fatigue substantiation of general aviation aircraft structures It describes the development of the Australian fatigue substantiation requirements for general aviation aircraft, it presents the results of local work in the acquisition of loads spectra for a range of aircraft, including pressurized and nonpressurized light twins, and it discusses some specific problems affecting the safe life and fail-safe substantiation of general aviation aircraft structures Recent Australian work on ground taxi load spectra and on the endurance and radiographic inspectability of laminated spar caps is described (Author)

A72-25576 **Reactions of pilots to warning systems for visual collision avoidance.** P M. Rich, W G Crook, R L Sulzer, and P R Hill (FAA, Washington, D.C) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720312.* 24 p. Members, $1.25, nonmembers, $2 00

The FAA conducted a series of six experiments having application to the development of pilot warning instruments (PWI) The experiments were concerned with the effect of warning rates on pilot performance, pilot response to imminent collision threats, the evaluation of scanning patterns, the value of warning-only, the effect of relative motion on pilot performance, and the effect of PWI display sector size The results of these experiments offer a variety of useful data in the area of visual collision avoidance (Author)

A72-25577 **SECANT - A solution to the problem of mid-air collisions.** J. L Parsons (RCA, Electromagnetic and Aviation Systems Div., Van Nuys, Calif.). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar. 15-17, 1972, Paper 720313* 16 p Members, $1 25, nonmembers, $2 00

The paper describes the principal characteristics of SECANT, a system for the separation and control of aircraft using non-synchronous techniques This cooperative, transponding collision-avoidance system, designed to be compatible within the entire aviation community, is capable of accommodating the dense air traffic anticipated for the 1980s and beyond It makes available to the pilot evasion or escape maneuvers in any direction SECANT helps the pilot to avoid midair collisions by transmitting probes and receiving replies with a 1-microsec pulse at 1000 pulses/sec on 24 different frequencies Various discriminants are used to eliminate undesired signals, and the false alarm rate is near zero (Author)

A72-25578 **A solid-state altitude encoder** D. Pollack *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720314* 6 p Members, $1 25, nonmembers, $2.00 Research supported by the Aerosonic Corp

An altitude encoder enables an ATC transponder to report the altitude of the airplane to the controller, in addition to its identity and position Several forms of altitude encoders have been designed This paper describes a digital altitude encoder with only one moving part, almost zero friction, proper accuracy, and all solid-state components In this encoder, frequency is the sensing parameter Also covered are the Gray code and the Gillham code. (Author)

A72-25579 **Weather radar for single engine aircraft** A R Applegarth, Jr *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720315.* 6 p. Members, $1 25, nonmembers, $2 00

A new approach to airborne weather radar using a simple steerable phased-array antenna is presented This antenna avoids the need for a dish of any kind and has no mechanical scanning device It is inexpensive to manufacture, using microstrip techniques throughout, and has an overall gain that is equal to or better than a dish of comparable size It is electronically scanned at about 17 frames/sec through a 90 deg total angle, producing a TV picture type display The range, using an 8 kW peak power X-band transmitter and an inexpensive receiver, is greater than 90 miles The model with beam width about 5 deg in the horizontal plane and 10 deg in the vertical plane fits entirely inside the wing of a Piper Cherokee (Author)

A72-25580 * **Flight evaluations of the effect of advanced control systems and displays on the handling qualities of a general aviation airplane.** P C Loschke, M R. Barber, C R Jarvis, and E K. Enevoldson (NASA, Flight Research Center, Edwards, Calif) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720316.* 12 p Members, $1 25, nonmembers, $2.00

Flight tests have shown that, by means of improved displays and advanced control systems, it is possible to transform a typical light airplane into a flying machine that borders on being perfect from a

handling-qualities standpoint. A flight-director display and an attitude-command control system used in combination transformed a vehicle with poor handling qualities during ILS approaches in turbulent air into a vehicle with extremely good handling qualities. The attitude-command control system also improved the ride qualities of the airplane A rate-command control system was less beneficial than an attitude-command control system. Although this paper deals primarily with general aviation aircraft, the results presented pertain to other types of aircraft. Short-takeoff-and-landing (STOL) aircraft would be a natural application of the control systems because, as a result of their low speeds, they encounter many of the handling-qualities problems noted on light aircraft The improved ride qualities should be of interest to all airline operations, and for STOL aircraft in particular, because of their prolonged exposure to low-altitude turbulence (Author)

A72-25581 Influence of an aft C. G. on longitudinal flying qualities. R. E Smith (Cornell Aeronautical Laboratory, Inc., Buffalo, N Y.). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720318* 15 p 14 refs Members, $1 25, nonmembers, $2.00

The effects of aft center-of-gravity (CG) travel on the total longitudinal response characteristics of the aircraft are reviewed, and the implications of this CG shift on the aircraft's longitudinal flying qualities are discussed. In addition, variations in pitch damping, control gearing, and speed effects are discussed at specific aft CG locations The examples used are based largely on experience gained during in-flight demonstration programs (Author)

A72-25582 * The NASA Advanced Transport Technology Program. T. G Ayers (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720319.* 7 p 9 refs. Members, $1 25, nonmembers, $2 00.

Review of an advanced technology program initiated by NASA to expedite the development and application of advanced technologies to the next generation of subsonic CTOL jet transports The major technical elements of this program include airframe and engine system studies for identifying technology needs, technology development for providing the necessary base in those areas of the aeronautical disciplines offering significant payoffs, and exploratory flight vehicles for validating advanced concepts and demonstrating specific benefits associated with civil applications The possible benefits and application of the NASA-developed supercritical aerodynamic technology are discussed in some detail Early experimental aerodynamic results obtained from wind tunnel and flight investigations are included. F.R L

A72-25583 Thick-wing flight demonstrations. W E Palmer (North American Rockwell Corp , El Segundo, Calif) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720320.* 9 p. 13 refs Members, $1 25, nonmembers, $2 00

Consideration of advances in aerodynamics with potential for structural weight reduction Supercritical aerodynamics, dealing with flow fields were local speeds are greater than the speed of sound, has provided a means whereby cruise flight speeds can be significantly increased to near-sonic conditions, or where considerably thicker wings, with the attendant increased useable volume and decreased wing weights, can be utilized without sacrificing cruise speeds Results of a series of flight tests on a modified Navy T2-C Buckeye trainer aircraft are presented The novel method of airplane modification, generalized qualitative results, and some potential applications are described F.R L.

A72-25584 Preliminary results of some experiments with a vortex augmented wing J Roskam and M Gleason (Kansas, University, Lawrence, Kan.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar. 15-17, 1972, Paper 720321* 11 p. 6 refs. Members, $1.25; nonmembers, $2.00 Research supported by the University of Kansas.

Description of an experimental three-dimensional wind-tunnel investigation of a vortex-augmented wing consisting of a leading edge cusp flap combined with split upper and lower trailing edge flaps The idea was to generate two strong spanwise vortices that would increase maximum lift and drag simultaneously Several interesting flow phenomena were observed and are described The results were not encouraging. The study is inconclusive and suggestions are presented with respect to future research, though little justification for further testing is believed to exist on practical grounds M.V E

A72-25585 An energy-absorbing seat design for light aircraft. B. Underhill and B. McCullough (Piper Aircraft Corp., Lock Haven, Pa). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720322.* 11 p. 5 refs Members, $1 25, nonmembers, $2.00

Aircraft seats that merely hold the occupants rigidly in place have been satisfactory when considering horizontal or lateral decelerations, but they have not proved sufficient when accidents occur resulting in large vertical deceleration This deficiency led to the concept of an energy-absorbing seat, which would utilize the space between the seat bottom and the floor to absorb impact energy and reduce accelerations, thereby increasing occupant survival potential. To establish the seat design strength requirements, a maximum tolerable 'g' load was chosen, and the maximum vertical velocity was calculated based on the available arresting distance. The effect of varying passenger weight was investigated, and a weight was chosen for design purposes This then defined the load-deflection requirements of the seat Other requirements established that weight and cost be kept to a minimum and that conventional materials and fabrication processes be used. The development and static and dynamic testing leading to the final design of a lightweight, economical, energy-absorbing seat are described (Author)

A72-25586 Methods of crashworthiness testing for aircraft design. A W Bloedel (Cessna Aircraft Co., Wichita, Kan) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720323* 10 p Members, $1 25, nonmembers, $2 00

Discussion of the design of a test facility capable of evaluating and improving the crashworthiness of aircraft A barrier crash site, drop tower, impact sleds, and pendulum impact devices, along with anthropomorphic dummies, high-speed cameras, and instrumentation, form the testing equipment The basic design concepts, whose implementation effectiveness is tested, include the production of a structure that will stay intact during a crash, restraint of the occupant during the crash, protection of flailing limbs from injury; and restraint of loose equipment in the cabin Destruction-type tests on full-scale vehicles assure structural integrity of the capsule and provide acceleration pulse shapes of primary structure as collapse occurs in the forward section of the fuselage M.V E

A72-25587 Crash fire hazard evaluation of jet fuels. S V Zinn, Jr (FAA, Washington, D C) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar 15-17, 1972, Paper 720324* 7 p Members, $1 25, nonmembers, $2 00

A fire hazard evaluation of jet fuels was performed by controlled laboratory test procedures, and the relative ignition characteristics of the fuels were analyzed under simulated survivable aircraft accidents where data previously were inadequate or did not exist The tests included fuel release modes, ignition sources, and environmental conditions which normally occur during a crash This report presents the details of the work performed, the data obtained, and the conclusions established (Author)

A72-25588 **Dynamic tests of general aviation occupant restraint systems.** H. Daiutolo (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720325.* 73 p. 6 refs. Members, $1.25; nonmembers, $2.00.

A series of twenty-two dynamic tests were conducted on general aviation occupant restraint systems. These tests utilized lap belt, and lap belt/shoulder harness restraint systems. The Federal Aviation Regulations require only lap belt restraint systems for emergency landing conditions. Based on the longitudinal deceleration/time response of anthropomorphic dummy occupants, it was demonstrated that the lap belt/shoulder harness restraint systems offered occupants successful restraint at occupant inertia force levels substantially above the current regulatory level. The tests, preliminary in nature, warranted continuation of the test program in that the lap belt/shoulder harness restraint systems showed promise for regulatory inclusion by virtue of the fact that results were achieved with restraint systems offered as options in recent years, requiring minimal weight increase with fuselage reinforcement adaptable to retrofit as well as new assembly (Author)

A72-25589 **Development of the Cessna Model 210 hydraulic power pack.** L. K. Evans (Cessna Aircraft Co., Wichita, Kan.). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720327* 6 p. Members, $1.25, nonmembers, $2.00.

The present power pack used on the Cessna Model 210 is an electrically driven hydraulic unit. This approach in power-pack design combines the advantages of the electric gear system and the hydraulic gear system without reducing the reliability of the total system. The hydraulic system provides light weight and remote location of power units without the use of large pushrods and their related routing problems. This, plus the low cost of electric power units and the deletion of all hydraulic components from the already crowded engine compartment, provides a very substantial improvement to the aircraft landing-gear system. (Author)

A72-25590 **Unpressurized Navajo air conditioning system.** R. C. Eklund (Piper Aircraft Corp., Lock Haven, Pa.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720328* 9 p. Members, $1.25, nonmembers, $2.00.

Discussion of the overall design and development program for the twin-engine unpressurized Piper Navajo air conditioning system. Specific details of the problems peculiar to this installation are stressed. The final system weighs 97.6 lb and provides a maximum ground cooling capacity of 18,000 BTU/hr on a 100 F day at 1000 to 1500 engine RPM. Flight testing failed to reveal measurable aircraft performance change with the system off. F.R.L.

A72-25591 **Electric heating system for aircraft applications.** J. A. Riff (Motorola, Inc., Franklin Park, Ill.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720329* 4 p. Members, $1.25, nonmembers, $2.00.

Description of a new concept for supplying aircraft cockpit heat with improved economy and safety through the use of an electrical heating system. The proposed heating system uses small-resistance wire coils to convert three-phase ac electrical energy from an alternator to heat energy. The heater coils are placed directly in a forced airstream and transfer their heat to this air, thus providing a completely controllable cabin heating system. The electrical heating system is essentially an air-temperature booster. The impedance of the heater elements is matched to the internal impedance of the alternator at engine cruise speeds, resulting in an optimized power transfer at these speeds. The transfer of power at other engine speeds is then limited by the inductive reactance of the alternator. A.B.K.

A72-25592 **An improved stall warning system for general aviation aircraft.** T. S. Donnelly (American Aviation Corp., Cleveland, Ohio). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720331.* 5 p. Members, $1.25; nonmembers, $2.00.

An improved stall warning system has been developed for general aviation aircraft. Existing stall warning systems are susceptible to false warning signals caused by rough or gusting air. These extraneous warning signals have been eliminated by adding a signal discriminator to the basic stall warning system. The design requires a low-cost, highly repeatable, time-delay module, capable of 'zero timing' at each independent actuation of the stall sensor switch. The development of this device is described, and the service test results are discussed. G.R.

A72-25593 **Pulse operated, multichannel annunciator.** R. L. Barnes (Beech Aircraft Corp., Wichita, Kan.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720333* 5 p. Members, $1.25, nonmembers, $2.00.

Review of the categories of annunciator indicators, and description of the circuit requirements, circuit design, and additional input circuits of a proposed pulse operated multichannel annunciator. A system block diagram is presented, and a description is given of the input circuitry, the latching circuitry, the flasher, the dimming circuit, and the regulator circuit. Additional input circuits for slow-risetime signals, time-delayed input signals, and low-level input signals are proposed. A.B.K.

A72-25594 * **A look at V/STOL for business aircraft.** T. W. Feistel, E. C. Stewart, R. M. Gerdes (NASA, Ames Research Center, Moffett Field, Calif.), and K. R. Smith, Jr. (Aerospace Corp., El Segundo, Calif.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720334* 18 p. 35 refs. Members, $1.25, nonmembers, $2.00.

Attempt to ascertain the economic viability of the V/STOL capability for business aircraft and the manner in which this viability depends on the aircraft concept. A cost-benefit analysis is presented which indicates that a VTOL business aircraft would be more viable economically than a contemporary turbine-powered business aircraft. The combination of traveler's time value and trip distance for which each aircraft dominates is shown. The significance of disk loading in V/STOL concept application is discussed, and preliminary design configuration studies for three different business-aircraft-sized V/STOLs, using three concepts covering a range of disk loading, are presented as examples. Finally, a discussion of operational aspects of interest to future users of V/STOL business aircraft is presented which centers around the requirements for routine IFR terminal-area operations. A.B.K.

A72-25595 **Consideration of application of currently available transport-category aerodynamic technology in the optimization of general aviation propeller-driven twin design.** J. D. Raisbeck (Robertson Aircraft Corp., Bellevue, Wash.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720337* 12 p. Members, $1.25, nonmembers, $2.00.

The application of extensive high-lift devices, in conjunction with increased low-speed lift/drag ratio, and advanced airplane control systems to general aviation aircraft is reviewed. Parametric studies of pertinent wing aerodynamic variables were performed for a typical twin-engine propeller aircraft. Wing loading and aspect ratio are optimized for both slow-speed engine-out operation and cruise speed and payload/range. The results are encouraging, and point the way for serious consideration of the integration of advanced technology aerodynamics with propeller-driven twins. Such integration greatly increases these aircraft's productivity, efficiency, speed, and safety. (Author)

A72-25596 **Commercial applications of quiet aircraft technology.** E D. Griffith and G F Roberts (Lockheed Missiles and Space Co , Sunnyvale, Calif.) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720339* 7 p 7 refs Members, $1 25, nonmembers, $2 00

Recent experimental developments in military programs in aircraft quieting are reviewed Comments are offered on the possible impact of developing noise abatement concerns, requirements, and legislation on general aviation Potentially productive design tradeoff studies necessary to ensure minimum cost and an acceptable level of performance in the field of commercial light aircraft design are suggested Reductions in the external acoustic noise signature of light piston-engine aircraft, to comply with requirements indicated by developing noise abatement interests, may logically be sought in the area of propulsion system design Aerodynamic noise produced by this type aircraft is usually not of sufficient magnitude to warrant concern G R

A72-25598 **Applications of hard anodizing at Cessna** M Hatch (Cessna Aircraft Co , Wichita, Kan) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper 720341* 5 p Members, $1 25, nonmembers, $2 00.

This paper covers the properties of hardcoat anodizing as it applies to changing surface properties of aluminum so it can be used in areas heretofore prohibitive Information concerning surface preparation, racking, equipment for the process, and post treatments is presented Hardcoat anodizing changes the surface properties of aluminum so that it can now be used in many new applications The process employs a refrigerated electrolyte maintained below 50 F, vigorous agitation, close control of processing conditions, and a higher current density than conventional anodizing Specifics about the process at Cessna Aircraft Co are presented, as is a discussion of racking, surface preparation, and post treatment The properties of the anodize-coated aluminum and the resultant possible applications are also described (Author)

A72-25599 **Fabrication and analysis of tetra-core - A layered anisotropic fiber composite.** F E Gordon, G. W Forman, and C D Reese (Kansas, University, Lawrence, Kan) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720343* 10 p Members, $1 25, nonmembers, $2 00

Discussion of the design, fabrication, testing, strength characteristics, and applications of Tetra-Core, a layered anisotropic composite material It is formed by stacking oriented, spaced-fiber lamina in a repeating -60, 0, and +60 deg pattern Layers are offset slightly as the stacking occurs to produce a tetrahedrally shaped element The results of a netting analysis, layered anisotropic stringer analysis, and layered anisotropic lamina analysis are shown to compare favorably. In addition to its main use as a core material for sandwich construction, Tetra-Core is considered for structural applications in aircraft. M V E

A72-25601 **Industry update of DDA model T63/250 turboshaft and turboprop engine programs** E P. Neate (General Motors Corp , Detroit Diesel Allison Div , Detroit, Mich) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar 15-17, 1972, Paper 720350* 10 p Members, $1 25, nonmembers, $2 00

The current status of the T63/250 engine program is outlined by identifying models and applications of both turboshaft helicopter engines and turboprop fixed-wing aircraft powerplants Major differences between engine versions are described and illustrated by section drawings, and schematic layouts are included for pneumatic and hydromechanical fuel control systems Power, temperature, airflow, pressure, and weight ratings are tabulated, and attention is given to progress in the development of higher-horsepower versions which improve the performance and utility of business aircraft T M

A72-25602 **Highlights of the design and development of a modern geared-fan jet engine.** M C Steele and F. L Roberts (AiResearch Manufacturing Co , Los Angeles, Calif) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar. 15-17, 1972, Paper 720351* 15 p Members, $1.25, nonmembers, $2 00

The Garrett AiResearch Model TFE731-2 two-spool geared-fan jet engine rated at 3500 lb thrust is being developed to fulfill the need for a modern small powerplant in the general aviation marketplace Rigorous preliminary design cycle optimization studies and the subsequent incorporation of proven component aerodynamic designs have resulted in an efficient, simple, and compact turbofan engine configuration Highlights of the performance, mechanical reliability, and ecological aspects of the program are discussed The engine is currently in the final stages of development with certification scheduled for April 1972 (Author)

A72-25603 **Development of the JT15D-1 turbofan engine.** D L. Cook (United Aircraft of Canada, Ltd , Montreal, Canada) *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan , Mar. 15-17, 1972, Paper 720352* 12 p Members, $1 25, nonmembers, $2 00

The JT15D-1 is a 2200-lb thrust turbofan engine of the high bypass ratio type The engine is a two-spool, concentric shaft, front fan with no inlet vanes, and it belongs to the same propulsive family as the JT9D which powers the Boeing 747 The engine is briefly described, and the scope of development testing and resources applied is reviewed A selection of major development problems is covered, and future developments are indicated T M

A72-25604 # **Elasto-plastic cyclic analysis of structural members** H A Koenig (Connecticut, University, Storrs, Conn), W Vogel (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn), and L Cernoch (Wesleyan University, Middletown, Conn) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-1* 5 p 5 refs Members, $1 00, nonmembers, $3 00

A two-dimensional elasto-plastic finite element analysis is developed herein which has the capability of analyzing structural members subjected to cyclic thermal-mechanical loadings The analysis, which is based on an effective stress-strain formulation, employs a tangent modulus approach in its execution. Both principal and conventional stresses are computed in the body Unloading procedures are established and subsequently employed in cyclic loading problems A turbine blade shroud, which has been mechanically loaded due to interference with its adjacent member, is analyzed Cyclic behavior is shown for a uniaxial tension specimen and then generalized to a multiaxial stress state A predictor-corrector procedure, which calculates the most efficient loading increment, is developed. (Author)

A72-25606 # **Nonlinear analysis of rotating stall.** H Takata and S. Nagano (Tokyo, University, Tokyo, Japan) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-3.* 15 p 13 refs Members, $1 00, nonmembers, $3 00.

A new stall model to describe rotating stall in axial-flow compressors is established, where blade rows are replaced by semiactuator disks, flow fluctuations are permitted to be finite and nonsteady, and blade row characteristics are taken into consideration in nonlinear and nonsteady forms Through numerical analysis using the finite difference method, it is attempted to make clear the aspects of rotating stall - such as number of stall cells, stall propagation velocity, wave shape and magnitude of disturbance and

their variations with flow rate through the compressor and the mechanisms which control them Most of the aims are achieved by taking into consideration the effects of blade row interference and the nonlinearities of blade row characteristics (Author)

A72-25607 # **Some studies of front fans with and without snubbers.** S Fujii (National Aerospace Laboratory, Tokyo, Japan). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-4* 21 p 8 refs Members, $1 00, nonmembers, $3 00

Full-scale front fans were designed and tested with satisfactory results The flow field in passing through the fans was estimated with a powerful method called streamline-curvature technique, and the first test-program was carried out in equipping the rotor blade row without snubbers (part-span shroud) and the second conducted with them. The detailed analyses of the test results showed that the snubbers had some effect on the operation of a fan stage at all locations within the stage and not only in locations locally near to the snubbers (Author)

A72-25608 # **An approximate analysis of the unsteady lift on airfoils in cascade.** R E Henderson (Pennsylvania State University, State College, Pa) and J H Horlock (Cambridge University, Cambridge, England) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-5* 8 p 12 refs. Members, $1 00, nonmembers, $3 00 Navy-supported research

An approximate analysis is presented for determining the unsteady lift on airfoils in moving cascades, subject to disturbances in the inlet axial flow The equations of motion are averaged across the pitch, and the mean pressure in each channel and the pressure difference across it are obtained. The lift on a reference blade dividing two blade channels is then estimated The analysis is limited to flows in which the frequency parameter based on blade pitch is small, and to blading of low lift coefficient Comparisons are given with earlier analyses, for flow past isolated airfoils (Sears), for quasi-steady flows through cascades (Gearhart, et al), and for flow through an actuator disk of small blade chord and flow through cascades of flat blades (Whitehead) (Author)

A72-25609 # **Turbine engine icing and ice detection** J J Lacey, Jr (Rosemount Engineering Co , Minneapolis, Minn). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-6* 5 p 7 refs Members, $1 00, nonmembers, $3 00

Ambient conditions of flight under which turbine engine icing is possible are discussed, together with the effects of ice buildup on turbine performance A revised definition is proposed for icing criteria in order to relate them to the actual conditions of the inlet air flow rather than to the general ambient conditions of flight. Engine instrumentation for control of icing is described V Z.

A72-25610 # **Impingement cooling performance in gas turbine airfoils including effects of leading edge sharpness.** D. E Metzger (Arizona State University, Tempe, Ariz), R T Baltzer, and C. W. Jenkins *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar. 26-30, 1972, Paper 72-GT-7.* 7 p. 13 refs Members, $1 00, nonmembers, $3 00.

An experimental study of the heat transfer characteristics of impingement into cavities which model the cooled leading edges of gas turbine engine airfoils is presented The study includes both two-dimensional slot jets and single lines of evenly-spaced circular jets For broad cylindrical cavities correlations are given for the maximum heat transfer rates attainable with optimum positioning of the jet nozzle with respect to the cooled surface For elongated narrow cavities heat transfer rates relative to these maximum values are presented for a variety of cavity shapes (Author)

A72-25611 # **Aerodynamic damping in turbomachinery.** Y Cavaillé (Electricité de France, Châtou, Yvelines, France) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-8* 11 p 5 refs Members, $1 00, nonmembers, $3 00

An experimental study of aerodynamic damping has been carried out on an axial compressor in which stagger angle, pressure ratio, and relative velocity was varied The study utilized explosive charges buried in the tip of the blade to provide excitation and found the damping by measuring the log decrement of the vibrations The blade vibratory mode was pure bending (Author)

A72-25613 # **The use of a powered model for subsonic nacelle optimization** D L Motycka, V J DiSabato, and L Q. Andersen (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-14* 10 p Members, $1 00, nonmembers, $3 00

The continual demands for improved technology aircraft propulsion systems require refined wind tunnel model testing techniques to more closely simulate full-scale performance Toward this end a test program was conducted using a subsonic powered nacelle model to statistically investigate the effect of key geometrical variables on nacelle pressure drag A comparison of test results with analytical prediction techniques is presented, along with the effects of various design parameters on drag The advantage of powered nacelle models for obtaining subsonic nacelle pressure drag information is also included (Author)

A72-25614 # **The effect of interaction between wakes from blade rows in an axial flow compressor on the noise generated by blade interaction** G J Walker and A R. Oliver (Tasmania, University, Hobart, Tasmania, Australia) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-15.* 8 p 13 refs Members, $1 00, nonmembers, $3 00 Research supported by the Department of Supply of Australia and Australian Research Grants Committee

The effect of interaction between the wakes from one row of blades and the boundary layers and wakes of the next row of blades downstream has been measured in an axial flow compressor by hot wire signals displayed on a CRO screen synchronized with the rotor It is shown that the two sets of wakes can be made to mutually cancel the greater part of the velocity defect in each at certain points Proper choice of axial and circumferential position of alternate rows of stationary blades so that the downstream row is in the middle of the wake street from the upstream row allows the velocity defect normally in the rotor wakes to be thus cancelled at the position of the stator and considerably reduces the noise produced at the rotor blade passing frequency by the rotor wakes on the stator The effect of stator wakes on rotor blades downstream of the first can be similarly reduced by lining up blades in successive rotor rows The deductions are confirmed by measurements of sound pressure level (Author)

A72-25615 # **A theoretical investigation of the jet-flap compressor cascade in incompressible flow.** U Stark (Braunschweig, Technische Universitat, Braunschweig, West Germany) *American*

Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-16 12 p. 21 refs Members, $1 00, nonmembers, $3 00 Research supported by the Deutsche Forschungsgemeinschaft

The use of jet flaps gives a new possibility of achieving high turning cascades In this paper a new theory for unstaggered cascades with jet flaps, developed under simplifying assumptions, is described With the help of this theory, besides turning angles and lift coefficients, for the first time pressure distributions on, and jet slope distributions behind, the blades were calculated The effect of stagger angle on the turning angles and lift coefficients is determined with the help of the Schlichting method, using the concept of the equivalent flat plate cascade Sample calculations illustrate the theory and, at the same time, give an insight into the behavior of cascades with jet flaps in inviscid flow Results of previously published experiments on cascades with jet flaps, where they fulfill the conditions of the theory, are compared with the theoretical results and demonstrate satisfactory agreement (Author)

A72-25616 # **Measurements of secondary flows in a rotating duct.** R E Wagner (Bell Telephone Laboratories, Inc , Holmdel, N J) and H R Velkoff (Ohio State University, Columbus, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-17* 10 p 11 refs Members, $1 00, nonmembers, $3 00

The paper presents a review of analytical and experimental work which has been done on flows in rotating ducts It presents the results of an experimental study to measure the secondary flows predicted by the previous analytical work A duct of approximately 3 ft in length with a cross section of 2 by 5 in was rotated up to speeds of 300 rpm Air was used as the working fluid Static pressures, total pressures, and yaw angles were measured at selected points along the channel. The flow regime examined was the developing flow from the entrance to the exit of the channel Pressure distribution across the height of the channel and across the width of the channel was obtained The magnitude of the cross-flow velocities in the channel were determined and mapped It was found that the data for various rotational speeds could be collapsed upon a single curve by dividing all data by the rotational speeds The results of the experimental study provide solid verification for the hypothesis of longitudinal vortices in rotating ducts (Author)

A72-25617 # **Axial flow compressor and turbine loss coefficients - A comparison of several parameters.** L. E Brown (Curtiss-Wright Corp., Wood-Ridge, N J) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-18* 9 p. 5 refs. Members, $1 00, nonmembers, $3 00

Many loss parameters are used in the turbomachinery field for correlating the effects on losses of numerous geometric and aerodynamic variables associated with blade rows. The parameter most common to these correlations is the ratio of a loss parameter to a velocity parameter, here called the loss coefficient Such loss coefficients of different forms are compared explicitly for possible use in both compressors and turbines. Over a range of Mach numbers, loss coefficient values are compared with loss levels fixed and for representative blading cascade test data, and pressure recoveries and stage efficiencies are compared with loss coefficient values fixed. It is shown that for a low Mach number the different parameters are equal and interchangeable, however, as the Mach number increases, differences appear and grow larger, so that a given combination of loss coefficient value and Mach number implies different entropy-rise values depending upon which parameter is being used The Soderberg parameter was found to be better for both compressors and turbines than the other loss coefficients investigated (Author)

A72-25619 # **Reaction bonded silicon carbide and silicon nitride for gas turbine applications.** R A Alliegro and S H Coes (Norton Co , Worcester, Mass.) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar. 26-30, 1972, Paper 72-GT-20* 5 p Members, $1 00; nonmembers, $3.00

Two unique ceramic materials offer the gas turbine designer the opportunity to substitute uncooled high temperature components for the presently cooled metal and alloy ones. Recrystallized silicon carbide made by a casting process and reaction bonded silicon nitride shaped by a simple machining process before firing, offer not only high temperature materials capable of living in the gas turbine environment, but also an intricacy of shape consistent with combustor, shroud and associated high temperature component needs. Silicon carbide's 3200 F capability and its thermal shock resistance makes it a sound choice, silicon nitride's low expansion coefficient, thermal shock resistance, and 2900 F capability make it a material of real merit. The properties of these materials are discussed in detail along with potential areas of application and design capabilities (Author)

A72-25621 # **Modification of jet fuels to decrease the fire hazard in survivable aircraft crashes.** R E Erickson, R M Krajewski, and W E Cohrs (Dow Chemical Co , Midland, Mich) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-25* 15 p 5 refs Members, $1 00, nonmembers, $3 00

This paper is directed to the modification of jet fuels to reduce the inherent fire hazard of such fuels Some of the problems and compromises involved in this development program are discussed The theoretical concept pursued is outlined and some of the physical properties of the final compromise modified fuel are shown (Author)

A72-25623 # **Crashworthiness of safe fuels.** R. A Rockow and L M Shaw (Dynamic Science, Phoenix, Ariz) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-27* 14 p 10 refs Members, $1 00, nonmembers, $3 00

The safety performance evaluation program described in this paper includes an initial series of screening tests designed to obtain the characteristics of safe fuels in the aircraft crash environment The authenticity of the screening tests relative to the full-scale crash environment was evaluated through a second series of experiments designed to simulate a full-scale aircraft crash environment A crashworthiness evaluation criterion was established in terms of an ignition susceptibility parameter to quantitize the relative safety performance of different fuels The conclusions of this research clearly show that significant savings in lives and equipment can be realized if safe fuels which perform within the nonhazardous envelope of the ignition susceptibility parameter are operationally incorporated in present-day aircraft (Author)

A72-25624 # **Development of crash-safe turbine fuels** R A Russell, Jr and R F Salmon (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-28* 15 p 15 refs Members, $1 00, nonmembers, $3 00

Under small-scale simulated crash conditions, the fire reduction benefits of fuel thickeners result from their ability to physically bind the fuel and thus reduce the rate of vaporization and the exposed surface area available to support a fire. Dozens of thickened fuel candidates have undergone cursory screening, and a small percentage of those that looked promising have been subjected to a crash fire rating system designed to provide relative values of candidate fuels Chemical and physical studies, completed in 1971, on two of the leading fuel candidates greatly improved their fluidic property with no adverse affect on their fire retardative properties, while in mist form (Author)

A72-25625 # **Non-contact system provides measurement and management of shaft horsepower.** J. R. Parkinson (Simmonds Precision Products, Inc., Vergennes, Vt.). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-29.* 6 p Members, $1.00; nonmembers, $3.00

For years, manufacturers and users of rotating machinery have searched for an accurate and easily used shaft power measurement technique. These users wanted a system with characteristics such as noncontact, no field calibration, shaft realignment compensated, adaptable to control and protective functions, plus high component reliability and accuracy This paper describes such a system. (Author)

A72-25626 # **Lift and pressure fluctuations of a cambered airfoil under periodic gusts and applications in turbomachinery.** H. Naumann (PCM Colleges, Chester, Pa.) and H Yeh (Pennsylvania, University, Philadelphia, Pa) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar. 26-30, 1972, Paper 72-GT-30* 10 p 11 refs. Members, $1 00, nonmembers, $3.00

Previous authors have considered the unsteady lift of a flat-plate (zero-cambered) airfoil travelling through sinusoidal gusts The present paper extends the analysis to cambered airfoils with angle of attack moving through both longitudinal and transverse gusts Closed-form analytical solutions are obtained The results are used to calculate the unsteady lift on a blade moving through periodic wakes in an axial-flow turbomachine Knowledge gained by this analysis clearly indicates design trends to obtain minimum lift fluctuations Since the interference effects of neighboring blades are ignored in this analysis, the conclusions on turbomachinery are strictly valid only for cascades with low solidity (Author)

A72-25627 # **Computation of shocked flows in compressor cascades.** S Gopalakrishnan and R Bozzola (Avco Corp , Lycoming Div , Stratford, Conn) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-31* 13 p 6 refs Members, $1 00, nonmembers, $3 00 Army-sponsored research

A numerical technique is presented for the calculation of shocked flows in compressor cascades The problem is posed in the time-dependent form and the asymptotic solution at large times provides the solution of the steady physical problem The solutions exhibit the formation and movement of shocks as the static pressure ratio across the cascade is varied The resulting inlet and outlet angles and total pressure loss are also shown (Author)

A72-25629 # **Design and test evaluation of a liquid metal regenerator for gas turbines.** S Moskowitz and J Horvath (Curtiss-Wright Corp., Wood-Ridge, N J) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-33* 12 p Members, $1 00, nonmembers, $3 00 Contract No NOw-66-0738-a

Description of a lightweight regenerator for a 4000-shp turboshaft engine in which liquid NaK is used as the heat transport fluid for heat transfer from the turbine discharge gas to the compressor discharge air The regenerator design includes an exhaust gas-to-metal heat exchanger, a metal-to-compressor air heat exchanger, and a rotary liquid-metal induction pump, forming a single hermetically sealed liquid metal circuit The results of an analytical study of the system and of performance and durability simulation tests are given and are compared with theoretical predictions Special system component production methods are also described V Z·

A72-25632 # **Investigation of air bearings for small high-performance aircraft gas turbines** P W. Curwen (Mechanical Technology, Inc., Latham, N.Y), W. E. Young (United Aircraft Corp , Pratt and Whitney Aircraft Div , West Palm Beach, Fla), and F. G. Furgurson (U.S Army, Mobility Research and Development Laboratory, Fort Eustis, Va) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-38* 9 p. 8 refs Members, $1.00, nonmembers, $3.00. Grant No. DAAJ02-69-C-0062

High temperatures and rotative speeds of future U.S. Army aircraft propulsion systems will impose increasingly severe operating requirements on oil-lubricated engine bearings and associated seals Accordingly, air-lubricated bearings are being investigated as a possible approach to alleviating the lubrication problems This paper presents the results of design and performance studies, as well as bearing component tests, relative to applying air bearings to a two-shaft, 3 5-lb/sec turboshaft engine The test results verify that air bearings can carry the maximum loads imposed by flight and landing conditions, and can survive the sliding contacts associated with 15,000 engine start/stop cycles. Incentives for pursuing the air-bearing approach are identified, as are also the development and problem areas (Author)

A72-25633 # **The use of cascade technology in centrifugal compressor vaned diffuser design.** R C Pampreen (AiResearch Manufacturing Co , Phoenix, Ariz). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-39* 6 p Members, $1.00, nonmembers, $3 00

This paper highlights some results from experience with use of cascade technology in the design of diffusers for centrifugal compressors The designs consisted of conformally transformed tandem blade-rows using 65-Series and double-circular-arc vane sections Performance results are presented and comparisons to conventional diffuser data are made. (Author)

A72-25634 * # **Low pressure ratio fan noise experiment and theory.** F B Metzger and D B Hanson (United Aircraft Corp , Hamilton Standard Div , Windsor Locks, Conn.) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-40.* 8 p 13 refs Members, $1.00, nonmembers, $3 00 Contract No NAS1-10896 NASA Order L-60739

Evaluation of data obtained from noise measurements on a wind-tunnel model of a Q-FAN, a new low-pressure-ratio, low-noise propulsion system. It is found that both rotor blades and stator vanes contributed to the noise signature of the test fan Tone noise at blade passage frequency and at the high harmonics of blade passage frequency was the result of unsteady inflow to the fan. Tone noise at twice blade passage frequency and several high harmonics resulted from interception of rotor blade wakes by the stators The midfrequency broadband noise also resulted from interception of wakes by the stators. Rotor vortex noise contributed only at high frequencies where the level of stator broadband decayed. A B.K

A72-25636 * # **Recent radial turbine research at the NASA Lewis Research Center** H E Rohlik and M G Kofskey (NASA, Lewis Research Center, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar. 26-30, 1972, Paper 72-GT-42* 9 p 7 refs Members, $1 00, nonmembers, $3 00

The major results obtained in several recent experimental programs on small radial inflow turbines for space applications are presented and discussed Specifically, experimental and analytical work associated with these systems that has included examination of blade-shroud clearance, blade loading, and exit diffuser design, is considered. Results indicate high efficiency over a wide range of specific speed, and also insensitivity to clearance and blade loading in the radial part of the rotor The exit diffuser investigation indicated

that a conventional conical outer wall may not provide the velocity variation consistent with minimum overall diffuser loss O H

A72-25639 # **Calculation of the flow properties up- and downstream of and within a supersonic turbine cascade.** O. K. Lawaczeck (Gas Dynamics Institute, Gottingen, West Germany). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-47.* 13 p. 25 refs. Members, $1.00, nonmembers, $3.00.

Supersonic turbine cascades have been investigated These are cascades that have supersonic flow up- and downstream and can be classified as choked and unchoked types A definition is given for these two types of cascade flow. A method has been described to compute, under certain conditions, the flow properties up- and downstream of these cascades and to calculate the pressure distribution The theoretical predictions have been compared with the experimental results obtained from wake flow measurements The comparison indicated relatively good agreement between theory and experiment. (Author)

A72-25640 # **Boundary layers on rough compressor blades.** K Bammert and R Milsch (Hannover, Technische Universitat, Hanover, West Germany) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-48* 14 p 10 refs Members, $1 00, nonmembers, $3 00

Through measurements on rough deceleration cascades consisting of NACA 65-series compressor blade sections in different geometrical variations, information about the changes in the pressure distribution around the profile, the boundary-layer development along the profile contour, and the velocity distribution in the boundary layer due to increasing roughness was obtained For the friction coefficient of the laminar boundary layer, the point of laminar-turbulent transition, and the conditions under which separation of the turbulent boundary layer occurs, relationships were found which allow more accurate determination of these data by suitable boundary-layer prediction methods (Author)

A72-25644 # **Feasibility study of a radial inflow compressor.** M P. Boyce and Y S Bale (Texas A & M University, College Station, Tex). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-52* 13 p 24 refs Members, $1 00, nonmembers, $3 00.

This paper is a feasibility study of the radial inflow compressor The goal was to study theoretically the flow in such a compressor The blade loadings have been computed for various pressure ratios and the optimum loading is presented The rotor efficiency of such a compressor is lower than that encountered in a similar pressure ratio radial outflow impeller The efficiency in the diffuser is slightly higher for the radial inflow compressor, with an axial relative flow discharge This combination leads to an efficiency between 70 to 75% for a 3 1 pressure ratio compressor stage This agrees favorably with two-stage radial outflow compressor in which the two compressors are close together for axial compactness Thus the radial inflow configuration could give comparable efficiencies when paired with a radial outflow compressor and more axial compactness (Author)

A72-25645 # **A comparison of the predicted and measured performance of high pressure ratio centrifugal compressor diffusers.** D P Kenny (United Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-54* 20 p. 11 refs Members, $1 00, nonmembers, $3 00. Research sponsored by the Defence Research Board and United Aircraft of Canada

A novel analysis of the hub and shroud wall boundary layer growth through the diffusing system of a centrifugal compressor is proposed to model the physical processes It is shown that the diffuser throat blockage and total pressure loss characteristics can be accurately predicted for a 6 1 pressure ratio stage The static pressure effectiveness and stalling limit are successfully predicted qualitatively, but are underestimated and overestimated by 14 and 12% respectively It is argued that diffuser performance is largely controlled by the combined effect of the boundary layer conditions on the hub and shroud walls at impeller exit and the diffusion required to the diffuser throat For this reason, it is contended that, for best performance at high pressure ratio, impeller exit Mach number must be minimized by employing zero to negative prewhirl at impeller entry which in turn maximizes impeller entry shroud relative Mach number (Author)

A72-25646 # **Instrumentation for flow measurements in turbomachine rotors** W F O'Brien and H L Moses (Virginia Polytechnic Institute and State University, Blacksburg, Va) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-55* 7 p. 15 refs Members, $1 00, nonmembers, $3 00

Flow measurements taken on the rotors of turbomachines are of great value for improved understanding and advancement of design techniques. On-rotor experiments have been limited in the past because of instrumentation problems, especially with the data transmission system Recent advances in miniature electronic systems and transducer technology have produced a renewed interest in this area These considerations are discussed, and research on a telemetry-type data transmission system is described with experimental verification using a strain gage on an axial-flow fan blade (Author)

A72-25648 # **Experimental investigation of gas-particle flow trajectories and velocities in an axial flow turbine stage** W Tabakoff, A Hamed, and M F. Hussein (Cincinnati, University, Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-57* 14 p 5 refs Members, $1.00, nonmembers, $3 00 Grant No DAHC04-69-C-0016

This paper describes the results from an investigation of the gas-particle flow trajectories, velocities and pressure distribution in an axial flow turbine stage A gas-particle flow cascade tunnel and high-speed photographic techniques were used to conduct the experimental investigation The pressure distribution on the blade surface was measured and compared with the theoretical analysis, the results exhibiting good agreement between the developed theory and experiment. (Author)

A72-25649 # **Review of new forming methods pertinent to the gas turbine industry.** K M Kularni (IIT Research Institute, Chicago, Ill) and G M Glenn (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-58.* 11 p 20 refs. Members, $1 00, nonmembers, $3 00

In the last few years a number of new metal forming techniques have been developed Some of these which have a potential for becoming important production processes for gas turbine components are reviewed For each method, the basic principle is first explained, then its present status is reviewed, and some areas in which additional development work is required are pointed out Finally, the gas turbine components for which the method may be used are indicated Processes considered include isothermal forging,

contoured cross rolling, squeeze casting, radial forging, form rolling, and forging of powder metallurgy preforms (Author)

A72-25651 # **Correlation of gas turbine emissions data.** F. W. Lipfert (General Applied Science Laboratories, Inc., Westbury, N.Y.) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-60* 16 p. 13 refs. Members, $1.00; nonmembers, $3.00

Analysis of existing gaseous emissions data from gas turbines has shown that a substantial improvement in data correlation is possible. These correlations serve to increase confidence in the data, identify out-of-control points, and facilitate comparisons between engine models. Furthermore, the NOx correlation implies that a simplified primary zone mathematical model may be used to formulate trends or influence coefficients, which may be used to adjust experimental data to a common base for comparison to a specification. Finally, the presence of water vapor in the combustion air is seen to have a noticeable effect on NOx emissions. This effect should be accounted for in comparing experimental results. (Author)

A72-25652 # **Variable pitch ducted fans for STOL transport aircraft.** R. M. Denning (Rolls-Royce, Ltd., Bristol Engine Div., Bristol, England) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-61* 11 p. 7 refs. Members, $1.00, nonmembers, $3.00

The variable pitch fan has a number of features which make it attractive as the basis for ultra-high bypass ratio ducted fans designed primarily for STOL aircraft. The variability imposes certain design constraints, particularly on fan pressure ratio, and leads to differences in engine geometry relative to equivalent fixed pitch engines. The merits of such engines are discussed under the headings of performance, noise, engine control, thrust modulation, provision of air bleed for high lift, reverse thrust, and development flexibility. (Author)

A72-25654 * # **Design studies of lift fan engines suitable for use in civilian VTOL aircraft.** R. J. Roelke (NASA, Lewis Research Center, Cleveland, Ohio) and S. Zigan (General Electric Co., Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-65* 8 p. 6 refs. Members, $1.00; nonmembers, $3.00

Preliminary engine design studies have been made of two general types of low-pressure-ratio lift fan engines that are receiving increasing attention as a means to provide low-speed lift for large civilian VTOL transports. The two engine types are integral fans and remote powered fans. A portion of the results of these design studies is summarized, including the crucial engine requirements, and some of the characteristics of the emerging engine designs of each type. O.H.

A72-25655 # **Military vertical takeoff and landing /VTOL/ propulsion systems design.** A. O. Kohn (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-73.* 7 p. Members, $1.00, nonmembers, $3.00.

This paper deals with the parameters that must be considered in the selection and design of propulsion systems for military VTOL aircraft. Some of these parameters, for instance lightweight, are applicable to engines for all types of aircraft. For the VTOL aircraft, special emphasis must be placed on many of these parameters since aircraft takeoff gross weight determines engine size. Other significant considerations in the selection of the propulsion system include (1) the ratio of subsonic cruise thrust to maximum thrust, and (2) exhaust downwash characteristics. Consideration (1) is important because, in the case where no auxiliary lift engines or devices are used, subsonic cruise thrust is about 25 to 30 per cent maximum, and at this low power setting, specific fuel consumption is increasing rapidly. Exhaust downwash characteristics are significant because of the variety of landing and takeoff sites likely to be encountered (i.e., shipboard or unprepared fields). (Author)

A72-25656 # **Using solid-state joining in gas turbine engines.** D. C. Martin (Battelle Memorial Institute, Columbus, Ohio) and F. R. Miller (USAF, Manufacturing Technology Div., Wright-Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-74* 16 p. 8 refs. Members, $1.00, nonmembers, $3.00.

The ability to fabricate materials and components needed to improve gas-turbine engine performance depends on an ability to achieve reliable joints. Solid-state joining provides this ability. Diffusion bonding of compressor blades, friction welding of engine rotors, and solid-state bonding of turbine shafts by coextrusion of dissimilar metals are discussed as examples of applications of solid-state bonding. Parts made by these techniques have successfully completed engine tests. (Author)

A72-25657 # **Exhaust emission characteristics of aircraft gas turbine engines.** A. W. Nelson (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-75* 9 p. Members, $1.00, nonmembers, $3.00

The results of attempts to identify the emission characteristics of aircraft gas turbine engines are presented. Employed methods and techniques are discussed, and it is shown that a complete traverse of the engine tailpipe is the best current technique for determining representative average emission levels. However, traversing is extremely time-consuming and, therefore, practical only for emission measurement of experimental engines. Measurement of gaseous emissions other than smoke by using turbine exhaust pressure averaging probes is promising as a rough evaluation of emission levels for some engine models, but further substantiation testing is required. It is evident that further research is necessary for developing sampling methods that will permit accurate, yet fast and efficient measurement of exhaust emissions. M.V.E.

A72-25658 # **Increasing the aerodynamic loading of axial flow turbines.** G. Karadimas (SNECMA, Moissy-Cramayel, Seine-et-Marne, France) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-78* 9 p. 8 refs. Members, $1.00, nonmembers, $3.00

Monitoring of velocity variation around airfoil profiles, together with computation of boundary layer variation, have made it possible to increase the aerodynamic loading of turbine blading, that is to say to increase both the Mach number level and the deviation, this being obtained without any reduction of the blading optimum operating envelope. Tests conducted on a flat blade cascade and on a complete turbine stage have permitted first to cross-check and validate the methods in use, and further, to successfully obtain the anticipated results. (Author)

A72-25659 # **Propulsion control considerations for V/STOL aircraft.** T. G. Lenox (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) *American Society of Mechanical*

Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-30, 1972, Paper 72-GT-79 8 p Members, $1.00, nonmembers, $3.00

Potential control requirements of various propulsion systems for V/STOL aircraft applications are discussed The considerations that will affect the design of propulsion control systems are identified for both military and commercial V/STOL aircraft. Of the requirements common to all configurations, the need for improved thrust control is emphasized as required total aircraft system trades to establish an approach which provides the desired power management performance with minimum weight and with maximum reliability and maintainability. O H.

A72-25661 # **Turbofan trends for short haul.** L G. Dawson and T. D Sills (Rolls-Royce, Ltd., Derby Engine Div , Derby, England). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar. 26-30, 1972, Paper 72-GT-86* 12 p. Members, $1.00, nonmembers, $3 00.

After a general indication of the noise problem the relation between conventional and STOL systems are broadly reviewed and their requirements as regards the powerplant are discussed. Some of the associated technical challenges are then considered. These include variable pitch fans, reduction gears, thrust reversal and the environment (noise and pollution) It is shown that the development of a quiet, clean propulsion engine is perhaps the most important and pressing single task for the powerplant constructor to attack (Author)

A72-25662 # **Hot corrosion of gas turbine rotor blade materials due to a long term field testing.** H. Doi, T Onoda (Mitsubishi Metal Mining Co , Ltd., Omiya City, Saitama, Japan), and Y. Harada (Mitsubishi Heavy Industries, Ltd., Akashi, Hyogo, Japan) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar. 26-30, 1972, Paper 72-GT-87* 16 p 13 refs Members, $1.00, nonmembers, $3.00

As a result of 22,000 hr gas turbine engine operation burning residual oil fuels of high sulfur concentration, Inconel-700 blade has been severely affected owing to hot corrosion, whereas Inconel-X has been virtually free from such an attack Consideration of the alloy composition suggests that molybdenum and cobalt in Inconel-700 and iron in Inconel-X are important elements in relation to hot corrosion On the basis of metallographic, electron microprobe and X-ray diffraction analyses, the effect of the alloy composition in regard to hot corrosion mechanisms has been discussed in some detail. (Author)

A72-25663 # **Continuous measurement of exhaust emissions from a high pressure cannular combustor.** H Shaw, W. F Taylor, C J McCoy, and A Skopp (Esso Research and Engineering Co., Government Research Laboratory, Linden, N J) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-88* 7 p. 14 refs Members, $1 00, nonmembers, $3 00 USAF-sponsored research

A high pressure cannular combustor has been developed to simulate aircraft turbine engine emissions In conjunction with this combustor, a continuous analytical and sampling system was assembled This system is capable of complete on-the-spot analysis of CO2, O2, CO, H2O, unburned hydrocarbons, and NOx The measured emission levels obtained from burning Jet A are in good agreement with those reported from operating aircraft turbine engines. Data showing the effect of equivalence ratio and pressure on the concentration of combustion products are presented (Author)

A72-25665 # **Design considerations for high-pressure-ratio centrifugal compressors.** C Rodgers and L Sapiro (International Harvester Co., San Diego, Calif.). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-91.* 16 p 11 refs. Members, $1.00, nonmembers, $3.00.

Major design considerations involved in selecting geometries for high-pressure ratio, single-stage centrifugal compressors are discussed. The results of a parametric study are included to indicate optimum regions of design and to project the potential performance of centrifugal compressors with rotating diffusers Several different candidate design solutions are evaluated on the basis of providing improved performance at high pressure ratios consistent with maintaining the inherent simplicity and low-cost features of centrifugal compressors (Author)

A72-25666 # **Unsteady forces and noise from fan-in wing model in cross flow.** A N Abdelhamid (Carleton University, Ottawa, Canada) and U W Schaub (National Research Council, Div. of Mechanical Engineering, Ottawa, Canada) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif , Mar 26-30, 1972, Paper 72-GT-92* 15 p 7 refs. Members, $1.00, nonmembers, $3 00.

Unsteady forces and noise from a fan-in-wing model operated in cross flow are investigated Based on experimentally determined inlet and outlet flow distortions the unsteady forces on the rotor blades are determined analytically taking into account the effects of blade angle of attack and blade camber Results of unsteady forces due to flow distortions are compared with those on the rotor blades due to potential interaction with the stator vanes The calculated unsteady forces on rotor blades are used to calculate the discrete frequency noise emission characteristics of the fan. The predicted sound pressure levels are compared with those due to potential and viscous interactions It is shown that the predicted unsteady forces on the rotor blades due to cross velocity do not significantly contribute to the noise generated by the fan (Author)

A72-25667 * # **The NASA quiet engine program** J J Kramer and F J Montegani (NASA, Lewis Research Center, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-96* 9 p 12 refs Members, $1 00, nonmembers, $3 00

The NASA quiet engine program will incorporate all available noise-reduction technology into a propulsion system suitable for subsonic civil transport aircraft Full-scale experimental hardware is being built and tested primarily for noise performance The program is in process, and component and engine tests to date indicate that it is possible to achieve or exceed noise reduction objectives of 15-20 PNdB below the levels of 707/DC-8 long-range transport aircraft (Author)

A72-25668 # **Experimental study on high loading combustor for lift jet engine.** K Yamanaka (Ishikawajima-Harima Heavy Industries Co , Ltd , Tokyo, Japan) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-99* 14 p 6 refs Members, $1 00, nonmembers, $3 00

This paper deals with parameters specifying the performance of a spray-type high loading combustor for a lift jet engine The mixing parameter to control combustion efficiency was obtained analytically by means of simplifying a primary zone, and its effectiveness was confirmed experimentally The combustor geometry used for the test was a 90-deg sector model of an annular type, the 42 combinations of different seven swirlers and six deflectors were tested systematically The maximum combustion loading of 20 million Btu/hr/cu ft combustion volume per atmosphere was obtained (Author)

A72-25669 # **Data validity criteria for supersonic axial compressors.** J. Paulon and J Reboux (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif, Mar. 26-30, 1972, Paper 72-GT-100.* 15 p 8 refs. Members, $1 00, nonmembers, $3.00

Data validity criteria are defined for the acceptance, rejection, or correction of experimental data on axial supersonic compressors. In particular, correction techniques are proposed, and their application to supersonic Freon axial compressor data is discussed. An example of experimental results obtained for a rotating supersonic cascade is presented, along with completely processed data. M.V E

A72-25670 # **Cycle flexibility - Its impact on V/STOL tactical aircraft propulsion systems.** C. A. Hoelzer and R. A. Cea (Grumman Aerospace Corp , Bethpage, N Y.) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-105.* 13 p 7 refs Members, $1.00, nonmembers, $3 00.

The design of a V/STOL aircraft, incorporating only one lift-cruise engine, places great emphasis on the flexibility of its propulsion system to provide sufficient thrust for take-off and efficient fuel consumption for cruise. In order to attain a reasonable range with a lightweight vehicle this inconsistency of thrust and SFC mis-match must be resolved A brief survey of engine technology predictions for the next decade indicates that future aircraft systems would be offered a wider choice of cycle characteristics, higher technology levels, and added cycle flexibility A comparative parametric study was conducted to determine the effect of these advancements on a postulated 1983 V/STOL aircraft In particular the effect of increasing thrust through the use of thrust lapse-rating and variable turbine geometry were compared to more conventional augmentors such as duct burning and water injection Additionally, the effects of varying cycle characteristics to realize SFC improvements were investigated (Author)

A72-25671 # **Propulsion system and airframe integration for jet-lift V/STOL airplanes** H A Weber and A Karemaa (General Dynamics Corp , Convair Aerospace Div , San Diego, Calif) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-106* 10 p 7 refs Members, $1 00, nonmembers, $3.00

Propulsion system/airframe matching in hybrid V/STOL vehicle propulsion system designs is discussed using a VTOL transport general arrangement as the basis. Special attention is given to thrust-vector management, lift-engine bypass ratio, airframe-engine interaction, and powerplant packaging design considerations It is concluded that a high-bypass-ratio lift fan must be used if noise is a factor and that ground erosion and reingestion problems can be minimized by using such a fan with a low exhaust dynamic pressure The significant lift-engine system parameters affecting the aircraft gross weight are identified as the number of engines, contingency rating, and the thrust-to-weight ratio The hybrid jet-lift aircraft design is characterized as a viable one in terms of present technology V.Z

A72-25673 # **A steady-state radial inlet pressure distortion index for axial-flow compressors.** D. F Brunda and J. F. Boytos (U S. Naval Air Propulsion Test Center, Trenton, N.J) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-109* 10 p Members, $1.00, nonmembers, $3 00

A radial inlet pressure distortion index is derived using a mathematical compressor model, the two-dimensional continuity equation and the expression for radial velocity upstream of a low hub-tip ratio, multistage compressor. These expressions are combined with two conditions required for inlet flow similarity at compressor stall, namely, constant rotor angle of attack and constant ratio of mixing time to air residence time in the blade passage The theory was tested on a twin-spool turbojet engine at sea level static conditions (Author)

A72-25674 # **Turbotip lift fan design.** W W. Thomas (General Electric Co., Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar. 26-30, 1972, Paper 72-GT-111.* 15 p Members, $1.00, nonmembers, $3.00.

This paper discusses the basic design approach and features of the turbotip lift fan concept, initially developed for application in the XV-5 VTOL research aircraft. Design changes necessary to meet the requirements of the proposed NASA V/STOL transport research aircraft and future commercial transport systems are reviewed. Emphasis is placed on the effects of acoustic, installation, control response and life/maintenance objectives on component design and lift fan geometry (Author)

A72-25733 **Scale effects in the bending vibrations of helicopter rotor blades.** M I Young (Delaware, University, Newark, Del.) *Journal of Sound and Vibration,* vol 21, Mar 8, 1972, p 127-132 6 refs Research supported by the University of Delaware, Grant No DA-ARO(D)-31-124-71-G112.

Scale effects and dynamic similarity in the bending vibrations of helicopter rotor blades are examined by expressing the first three modes of bending vibration of a uniform, conventional rotor blade by a series of Legendre polynomials as suggested by Wilde and others. The natural frequency ratios for these three modes are then determined as functions of a dynamic similarity parameter over the entire range of designs and operating conditions from very flexible, rapidly rotating blades to highly rigid, slowly turning conditions. (Author)

A72-25735 * # **An experimental study of the hypersonic aerodynamics of delta wings.** D M. Rao (NASA, Langley Research Center, Hypersonic Vehicles Div , Hampton, Va). *Aeronautical Society of India, Journal,* vol 23, Nov 1971, p. 183-190 25 refs Research supported by the Ministry of Technology

Results of aerodynamic balance and pressure measurements carried out in a hypersonic gun tunnel (at a free-stream Mach number of 8 2 and a Reynolds number of 800,000) on delta wings having sharp leading edges swept at 70 and 76 deg The experimental force and pressure coefficients and shock angles are discussed in relation to simple prediction methods Some transition data are also included (Author)

A72-25811 # **Lifting surface volume and fuel tankage.** K L Sanders (Teledyne Ryan Aeronautical Co , San Diego, Calif) *U.S Air Force Systems Command, Weight Prediction Workshop, 6th, Wright-Patterson AFB, Ohio, Oct 21, 22, 1970, Paper* 20 p 10 refs

Derivation of an equation for wing or empennage volume in terms of area, aspect ratio, root thickness ratio, airfoil section type, tankage utilization factor, front and rear box web chordwise stations, chord and thickness taper ratio, and dimensionless spanwise coordinate Effects of the last four parameters are presented in a set of charts, greatly facilitating the direct determination of available volume, or of chord and spanwise extent of tankage for a given wing fuel volume The importance of wing volume in aircraft performance and wing sizing is briefly discussed The equation is limited to straight tapered planforms having linear element lines, but may also be applied to kinked planforms if the aforementioned parameters are related accordingly to the respective individual panels (Author)

A72-25812 **For the transportation of bulky objects - The 201 Super-Guppy of Aero-Spacelines Inc. (Pour le transport d'objets volumineux - Le Super-Guppy 201 d'Aero-Spacelines Inc.).** G Bruner (Centre de Documentation de l'Armement, Paris, France) *L'Aéronautique et l'Astronautique,* no 34, 1972, p 5-10 In French

Description of the Super-Guppy, a 4-engine aircraft derived from the Boeing Stratocruiser It is intended for the air transportation of large sections of the Airbus from the plants where they are manufactured to the place of final assembly The characteristics and performance of the aircraft are given, as well as a detailed description of the loading device F R L

A72-25814 **Flow control by cross jet (Contrôle d'écoulements par jet transversal).** H. Werlé and M Gallon (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *L'Aéronautique et l'Astronautique,* no 34, 1972, p 21-33 11 refs In French

Studies carried out by the Lockheed Company and by ONERA show that a jet sprouting crosswise reduces noticeably the flow separation around models Water tunnel visualizations presented in this article confirm results obtained in air The data illustrate the flow pattern and its evolution through the jet action, and they demonstrate the efficiency of the process in a variety of cases cylinder, perpendicular flat plate, contoured wall, rearward step, unswept wing, deflected flap, swept wing, diverging duct, fluidic system, and others (Author)

A72-25815 **The ablation-phase duration of a body during a decelerated hypersonic flight (Durée de la phase d'ablation d'un corps au cours d'un vol en régime hypersonique décéléré).** J. Luneau (Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse, France) *L'Aéronautique et l'Astronautique,* no. 34, 1972, p. 43-56. 30 refs. In French.

When a spacecraft reenters the atmosphere, the deceleration causes the density of heat flow acting on the wall to decrease at the end of the trajectory. Hence, the phase of ablation is of limited duration. A theoretical model based on quasi-steady assumptions makes it possible to forecast this duration as a function of the geometrical and physical characteristics of the covering material. The experimental checking is done by investigating the aerothermic behavior of metallic models launched at high speeds in the ballistic range of the Institut Franco-Allemand de Recherches de Saint-Louis (Author)

A72-25816 **Medical and physiological problems for passengers and crews of supersonic transports (Problèmes médico-physiologiques posés aux passagers et aux équipages des avions de transport supersoniques).** J Colin (Centre d'Essais en Vol, Brétigny-sur-Orge, Essonne, France) *(Journées d'Etude des Problèmes Posés par l'Aviation Commerciale Supersonique, Toulouse, France, Apr 27-29, 1971.) L'Aéronautique et l'Astronautique,* no 34, 1972, p 57-68 7 refs In French

This paper was read by the author, at the workshop 'Supersonic problems for commercial aviation', held at Toulouse in April 1971 That studious meeting was to evaluate present answers to the new challenges of supersonic transportation As explained by J C Wanner at the same meeting, the sonic boom is experienced on the territory under the supersonic flight and provokes protests of chiefly psychological and social motivation The most objectively serious problems are about the measurably cumulative cosmic irradiation and the definite risk of sudden decompression from some high altitude leak in the pressurized cabin But the review conclusions remain generally reassuring for the future of supersonic transportation (Author)

A72-25817 **Statistical diagnosis - Synthesis of data related to the reliability and maintenance of an aeronautical system (Diagnostic statistique - Synthèse des informations relatives à la fiabilité et à la maintenance d'un matériel aéronautique).** L -F. Pau (Institute for Mathematical Statistics and Operations Research, Lyngby, Denmark, Centre de Documentation pour l'Armement, Paris, France) *L'Aéronautique et l'Astronautique,* no. 34, 1972, p. 69-76 10 refs. In French

Statistical diagnosis is an original technique of selection of the *failure causes of highest probability without disassembly of the* ill-working equipment, it also yields the foremost environmental or maintenance aspects influencing the operational availability of the system This technique uses a reduction of all statistical data concerning the system by means of Benzecri's factorial analysis, the final decision requires either a simple graphical representation and some judgment or automatic statistical pattern recognition procedures Examples are given as an illustration of the advantages of this method, both at the execution or inspection levels of maintenance and when the concern will be to develop the technical design of the system on the basis of a synthetic vision of previous experience. This paper aims at presenting the methodology of statistical diagnosis and not the theories applied which are described in the bibliography. (Author)

A72-25823 # **A fatigue crack initiation detector.** D E Marlowe and J S. Steel (National Bureau of Standards, Washington, D C) *Journal of Materials,* vol 7, Mar 1972, p 28-31 Navy-sponsored research

An instrument which detects the initiation of a fatigue crack in the head of a bolt, by measuring the change in relative position of the two ends of the double shear test joint at the maximum of the cyclic load as the crack propagates, has been developed Increases in relative displacement of 0 00002 in can be reliably detected using the output of a linear variable differential transformer Detection of the initial head fillet crack should be a more reliable fatigue failure *criterion and should result in less experimental scatter than cata*strophic failure of the bolt A detailed description of the instrument and examples of its use and performance are given (Author)

A72-25875 **ATC for the seventies. III.** K P Gray (FAA, National Airspace System Program Office, Washington, D C.). *Shell Aviation News,* no 404, 1972, p 20-23

The implementation of the NAS En Route Stage A system is being accomplished in two phases The first phase provides an automated flight data processing capability in the en route environment The second phase adds primary and secondary radar processing functions to the Flight Data Processing program The Terminal Automation Program is discussed Terminal automation provides the controller with continuous aircraft identify, ground speed, and Mode C altitude data from transponder-equipped aircraft G R

A72-25922 # **The effect of aerodynamic lag on the bending response of wings at supersonic speeds.** B R. Somashekar (National Aeronautical Laboratory, Bangalore, India) *CASI Transactions,* vol. 5, Mar 1972, p 45, 46

Results of a theoretical study have revealed that the effect of lag on the response characteristics of a flexible wing is not negligible, as in some cases the peaks may be affected as much as 100% Hence, lag has to be necessarily included in estimating dynamic stresses or transient loads due to gusts etc The results also show close correspondence of response for the accurate and quadratic approximation of the lag function O.H.

A72-25923 **Economic regulation of the world's airlines: A political analysis.** W E O'Connor (FAA, Civil Aeronautics Board, Washington, D C.) New York, Praeger Publishers, Inc., 1971. 193 p. 210 refs. $15

This study evaluates the present method of economic regulation of the world's airlines and considers alternatives Emphasis is placed on the broad goal of a worldwide system of frequent, safe, efficient, low-cost air transportation for passengers, cargo, and mail on a scheduled basis, available to the peoples of the world. Particular attention is given to methods by which the economic regulation of world airline services might be reconstituted so as to make improved use of the practices of international administration Efforts toward a multilateral agreement for the periods 1944 to 1947, and 1948 to 1969 are analyzed. The competitive situation of world airline services is evaluated F.R L

A72-25998 # **An invalid equation in the general momentum theory of the actuator disk.** P M Goorjian (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) *AIAA Journal,* vol 10, Apr 1972, p 543, 544

The general momentum theory of the actuator disk model of a propeller, including a helicopter rotor, as proposed by Durand, is shown to be incorrect An unverified equation is included in the theory which, when combined with the other equations, leads to a contradiction. It is also shown that the problem of determining the flowfield of an actuator disk model can be properly formulated in terms of finding the solution to a nonlinear elliptic partial differential equation with boundary values O H

A72-26020 # **Rapid decompression in a supersonic trainer aircraft /A case report/.** M. B Dikshit (Indian Air Force, Delhi, India). *Aero Medical Society of India, Journal,* vol 14, Oct 1971, p 42-45.

A case report is presented of a sudden failure of cabin pressurization in a pressurized supersonic trainer aircraft at one of the fighter bases The various aspects of this incident, such as physical effects, time for decompression, safe or unsafe pressurization, decompression sickness and hypoxia, and blast effects are briefly discussed. O.H

A72-26029 **House noise-reduction measurements for use in studies of aircraft flyover noise.** *SAE Aerospace Information Report,* AIR 1081, Oct. 1971 18 p.

The results of some aircraft-flyover house noise reduction measurements made in five locations in the U S between 1966 and 1969 are described. The noise reduction data presented can be applied to measurements of aircraft noise made outdoors in order to estimate the noise levels indoors M V E

A72-26030 **Installation of liquid oxygen systems in civil aircraft.** *SAE Aerospace Information Report,* AIR 1223, Nov 1, 1971 12 p

Design and installation considerations are detailed on liquid oxygen supply systems for breathing oxygen for the crew and/or passengers of transport aircraft The more specific requirements for either a 70 or 300 psig liquid oxygen system are covered. The standard 70 psig nominal pressure is recommended for use except for cases when excessive pressure drop or some continuous flow regulators require the 300 psig nominal pressure system. M V E

A72-26032 **Altitude alerting devices and systems.** *SAE Aerospace Recommended Practice,* ARP 1061, Nov. 15, 1971 12 p

An industry recommended practice is presented for altitude information warning devices and systems used as an alerting means related to altitude information normally employed for aircraft height control, but not including the remote sources of such information A definition of the recommendation scope is followed by a presentation of general and detail requirements, test conditions, and individual performance and qualification tests M.V E

A72-26036 * # **Research trends in turbine aerodynamics.** W L Stewart and A. J Glassman (NASA, Lewis Research Center, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine and Fluids Engineering Conference and Products Show, San Francisco, Calif., Mar 26-29, 1972, Paper* 7 p

Brief description of some of the recent trends in turbine aerodynamics research Areas covered include cooled turbine aerodynamics, high work-factor turbines, pneumatic variable geometry, and computer analysis Most of this research is shown to have been directed primarily toward allowing the turbine to accept efficiently higher inlet temperatures and blade loading M V E

A72-26037 * # **Methods for reducing pollutant emissions from jet aircraft.** H F Butze (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, 92nd, Washington, D C , Nov 28-Dec 2, 1971, Paper.* 16 p. 6 refs.

The purpose of this paper is to define the problem of pollutant emissions from jet aircraft and to review NASA-Lewis combustion research aimed at reducing these emissions The problem of smoke formation and results achieved in smoke reduction from commercial combustors are discussed Experimental results of parametric tests performed on both conventional and experimental combustors over a range of combustor-inlet conditions are presented Combustor design techniques for reducing pollutant emissions are discussed Improved fuel atomization resulting from the use of air-assist fuel nozzles has brought about significant reductions in hydrocarbon and carbon monoxide emissions at idle Diffuser tests have shown that the combustor-inlet airflow profile can be controlled through the use of diffuser-wall bleed and that it may thus be possible to reduce emissions by controlling combustor airflow distribution Emissions of nitric oxide from a shortlength annular swirl-can combustor were significantly lower than those from a conventional combustor operating at similar conditions (Author)

A72-26041 # **Directivity of jet noise.** W. T Chu, R A Petersen, and K Kao (Southern California, University, Los Angeles, Calif). *Acoustical Society of America, Journal,* vol 51, Mar 1972, pt 1, p 830-832 13 refs U S Department of Transportation Grant No. OS-0002

Ribner's (1963) proposed basic directivity of jet noise and Lighthill's (1952) convection effect, as modified by Ribner (1962) and Ffowcs Williams (1963), are used to predict the acoustic power of subsonic jets from a single point intensity measurement at 90 deg from the jet axis The predictions are found to be good from low subsonic to near sonic speeds for a 2-in -diam model jet (Author)

A72-26068 # **Providing for reliable operation of aircraft engine elements (Obespechenie nadezhnoi raboty detalei aviatsionnykh dvigatelei)** A M Zaitsev Moscow, Izdatel'stvo Transport, 1971 196 p 20 refs In Russian

Various aspects of the problem of analyzing defects and causes of failure of aircraft engine elements are examined along with means of preventing defects and failures Particular attention is given to modern methods of studying fractured elements, analyzing fractures, and evaluating and predicting the service life of aircraft engine elements Defects and failures due to structural shortcomings, technological and production deficiencies, and inadequate operational conditions are investigated The book is intended for engineers and technicians, but should be useful also to students V P

A72-26234 **Applications of advanced composites for aircraft.** R R. June and J B. Kelly (Boeing Co , Commercial Airplane Group, Renton, Wash.). *SAMPE Quarterly,* vol. 3, Jan. 1972, p. 58-66

Boron or graphite composites, as material systems, permit design concept flexibility which is unattainable with an isotropic material This design flexibility has led to two basic approaches for the utilization of advanced composite materials including multidirectional all-composite construction and composite reinforced metal construction A multitude of flight test programs and developmental programs are currently being conducted G.R.

A72-26285 **Transportation forecasting - A review.** D. E McDaniel (U.S. Coast Guard, Merchant Marine Technical Div., Washington, D.C). *Technological Forecasting and Social Change,* vol. 3, no. 3, 1972, p. 367-389. 86 refs.

Examination of how technological forecasting and long-range planning have been applied to transportation The strengths and weaknesses of forecasting approaches which have been applied to date are evaluated, and some directions for future work in transportation forecasting and planning are suggested. Major attention is given to the overall dimensions of transportation, and with the movement of people rather than goods. F.R.L.

A72-26287 **Nondestructive testing of high temperature coatings.** R C Stinebring (General Electric Co , New York, N Y) *Materials Research and Standards,* vol 12, Apr 1972, p 18, 19, 53 USAF-supported research

Nondestructive testing techniques have been developed for evaluating diffusion formed coatings on refractory alloys and superalloys in programs sponsored by the Air Force Materials Laboratory. These techniques have been used, primarily, to detect or measure coating thickness variations, abnormal coating chemistry, cracks, porosity, and substrate-alloy segregation In addition, the eddy current technique has shown considerable promise for monitoring the amount of diffusion and other wearout parameters when a coating is exposed to high temperatures for extended periods of time. (Author)

A72-26291 **Using interactive graphics for fighter pilot training.** K J. Kinsella and A J Matthews (Adage, Inc., Boston, Mass). *Information Display,* vol 9, Mar -Apr 1972, p. 15-20, 31 5 refs.

Description of a new all-electronic system, which provides display facilities including a 'three-dimensional,' real-time CRT display of air combat maneuvers and accompanying dynamic data on interactive graphics terminals. The display system accepts a three-dimensional image description, in this case the maneuvering range and aircraft within it, and displays it as a precise drawing from any viewing orientation, scale, and position. The perception of dimensionality is aided by intensity depth cuing and aircraft scaling, an aircraft closer to the observer, at any viewing orientation, is brighter and larger than one further away. The display will permit an air-combat instructor on the ground to view tactical dog-fights with simulated missile firings from almost any vantage point by a flick of his wrist, will cut down the hardware expense of practice missile firings at drone targets, will give the pilot much more missile-firing practice through simulation and will immensely aid flight-test range safety officers in their efforts to identify and repair aircraft which have suffered damage as the result of undue strain (Author)

A72-26292 **Integrated displays for multicrew military aircraft** J Frost and N F Sullivan (North American Rockwell Corp., Autonetics Div , Anaheim, Calif) *Information Display,* vol 9, Mar -Apr 1972, p 23-28

Discussion of considerations involved in the design of integrated display systems for high-performance military aircraft that must negotiate complex flight profiles, counter sophisticated enemy defenses, and accurately deliver weapons Specialized sensors provide information to centralized data processing centers for automatic and semiautomatic conduct of mission operational functions Controls and displays provide the interface between human operators and the electronic equipment associated with the functional segments of the avionics configuration The displays afford a monitoring capability for the augmentation and/or override of automatic controls and also provide the means for effecting decisions and manual operations regarding navigation update and weapon delivery, reconnaissance and bomb damage assessment, threat and terrain avoidance, and numerous supplementary functions. T M.

A72-26316 # **Determination of target distances with a passive detection radar (Opredelenie dal'nosti do tseli passivnym radiolokatorom).** O V Belavin In Radar theory and techniques Number 3 Moscow, Izdatel'stvo Mashinostroenie, 1971, p 216-223 In Russian.

Holahan's (1958) passive detection system for bombers, which determines target locations from the signals emitted from the target is analyzed Several versions of system application to the determination of the target distance are examined Formulas for the target distance in the case of horizontal flight and in the presence of pitch angles are obtained, and the accuracy requirements placed on the measurement of geometrical quantities are formulated. V P.

A72-26391 **Active vibration isolation for aircraft seating.** P C Calcaterra (Barry Wright Corp , Watertown, Mass) *Sound and Vibration,* vol 6, Mar 1972, p 18-23 26 refs

The general nature of human response to vibration is briefly discussed, together with the application of active vibration isolators for protecting aircraft pilots from severe environments, such as turbulence encounters of commercial jet transports and general helicopter missions It is pointed out that human subjects are most susceptible to vibration in the region from 4 to 10 Hz. Active isolation systems can provide the required degree of vibration isolation and displacement control for personnel seating Continuing human factors research will provide the necessary data to determine trade-offs between vibration isolation and task performance G.R.

A72-26442 # **Use of the rank correlation method to choose the controlled parameters of complex control plants (Primenenie metoda rangovoi korreliatsii dlia vybora kontroliruemykh parametrov slozhnykh ob'ektov).** V. S Bogdanov and M I Frolin. In Automatic monitoring and electrical measurement methods Volume 1 Novosibirsk, Izdatel'stvo Nauka, 1971, p 79-87 6 refs In Russian

Description of the rank correlation method, and illustration of its use in objectively processing subjective data concerning a complex process for a preliminary selection of the essential parameters affecting the output parameter of a control plant. The determination of the rank correlation coefficient by Spearman's and Kendell's formulas is discussed, formulas are presented for calculating the upper and lower confidence limits of significance of the rank correlation coefficient for the case where more than ten control plants are being monitored, and the use of the rank correlation method to select the most important parameters required for monitoring an aircraft power system is considered A B K

A72-26515 # **Preliminary observations of 1-16 Hz natural background infrasound and signals from Apollo 14 and aircraft.** E S Posmentier (New York University, Bronx, N.Y) *(Washington State University and University of Idaho, Workshop on Infrasonic Research, Pullman, Wash. and Moscow, Idaho, Nov 1970) Geophysical Journal,* vol 26, Dec 1971, p 173-177 7 refs. NSF Grant No GA-15118.

Infrasound with frequencies of 1-16 Hz, detected by an array of four thermistor flow-meter microphones in Sterling Forest, New York, was observed to have a continuous background with peak energy distributed near 16 Hz in frequency, with amplitudes of about 1 dyn/sq cm, and arriving from the south-west and south-east at slightly above the speed of sound in air at ground level The same array of microphones detected 5 dyn/sq cm signals from the Apollo 14 The earlier part of the 10-min signal arrived from the first stage reentry, the later from the launch site vicinity It is shown that aircraft beyond the visible and audible range can be detected and tracked by monitoring the infrasound emitted throughout most of the 1-16 Hz frequency band. (Author)

A72-26559 Legal foundations of the charter air traffic (Rechtsgrundlagen des Charterluftverkehrs). H.-W. Paas. *Zeitschrift fur Luftrecht und Weltraumrechtsfragen,* vol 21, Apr 1, 1972, p 55-64. In German

The word 'charter' is not mentioned in German Air Law The law distinguishes between air traffic conducted by the air lines and other commercial air traffic. The classification of flights into the two categories in practice is often very difficult. The differentiation between air lines and other companies engaged in commercial air traffic, in particular, appears in many cases almost impossible. The legal regulation of charter air traffic is concerned with providing adequate safeguards for the qualifications of the companies engaging in this traffic, taking into consideration economic, personnel, technical, and organizational factors G.R

A72-26561 The definition of the concepts of aircraft and spacecraft in international and national law (Die Begriffsbestimmung von Luftfahrzeug und Raumfahrzeug im Volkerrecht und innerstaatlichen Recht). M Dauses. *Zeitschrift fur Luftrecht und Weltraumrechtsfragen,* vol 21, Apr 1, 1972, p 75-89. 43 refs In German.

International law has no generally valid definition for aircraft Various states have defined in their national law the concept 'aircraft' on an enumerative basis The German definition of the word is not suitable for the differentiation between aircraft and spacecraft Enumerative definitions in French and English law are also discussed together with abstract definitions A generally recognized definition of the term 'spacecraft' does not exist in international law. The meaning of the term on the basis of the definitions given by various international and national agencies is considered G R.

A72-26577 * Nonlinear actuator disk theory M D. Greenberg (Sage Action, Inc , Ithaca, N Y , Delaware, University, Newark, Del) *Zeitschrift fur Flugwissenschaften,* vol 20, Mar 1972, p 90-98. 8 refs Contracts No NAS1-6349, No NAS1-8173.

Results obtained from a recent investigation of the flowfield induced by a heavily loaded actuator disk First, the governing nonlinear integral equations are formulated from two different points of view, and the iterative solution is briefly outlined Calculated flow patterns are presented for representative advance ratios and blade circulation distributions For the static condition, the experimentally observed lingering of the tip vortices in the propeller plane, and the insensitivity of the streamline pattern to thrust coefficient are both accounted for, and a 'dividing streamline' - apparently not previously discussed in the literature, is predicted for the nonstatic case Finally, the relationship between the actuator disk flow and the zero harmonic of the flowfield induced by a finite-bladed propeller is considered (Author)

A72-26578 Subsonic and supersonic flow around non-axisymmetric fuselages (Die Umstromung nichtrotationssymmetrischer Rumpfe in Unter- und Überschall). H Rothmann (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur theoretische Gasdynamik, Aachen, West Germany) *Zeitschrift fur Flugwissenschaften,* vol. 20, Mar 1972, p 98-105 22 refs In German

Description of a method for calculating the flow about nonaxisymmetric bodies in subsonic and supersonic flow The bodies are constructed by means of the streamlines on their surface. Source, dipole, and quadrupole singularities are assumed on a curved camberline, the differential equations for the streamlines are derived and are numerically integrated At the tip of the body, which is the initial point of the integration as well as a singular point of the differential equations, the problem can be solved by a transformation to 'conical' coordinates Different cross-sections and longitudinal sections of the body can be produced by varying the source, dipole, and quadrupole strengths as well as the 'camber' of the camberline This method seems to be particularly suitable in cases in which the streamlines are of interest Using this method, the pressure distribution and the air forces on bodies can be determined (Author)

A72-26579 Unsteady air forces on a flat plate in incompressible potential flow in the presence of small local surface perturbations (Instationäre Luftkrafte an der ebenen Platte in inkompressibler Potentialstromung bei kleinen lokalen Storungen der Oberfläche). H Stumke (Stuttgart, Universitat, Stuttgart, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 20, Mar 1972, p 105-112 9 refs In German

Use of a well-known formula for the lift distribution in the vicinity of a step on the surface of a thin airfoil in plane incompressible potential flow to derive the lift distribution and the aerodynamic functions of a small local perturbation of the surface, which are of interest in flight dynamics With a fixed center of gravity of the airfoil, the frequency response of the angle of attack to periodic local perturbations is systematically investigated as a function of the position of the disturbance and is discussed using a numerical example. A local perturbation of the surface in a definite position before (or behind) the middle of the airfoil makes the whole system act as a mechanical high-pass filter (or as a low-pass filter) The static pitching moment about the center of gravity has, in general, a sign opposite to that of the moment generated by a spoiler extended at the same spot toward the same side (Author)

A72-26657 # Maneuvering and striking (Manovrare e colpire). G Rotondi *Alata Internazionale,* vol 28, Mar 1972, p 32-38 In Italian

Examination of the three main requirements of a fighter plane other than horizontal and climbing speed - namely, maneuverability, radius of action, and armament Limitations on maneuverability due to sudden increases in drag and large excursions of the center of pressure are discussed, noting a trend toward a decrease in wing loads in the newest aircraft The advantages of the canard configuration over the delta configuration in achieving improved maneuverability are reviewed. The qualities desired in a fighter plane with a large radius of action are cited, and a study is made of the relation between the maneuverability of a fighter plane and the ability of the pilot to make proper use of the armament with which the aircraft is equipped A B K

A72-26730 The center of gravity of the spectrum of the received signal and the effective antenna centers of a Doppler-type velocity meter V I Baburin, L. N Zakhar'ev, and A. A Lemanskii *(Radiotekhnika,* vol 26, June 1971, p 49-54.) *Telecommunications and Radio Engineering, Part II - Radio Engineering,* vol 26, June 1971, p 86-90 5 refs Translation.

The beam direction corresponding to the data weight center in the signal spectrum of an airborne Doppler velocimeter is determined together with the point (effective antenna center) at which this beam intersects the antenna aperture The influence of factors causing

asymmetrical illumination of the ground surface is examined. The study is conducted for the case of identical receiving and transmitting antennas on an aircraft in horizontal flight T M

A72-26816 # **Some design problems of special drilling machines with programmed digital control systems (Nekotorye voprosy proektirovaniia spetsial'nykh sverlil'nykh ustanovok s chislovymi sistemami programmnogo upravleniia).** *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Aviatsionnaia Tekhnologiia i Organizatsiia Proizvodstva,* no 131, 1971, p 9-13 In Russian.

Discussion of carriage position-to-position shift rates in countersink drilling machines providing an optimal output-precision tradeoff when such machines with programmed-control systems are used for precision-spacing multiple hole drilling in extended aircraft engine components. Theoretical considerations and drill specifications are given for the optimization of this drilling technique V.Z

A72-26819 # **Use of constraining frames during the hydrojet-shot blasting treatment of compressor blades for gas turbine engines (Ispol'zovanie agranichitel'nykh kasset pri gidrodrobestruinoi obrabotke lopatok kompressora GTD).** N. A Dunin and O M Efimov *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Aviatsionnaia Tekhnologiia i Organizatsiia Proizvodstva,* no 131, 1971, p. 48-52 In Russian

Tests were carried out to investigate the effectiveness of U-shaped frames in protecting blade edges from direct hits by shots during the hardening of compressor blades by hydrojet-shot blasting treatment The equipment used is described and the theory of this treatment is discussed The positive effect of U-shaped constraining frames is noted. V Z

A72-26820 # **Production of special equipment for strengthening the inner surfaces of heavily-loaded components of a helicopter (Sozdanie spetsial'nogo oborudovaniia dlia uprochneniia vnutrennikh poverkhnostei vysokonagruzhennykh detalei vertoleta).** V E Ustinov and I. N Shkanov *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Aviatsionnaia Tekhnologiia i Organizatsiia Proizvodstva,* no 131, 1971, p 57-63 In Russian

Experimental helicopter rotor blade spars were subjected to work hardening by impacts of steel balls during vibrations in sectional single and two-position centrifugal vibrators of special designs A semiautomatic work-hardening machine with a cyclic programmed-control system was also used as a more efficient alternative to the existing equipment for component surface hardening by the ball-impact vibration process Optimal conditions are selected for the application of this machine on Cr-Mo-Ni steel components operating under alternate loads V Z.

A72-26821 # **Fatigue strength and stress concentration sensitivity of titanium alloys at normal and elevated temperatures (Ustalostnaia prochnost' i chuvstvitel'nost' k kontsentratsii napriazhenii titanovykh splavov pri normal'nykh i povyshennykh temperaturakh).** D Ia Bragin, I. N Shkanov, N Z Loginov, and A M Il'chenko *Kazanskii Aviatsionnyi Institut, Trudy, Seriia Aviatsionnaia Tekhnologiia i Organizatsiia Proizvodstva,* no 131, 1971, p 64-71 In Russian

Investigation of the effect of grain sizes on the fatigue strength of fine-grain and coarse-grain VT8 and VTZ-1 titanium alloy specimens at temperatures up to 450 C under cyclic loads. A high sensitivity of specimens to stress concentrations is established at lower temperatures, irrespective of grain sizes The sensitivity tended to decrease with temperature and remained virtually unchanged with time during 2000 hr tests, while the fatigue strength of both smooth specimens and those with cuts slightly decreased with the progress of tests V Z

A72-26892 # **Certain comments on the cooling of aircraft turbine engine blades (Pewne uwagi o chlodzeniu lopatek turbin silnikow lotniczych).** J Otys and S Szczecinski *Technika Lotnicza i Astronautyczna,* vol 27, Mar 1972, p 5-8 5 refs In Polish

A proposed approximate method of calculating turbine blade-cooling effectiveness makes it possible to predict the mean wall temperatures of stator and rotor blades for given ambient gas temperatures and known coolant (air) flow rates Simplifying assumptions disregard the effects of heat exchange by radiation and by conduction through the disk (for rotors) and through the frame (for stator blades) Effects of ducted-blade cooling on the structural features and load-endurance characteristics of blades are briefly characterized T.M

A72-26893 # **Critical lift of a helicopter rotor II (Krytyczna nosnosc wirnika smiglowca. II)** K Szumanski *Technika Lotnicza i Astronautyczna,* vol 27, Mar 1972, p 9-12 In Polish.

Effects produced by flow separation on the main-rotor blades of a helicopter are analyzed, and methods used to evaluate the critical lift of the rotor are evaluated The blade angle-of-attack criterion for flow separation and attachment is explained in detail, and graphs compare critical-lift curves based on various flow separation criteria T.M

A72-26895 # **Methods of localizing failures of aircraft electrical equipment (Metody lokalizacji uszkodzen urzadzen elektrycznych samolotu).** J Poddenek *Technika Lotnicza i Astronautyczna,* vol 27, Mar 1972, p 19-22 6 refs In Polish

Localization of damage in complex on-board electrical systems involves the identification of failed elements and is usually four times as long an operation as the repair of the elements themselves The localization process is based on a program listing the number of operations required for each checkout and delineating the order in which checkout functions must proceed. Analytical and nonanalytical procedures for tracing failed elements are described, together with automatic indication techniques and a dynamic programming method. T.M.

A72-26999 **Skyguide.** W C Janzer (Eastern Air Lines, Inc , New York, N Y) *Shell Aviation News,* no 403, 1972, p 8-11

The airline industry's new navigation system, Area Navigation, appears to offer some promise in reducing congestion by utilizing currently unused airspace Area Navigation denotes an airborne computer system that enables an aircraft to navigate accurately between any two or more geographical locations, without adhering to precise tracks dictated by land-based aids New system components are discussed together with aspects of flight crew monitoring, and problems of optimizing the new system G.R

A72-27000 **ATC for the seventies II** K P Gray (FAA, National Airspace System Program Office, Washington, D.C) *Shell Aviation News,* no 403, 1972, p 14-19

The computer program subsystem provides the means for effective and efficient utilization of the central computer complex in performing the required tasks The two major components of the subsystem include the operational program component and the nonoperational program component The data entry and display subsystem provides the interface for information exchange between the air traffic controller and the central computer complex Other subsystems discussed include the communication subsystem, the personnel subsystem, and the environmental subsystem G R.

A72-27001 **Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Sessions 1, 2, 3 & 4.** Symposium sponsored by the Society of British Aerospace

Companies London, Society of British Aerospace Companies, Ltd , 1971 Session 1, 64 p , session 2, 69 p , session 3, 61 p., session 4, 27 p Price of set, S7 40

External vision requirements for military aircraft, aircraft windshield requirements, current experience with aircraft transparencies, and future requirements from a civil operator's viewpoint are discussed Attention is given to new developments in aircraft transparencies, mechanical strength testing of strong glass samples, better use of glazing materials, some properties of polycarbonates relevant to the design of optical transparencies for aircraft, and aircraft transparency applications of polycarbonates

F R L

A72-27002 # **External vision in military aircraft** E. M B Smith (RAF, Institute of Aviation Medicine, Farnborough, Hants , England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 1 London, Society of British Aerospace Companies, Ltd , 1971, p 13-17

Consideration of the structural and optical problems of providing adequate transparencies in high-performance aircraft The visual process is briefly described in order to make possible an appreciation of the interplay between the visual mechanism, the external field of view, and transparencies There are visual requirements common to broad groups of aircraft (e g , fixed wing or rotary wing) and specific requirements conditioned by the aircraft role The determination of the extent of cockpit transparencies will therefore require consideration of the view requirements for each phase of flight, the operational aspects, the performance envelope, and aircraft structural design considerations F.R L

A72-27003 # **The specification of optical requirements for aircraft transparencies** N S Corney and W Shaw (Ministry of Defence /Aviation Supply/, England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 1 London, Society of British Aerospace Companies, Ltd , 1971, p 19-34, Discussion, p 35 14 refs

There is a real need for rationalisation of the requirements for optical quality of aircraft transparencies In this paper eight areas are identified for definition for the various grades of transparency from that of the pilot's windscreen down to a cabin window These areas are optical resolution, haze and halation, light transmission, optical deviation, distortion, binocular deviation, double imaging, and finally minor scratches and inclusions Each of these is discussed in turn and various limiting values are proposed in order to achieve the required optical quality consistent with the use of the transparency in question A number of problem areas requiring investigation are identified A range of test methods has been examined for the parameters in question and some of these are recommended for use with the aim of achieving some standardisation of procedures

(Author)

A72-27004 # **Aircraft windshield requirements.** D P Davies (Air Registration Board, Redhill, Surrey, England). In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 1 London, Society of British Aerospace Companies, Ltd , 1971, p 36-44; Discussion, p 44-46

Discussion of the optical qualities of windshields and direct vision windows The optical qualities of individual panels involve the color and amount of light transmitted, small localized faults and imperfections, heating elements, distortion, inside reflections, and double images It is suggested that attention should be given to the nonreflective qualities of instrument glasses In general, fields of view have been improving as new aircraft are developed Direct vision windows are considered desirable in view of the possibility of hail damage to the windshield F.R L

A72-27005 # **Current experience with aircraft transparencies and future requirements from a civil operator's viewpoint** B D Gibbs (British European Airways Corp , Ruislip, Middx , England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 1 London, Society of British Aerospace Companies, Ltd , 1971, p 47-56, Discussion, p 56-58

Outline of problems currently being experienced with aircraft transparencies, with discussion of some of the more important requirements that should be incorporated in the design of new transparencies Flight deck windows, the majority of which are electrically heated, constitute the major proportion of the cost of transparencies Operational, technical, and commercial aspects of transparencies are discussed F R L

A72-27006 # **New developments in aircraft transparencies** D L A Hand and R D King (Triplex Safety Glass Co , Ltd , London, England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 2 London, Society of British Aerospace Companies, Ltd , 1971, p 1-8, Discussion, p 9

Discussion of a windscreen design improvement program which produced a high strength glass suitable for structural applications with a weight saving of about 30% Also developed was a highly adhesive electroconductive film absorbing no more than 5% of visible light with a substantial resistance capacity Curved glass-faced acrylic structural components were also produced and are presently being evaluated Emphasis in all research and development work was on the improvement of service life V Z

A72-27008 # **Better use of glazing materials** P J Sharp (Lucas Aerospace, Ltd , England) In Symposium on Optical *Transparencies, 2nd, London, England, June 9, 10, 1971, Proceed*ings . Session 2 London, Society of British Aerospace Companies, Ltd , 1971, p 19-24, Discussion, p 25-27

Aircraft fuselage glazing design problems are discussed, covering fail safe test rigs used to meet airworthiness requirements, passenger cabin window designs using stretched acrylic, various cockpit windscreen designs, and thin surface coatings of various designs, culminating in thin glass sheets laminated to the external plastic surface The properties of polyvinyl butyral, known as vinyl, are discussed, considering both its advantages and disadvantages Polyurethanes are evaluated as a potential alternative material for interlayer development V Z

A72-27009 # **Some properties of polycarbonates relevant to the design of transparencies for aircraft structures** A. P Holliwell (Bayer Chemicals, Ltd , Richmond, Surrey, England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 2 London, Society of British Aerospace Companies, Ltd , 1971, p 28-30

The properties of acrylics and polycarbonates in applications for aircraft transparencies are compared, with particular attention to cost and to optical, mechanical, thermal, and chemical properties Toughness and impact strength at widely varying temperatures, coupled with outstanding fire and heat resistance, are found to be the advantages of polycarbonates over acrylics in optical transparency applications, against the disadvantages of a relatively poor scratch resistance and higher cost V.Z

A72-27010 # **Aircraft transparency applications of polycarbonates.** W A Miller (Sierracin Corp , Sylmar, Calif) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 2 London, Society of British Aerospace Companies, Ltd , 1971, p 31-39, Discussion, p 40, 41 7 refs

Discussion of the advantages (good heat resistance, high toughness and impact resistance, and deep compound contour) and disadvantages (poor optical quality, poor chemical and abrasion resistance, bubbling at elevated temperature, and outdoor weathering) of polycarbonates as potential alternatives to acrylics in aircraft transparency applications Techniques for minimizing these polycarbonate deficiencies are described It is anticipated that polycarbonates will provide an impact protection superior to that of any other material of the same thickness when deficiency minimization techniques and certain precautions are properly matched within a polycarbonate design V Z

A72-27011 # **The development of windscreen reliability.** W G Roberts (Triplex Safety Glass Co , Ltd , London, England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 3 London, Society of British Aerospace Companies, Ltd., 1971, p 1-8, Discussion, p 8-10.

The causes and nature of windscreen delamination, and also windscreen designs, interface shear stress effects and edge heating are discussed in the context of windscreen reliability The existence of an analogy between windscreen delamination and metal fatigue is indicated Design recommendations are made in terms of maximum heated area, low control temperature, edge heating, edge release systems and maximum adhesion levels The progress made by Triplex in repeated applications of thermal and mechanical loads under simulated flight conditions is reviewed V Z

A72-27012 # **The design and testing of Concorde transparencies.** W P C Soper (British Aircraft Corp , Ltd , Commercial Aircraft Div , Filton, Bristol, England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 3 London, Society of British Aerospace Companies, Ltd , 1971, p 11-17, Discussion, p. 18, 19

Design features of the Concorde visor are discussed, covering configuration, forward windscreen, flight deck side windows, and transparencies Detail testing, optical assessment, bird strike tests, and reliability tests are also included Flight characteristics of the Concorde are given V Z

A72-27013 # **Experimental investigation into the bird impact resistance of flat windscreen panels with clamped edges** M J Mott (Hawker Siddeley Aviation, Ltd , Hatfield, Herts , England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 3 London, Society of British Aerospace Companies, Ltd , 1971, p 20-24, Discussion, p 24, 25

Discussion of a test program under which a total of 113 panels were given 252 shots in a reassessment of the bird impact resistance of flat windscreen panels of the Concorde because of a discrepancy between predicted and achieved penetration speeds which came up in previous tests for the Concorde project Program details and test results are given for the effects of clamping width, ply thickness and composition, impact angle and position, and temperature on thermally toughened glass windscreen panels, stretched acrylic windscreen panels and high-strength glass windscreen panels A revised design formula is proposed on the basis of the test results V Z

A72-27014 # **Windscreens to resist bird strikes I, II.** G Poullain and Clamagirand (Avions Marcel Dassault, Vaucresson, Hauts-de-Seine, France) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 3 London, Society of British Aerospace Companies, Ltd , 1971, p 28-32, Discussion, p 33-35

Review of a test program designed to verify the validity of the empirical formulas proposed by the authors of the selection of thickness of structural plies in windscreens sustaining bird strikes Theoretical analysis is also made of the bird impact resistance of windscreen materials such as various types of glass, stretched acrylic and 'as cast' acrylic vs bird weight and speed, bird impact trajectory angle, window shape, size and perimeter characteristics and temperature V.Z

A72-27015 # **Recent developments in the field of transparent armor - Ballistic and bird.** A V Johnson (PPG Industries, Inc , Bloomfield, N.J.) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 4 London, Society of British Aerospace Companies, Ltd , 1971, p 1-4, Discussion, p 4-6.

Discussion of the shielding properties of new transparent polycarbonate glazing systems being tested as candidate armors against projectile and bird impacts in striking and interior plies and interlayer and backplate materials. It is believed that combinations of *these systems provide a basis for the development of bird-resistant* transparencies superior to other available materials of comparable weight V Z.

A72-27016 # **Chemically strengthened glass for frangible aircraft canopies.** R E Wittman (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 4 London, Society of British Aerospace Companies, Ltd , 1971, p 7-10

The feasibility of a frangible 'eject-through' type canopy design in aircraft emergency escape systems is discussed The basic criteria of such designs are specified A specific low temperature ion exchange process used in a canopy application study is described The suitabilities of Dow-Corning Dielectric Gel 51, and Swedlow 5272M and 5272Y for these applications are compared It is concluded that ejection through these types of frangible canopy is feasible but requires protection against possible eye and face damages V Z

A72-27017 # **Escape through aircraft transparencies** G. T. Hudson (Hawker Siddeley Aviation, Ltd , Kingston-on-Thames, Surrey, England) In Symposium on Optical Transparencies, 2nd, London, England, June 9, 10, 1971, Proceedings Session 4 London, Society of British Aerospace Companies, Ltd , 1971, p 11-20, Discussion, p 21

Consideration is given to the requirements of emergency escape from high performance military aircraft both during flight and on the ground The effects of aircraft configuration, performance and role upon these requirements is discussed with particular reference to the jettison or effective removal of a cockpit hood in order to effect quickly, an adequate and safe escape path The design and development of a system using explosive cord to cut or break-up aircraft transparent materials for this purpose is described (Author)

A72-27091 # **Influence of the inertia of the base on the dynamic deflection of an elastic plate (Vliianie inertsionnosti osnovaniia na dinamicheskii izgib uprugoi plastiny)** V P. Privarnikova and Iu K Privarnikov (Dnepropetrovskii Gosudarstvennyi Universitet, Dnepropetrovsk, Ukrainian SSR) *Prikladnaia Mekhanika*, vol 8, Jan 1972, p 107-110 In Russian

A system of equations in series form is derived which describes the dynamic deflection of an elastic rectangular plate hinged to a ponderable absolutely rigid base which moves together with the plate under the action of a sinusoidal pressure pulse uniformly distributed

over the plate It is shown that appreciable errors (5%) can arise in the determination of the maximum dynamic deflection of the plate if the displacement of the base is neglected V.P.

A72-27103 **Trends in civil air traffic control.** D. Boots (Raytheon Co., Equipment Div, Waltham, Mass.). *Electronic Progress,* vol. 14, Spring 1972, p. 2-11.

A number of tables showing the expected growth of air traffic through 1995 is presented. The most difficult aspect of accommodating the projected growth involves the control of traffic in terminal areas. Present civil air traffic control systems are described. Plans for increasing terminal capacity are discussed together with a new surveillance system, aspects of intermittent positive control, and an Aerosat program for evaluating the use of multiple satellites in near synchronous orbit to improve the efficiency of oceanic travel. G.R.

A72-27105 **Distance measuring equipment** R. W. Dankwardt (Raytheon Canada, Ltd, Waterloo, Ontario, Canada). *Electronic Progress,* vol 14, Spring 1972, p 18-22

To maintain a proper course, an aircraft must locate itself by means of an airborne VOR receiver, providing azimuth information with respect to a VOR ground station, and an interrogator-receiver, providing distance information from a DME (Distance Measuring Equipment) ground station DME is an active system providing the aircraft with range information A DME transponder is installed on the ground in order to detect and decode the pulse interrogations received from the aircraft and to encode and generate an appropriate pulse reply for transmission back to the aircraft A completely new DME ground transponder is described G.R

A72-27106 **Microminiature ILS.** H P Mansfield (Cossor Electronics, Ltd, Harlow, Essex, England) *Electronic Progress,* vol 14, Spring 1972, p. 23-26

The Instrument Landing System (ILS) provides the pilot with bearing and glide slope information so that once properly started he can fly his aircraft almost all the way to touchdown On the ground the system employs, for each runway direction, two transmitter-antenna sets. The localizer antennas, providing left-right information, are located beyond the far end of the runway on its extended centerline They radiate two overlapping beams whose line of intersection is aligned with the centerline The pilot flies to maintain equality of received modulation frequencies in order to stay aligned with the runway. G R.

A72-27108 **A.300B Airbus - A European aircraft challenges a difficult market.** *Interavia,* vol 27, Apr 1972, p 334-341

Discussion of the A 300B Airbus, which is to be constructed in three configurations, Models B1, B2, and B4 The A 300B is a large-capacity medium hand aircraft Compared with the basic B1 version now in process of assembly, the B2 model ordered by Air France will have three extra rows of seats in the cabin and space for four extra cargo containers The B4 ordered by Iberia is identical with the B2, but with the addition of extra fuel tankage located in the center section of the wing The development and production programs, sales prospects, and after-sales service and technical support are considered F R L

A72-27110 **Landing systems for future civil and military operations.** M Bohm (Standard Elektrik Lorentz AG, Stuttgart, West Germany). *Interavia,* vol 27, Apr. 1972, p. 394-396

Discussion of work based largely on the supposition that developing a new landing system on the basis of existing designs, signal formats, and frequency bands would be the most effective method. The semicompatible Sector-TACAN (SETAC) system and the DME-based landing systems (DLS) are described. SETAC provides the three polar coordinates of azimuth, elevation, and range to all approaching and landing aircraft. DLS, a new concept, is based on the use of circular antenna arrays, or the azimuth and elevation ground stations Both SETAC and DLS demonstrate clearly that an ILS replacement system can be developed and produced on the basis of existing systems. F R.L.

A72-27166 **VAK 191B - Germany's V/STOL fighter.** *Flight International,* vol 101, Apr. 13, 1972, p 502-506

The first flight with a VAK 191B took place on Sept. 10, 1971, ten years after the start of the first project studies Particular attention was given to the development of technology in a number of specific areas including redundant flight control systems using fly-by-wire techniques, a triplex autopilot, a hydraulic system, and an airborne auxiliary power unit. There are problems regarding the suitability of the aircraft for present NATO defense schemes. It is, therefore, questionable whether the aircraft will ever be introduced into service as a fighter G.R

A72-27198 **The philosophy of nondestructive testing as an adjunct to the design process and product analysis** H J McFaul (Douglas Aircraft Co, Long Beach, Calif) *Materials Evaluation,* vol 30, Apr 1972, p 18A-22A

Fundamental relations in nondestructive testing methods applied to aircraft design and reliability are described Simplifications are obtained in a maintenance program through the use of nondestructive methods for predictive fatigue life analysis and in-service monitoring Structural development and qualification test programs are formulated from an extensive background of testing on a former jet transport aircraft structure Current programs involve the systematic testing of structural elements, aircraft components, and the complete airframe G R.

A72-27235 # **Runway stability of an aircraft with wheels that are elastic in the sense of the hypothesis of moment-induced drift (Pro stiikist' na zl'otno-posadochnii smuzi litaka z elastichnimi za momentnoiu gipotezoiu vidvedennia kolesami)** L G Lobas (Kiivs'kii Politekhnichnii Institut, Kiev, Ukrainian SSR) *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Tekhnichni i Matematichni Nauki,* vol 34, Jan 1972, p 76-79 6 refs In Ukrainian

The motion of an aircraft with a three-wheel landing gear along a runway is examined under the assumption that the system of reactions reduced to the center of contact of a wheel can be expressed through a transverse reaction and a moment with respect to the normal These quantities are assumed to be linear functions of the wheel drift angle According to the conventional drift hypothesis, a necessary condition for aircraft stability is that the point of intersection between the nose wheel strut and the runway be located in front of the point of contact According to the hypothesis of moment-induced drift, this is desirable but not necessary D-partitioning of the parameter plane in the sense of the moment-induced drift hypothesis can be obtained from the D-partitioning in the sense of the conventional hypothesis by substituting the coefficients V P

A72-27268 # **The characteristics of the aerodynamic design of the Tu-154 (Die Besonderheiten der aerodynamischen Gestaltung der Tu-154).** F Voloshin and S Iurovskii *(Grazhdanskaia Aviatsiia,* no 10, 1971) *Technisch-okonomische Informationen der zivilen Luftfahrt,* vol 8, no 2, 1972, p 65-69. In German (Translation)

Investigations regarding a suitable wing design showed the superiority of the arrow wing The wing profile selected ensures for the aircraft a high quality of the aerodynamic characteristics in a relatively wide Mach number range Each of the three propulsion units of the aircraft provides a thrust of 9500 kgf at takeoff Problems of propulsion unit location are discussed together with other aspects of aerodynamic significance for the aircraft G.R

A72-27269 # **The decision height (Die Entscheidungshohe).** S L Belogorodskii (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR). *(Grazhdanskaia Aviatsiia,* no. 11, 1971) *Technisch-okonomische Informationen der zivilen Luftfahrt,* vol 8, no 2, 1972, p. 70-75 In German (Translation).

The aircraft should have a certain minimum altitude during the approach under conditions of limited visibility to ensure the safe passing of obstacles Minimum safety flight altitudes differ for various landing systems Aspects of the accuracy of the approach are discussed together with permissible lateral deviations A diagram showing the statistical distribution of the lateral deviations of an aircraft from the center line is presented together with a representation of the required distances for the correction maneuver G R

A72-27270 # **The problem of reducing smoke emission from aircraft equipped with gas turbine power plants (Das Problem der Rauchverminderung bei Flugzeugen mit Gasturbinentriebwerken).** W Zinnert *Technisch-okonomische Informationen der zivilen Luftfahrt,* vol. 8, no 2, 1972, p. 77-85. 5 refs In German

The composition of the exhaust gases from gas turbine power plants is discussed together with the dangers presented by these aircraft emissions Various approaches for reducing the smoke formation in the interior of the combustion chambers of aircraft gas turbine power plants are considered, taking into account aspects of elementary carbon formation, the fuel-air mixture, and the effect of processes in the intermediate zone on the smoke formation Three methods are generally used for the determination of the amount of carbon in the exhaust gases Light absorption effects are utilized in approaches for the observation and evaluation of the smoke trail left by aircraft with gas turbine power plants G R.

A72-27272 # **Legal aspects involved in the prevention of the unlawful seizure of aircraft (Rechtliche Probleme der Bekampfung von Flugzeugentfuhrungen).** G Damm (Ministerium fur Verkehrswesen, Berlin, East Germany) *Technisch-okonomische Informationen der zivilen Luftfahrt,* vol 8, no 2, 1972, p 89-93 In German

It is pointed out that the expectation of the hijacker not to be punished is an important factor in his motivation Only the cooperation of the states participating in international air traffic can eliminate this factor The steps undertaken to ensure such a cooperation are discussed, giving attention also to the participation of the German Democratic Republic in the international agreements reached G R

A72-27343 # **Dynamic behaviour of fibre reinforced materials.** G C Wright (Southampton, University, Southampton, England) In Applications of experimental and theoretical structural dynamics, Proceedings of the Symposium, Southampton, England, April 18-20, 1972 Southampton, University of Southampton, 1972, p 19 1-19 11 5 refs

The dynamic properties of high-performance thermosetting plastic composites unidirectionally reinforced by boron and carbon fiber with high elastic moduli are discussed in a study of the suitability of such materials in high-performance aircraft structural applications The dynamic flexural moduli of thin beams with free ends and several fiber-resin combinations are determined at temperatures from 50 C down to -20 C. Approaches to predicting the behavior of multilayer plates and to relating the theoretical predictions to practical tests are considered A free-free beam test appeared to be accurate in determining the modulus and loss factor of a composite material, especially when the non-contacting exciter and displacement transducer eliminated the uncertainties of correction techniques V Z

A72-27349 **Performance of inward radial flow turbines under unsteady flow conditions with full and partial admission.** F J Wallace and J Miles (Bath University of Technology, Bath, Somerset, England) *Institution of Mechanical Engineers, Proceedings,* vol 185, no 77, 1970-1971, p 1091-1105 7 refs Research sponsored by the Science Research Council

Unsteady flow conditions for inward radial flow turbines with single, two, and three entry casings are analyzed, using the method of characteristics The results of a large number of cold tests are presented Pulse conditions in multicylinder diesel engines were simulated with the aid of single, two, and three port rotary valves matching the single, two, and three entry turbine casings It is found that the quasi-steady flow treatment based on an investigation by Wallace (1969, 1970), with a very much shorter computer program than that for the full unsteady flow treatment, gives acceptable results in terms of pulse amplitude predictions G R

A72-27355 # **Characteristics and applications of multibeam spacecraft antennas.** K G Schroeder (Aerospace Corp , San Bernardino, Calif) *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference, 4th, Washington, D C., Apr. 24-26, 1972, Paper 72-530* 18 p 22 refs Members, $1 50, nonmembers, $2 00

Analysis of operational criteria, electrical properties, and relative merits of multibeam antennas for applications in communications and data relay satellites The high gain associated with narrow beams is used to achieve higher capacity, reduced satellite power, or the reduction of ground terminal gain Some of the advantages of narrow multiple beams are discussed, such as efficient spectrum utilization resulting in increased effective bandwidth, capability to reduce interference, and reduction of terminal size and cost Interference criteria are summarized for various beam layouts and modulation techniques Various possible multibeam antenna configurations are described, such as multiple-feed reflectors, bootlace lens antennas, or passive and active phased arrays Relative performance is discussed, and examples of total systems cost tradeoffs are given for multiuser satellite systems for communications, air traffic control, and TV broadcasting applications (Author)

A72-27376 # **A study on satellite communications for mobiles.** Y Hirata, M Kyogoku, and E Isomura (Kokusai Denshin Denwa Co., Ltd , Tokyo, Japan) *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference, 4th, Washington, D C , Apr 24-26, 1972, Paper 72-565* 9 p 12 refs Members, $1 50, nonmembers, $2 00

The technical feasibility of public correspondence for aeronautic and/or maritime vehicles using stationary satellite is examined, and an example of mobile communication system is presented, which is designed based upon the use of UHF frequency band and the demand assignment operation with 30 duplex voice channels and additional calling channels This paper also contains the consideration in terms of the optimum multiple access technique and the configuration of satellite repeater and mobile communication equipment. The study concludes that the adoption of multiple spot beam system with switching function on-board satellite seems very attractive for simplifying the antenna equipped in mobile stations, and that TDMA is recommendable, than FDMA, for the link from earth stations to mobile stations, while FDMA seems to be best fitted for the link from mobile stations to earth stations (Author)

A72-27402 **Optical landing aids on regional airports and air traffic terminals (Optische Landehilfen auf Regionalflughafen und Verkehrslandeplatzen).** S Schellenberg *AEG-Telefunken, Technische Mitteilungen,* vol 62, no 1, 1972, p 34-39 In German

The design and the characteristics of the lighting systems for the airports in the German Federal Republic are discussed The lighting of the take-off and landing zones is considered, giving attention to the lights at the beginning and the end of the runway, and the lighting of the boundaries of the runway on both sides The importance of the indication of obstacles by lighting devices is pointed out A number of the regulations described are concerned with the lighting conditions of the runway during the approach of the aircraft G R

A72-27403 **The Doppler radar on the basis of hollow conductor technology (Dopplerradar in Hohlleitertechnik).** K Steiner *AEG-Telefunken, Technische Mitteilungen,* vol 62, no. 1, 1972, p 39-41. In German

It is pointed out that the continuous wave radar principle is superior to approaches using radar pulses for an increasing number of applications Such applications include traffic supervision and control, area supervision, and the determination of velocities, rotational velocities, and vibrations Other applications are concerned with the control of ships and aircraft, and with altitude measurements The CW radar principle makes use of the Doppler effect A Gunn oscillator as a transmitter and a Schottky-barrier diode are used G R.

A72-27407 **Evolution of HYSAS** R A Evans (Honeywell, Inc , Government and Aeronautical Products Div , Minneapolis, Minn) and G W Fosdick (U S Army, Air Mobility Research and Development Laboratories, Fort Eustis, Va.) *VertiFlite,* vol 18, Mar.-Apr. 1972, p 2-8. 8 refs.

The progress accomplished in the development of a hydrofluidic stabilization system for military helicopters is reviewed The technical feasibility of simple hydrofluidic systems has been established and their reliability demonstrated The merits of hydrofluidics have been proved in flight tests of a three-axis yaw damper system integrated into the helicopter hydraulic system A test program is in progress that is aimed at demonstrating the capabilities of hydrofluidic systems to provide outer-loop modes, such as heading hold, altitude hold, and attitude hold M V E.

A72-27412 **AMA II - A new installation in Oberpfaffenhofen for conducting measurements with 'on-board' antennas (AMA II - Neue Messanlage fur Bordantennen in Oberpfaffenhofen).** H Mattes (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugfunk und Mikrowellen, Oberpfaffenhofen, West Germany) *DFVLR-Nachrichten,* Apr 1972, p 226-229 In German

The new test installation is suitable for conducting investigations of the spatial radiation characteristics of the antennas of satellites, aircraft, unmanned spacecraft, rockets, space probes, and reusable spacecraft Determinations of the isotropic radius of antennas can also be carried out, together with studies for the design and the optimization of antenna systems The design of the test installation is discussed together with details concerning the process of measurement G R.

A72-27413 **Investigations regarding the possibility of helicopter landings on ships (Untersuchungen über die Moglichkeit von Hubschrauberlandungen auf Schiffen).** E Skubinna (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Abteilung Flugverkehrswissenschaft, Stuttgart, West Germany) *DFVLR-Nachrichten,* Apr 1972, p 232-235 In German

It is pointed out that helicopter landings on ships depend ultimately on the ability of the pilot to adapt the approach and the landing process to the motions of the flight deck The landing is influenced by wind and visibility conditions The degree of the difficulty of the landing is partly determined by the stability and other flight characteristics of the helicopter Various factors involved were quantitatively investigated G R

A72-27414 **Problems of ice formation on helicopter rotors (Probleme der Vereisung von Hubschrauberrotoren)** H Bestek (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Drehflugelflugzeuge, Stuttgart, West Germany) *DFVLR-Nachrichten,* Apr 1972, p 236-238 In German

The conditions required for the occurrence of ice formation include the presence of water in liquid or solid form in the atmosphere at temperatures of 0 C or lower Factors affecting the deposition of ice at an arbitrary point of the rotor blade are the amount of undercooled water, the equilibrium surface temperature of the blade, centrifugal forces, and forces due to the air current The forms of the ice at the rotor blade are discussed together with the effects produced by the ice Protective measures are suggested for preventing the formation of ice at the rotor blade G R

A72-27416 **Design and test of an uncovered propulsion system test installation (Aufbau und Erprobung eines Freifeld-Triebwerksprufstands).** B Gehlhar *DFVLR-Nachrichten,* Apr 1972, p 246-248 In German

The test installation is equipped with a turbine jet propulsion system that provides gas for basic investigations regarding flame stabilization The propulsion system with and without afterburning is also used for acoustic studies Measurements of jet noise and investigations of compressor noise problems can be conducted The design of the device makes possible a rapid change from mechanical to aerodynamic flame stabilization G R

A72-27471 # **Evaluation of the lap belt, Air Force shoulder harness-lap belt and air bag plus lap belt restraints during impact with anthropomorphic dummies** J. F Sprouffske, T D Clarke, C D Gragg, E M. Trout, and W H Muzzy (USAF, Aerospace Medical Research Laboratory, Holloman AFB, N Mex) *Aerospace Medicine,* vol 43, Apr 1972, p 368-371 11 refs.

Abrupt linear decelerations (-Gx) were conducted using anthropomorphic dummies in order to investigate the impact protection afforded by three different restraints the automotive lap belt, the Air Force shoulder harness-lap belt, and the air bag plus lap belt. The study emphasizes the comparison of peak forces transmitted to the lap belt and seat pan at 9 g by dummies using each of the three restraint systems The results indicated that in comparison with the lap belt only and Air Force shoulder harness-lap belt systems, the air bag plus lap belt restraint significantly reduced the impulses and peak belt forces transmitted to the pelvis However, the efficacy of the air bag plus lap belt restraint using dummies as a test subject should be reviewed with caution since the anthropomorphic dummy is not the ultimate biodynamic surrogate of man (Author)

A72-27513 **A flight investigation of the effectiveness of a stability augmentation system for light airplanes.** G W Hall (Cornell Aeronautical Laboratory, Inc , Buffalo, N.Y.) *Society of Experimental Test Pilots, Technical Review,* vol. 11, no 1, 1972, p 5-17

Flight test investigations of the use of a stability augmentation system (SAS) installed in a light airplane were conducted, using 26

noninstrument-rated general aviation pilots as subjects. The stabilizing effects of the SAS were found to significantly improve the pilots' ability to maintain control during an inadvertent encounter with IFR conditions. F.R L.

A72-27515 **Computer assisted flight test - The WESTE system.** W. H Lawton, Jr (USAF, Washington, D.C). *Society of Experimental Test Pilots, Technical Review,* vol 11, no. 1, 1972, p. 22-30.

Description of the WESTE (Weapons Effectiveness and Systems Test Environment) instrumentation system, which is an example of an approach that utilizes both man and computer in evaluating Air Force weapon systems The system provides a capability for conducting tests in a simulated hostile combat environment without endangering life or property The basic time-space-positioning instrumentation is a modified Decca Navigational System consisting of a master and three slave stations F R.L

A72-27517 **Project pilot criteria for the preparation and execution of flight test specifications.** G L Colvin (Bell Helicopter Co., Fort Worth, Tex.) *Society of Experimental Test Pilots, Technical Review,* vol 11, no 1, 1972, p 35-41

Consideration of two general areas of interest with regard to flight test specifications with which the project pilot should concern himself once it is decided a specific program will be accomplished The first is the content of the flight test specification prior to its approval, and the second is the organization of the requirements before flight tests begin The manner in which a flight test specification is reviewed and organized depends on the type of test involved and the skill and experience of the people concerned F R L.

A72-27518 **The role for STOL.** H P Schmidt *Society of Experimental Test Pilots, Technical Review,* vol 11, no 1, 1972, p. 42-45.

STOL aircraft perhaps have even greater promise for the civil aviation system than the short range operation, in that they increase the productive capacity of real estate STOL capability provides many important peripheral improvements such as reduced noise, improved ATC system capacity, and naturally reduced weather minima capability. F.R L

A72-27519 **Flight testing the L-1011.** J F Woodman (Lockheed-California Co , Burbank, Calif) *Society of Experimental Test Pilots, Technical Review,* vol 11, no. 1, 1972, p. 57-73

The Lockheed L-1011 TriStar testing program calls for approximately 1600 flight hours Five TriStars are assigned to the program, three of which are now flying The flight flutter phase has been successfully completed, and all corners of the speed/altitude envelope have been explored The aircraft, the flight station, flight controls, center engine inlet, hydraulics, auxiliary power unit, wheel brakes, and power plant are described Noise and smoke are unusually low. Flying qualities are said to be beyond those of current generation transports. F R L

A72-27520 **A flight test investigation of direct side force control** G. W. Hall (Cornell Aeronautical Laboratory, Inc , Buffalo, N Y). *Society of Experimental Test Pilots, Technical Review,* vol 11, no 1, 1972, p. 74-89. Contract No. F33615-71-C-1240.

Development of a controllable side force by deflecting the rudder and using asymmetrical drag to cancel the resulting yawing moment. The concept was flight tested using the USAF/CAL variable stability T-33 airplane Primary objectives were to mechanize a system that allowed direct control of side force, qualitatively evaluate the usefulness of direct side force control, and evaluate the type of controller that might be useful in its employment Methods provided were a thumb controller mounted on the stick, the aileron stick, and the rudder pedals The capability to perform a steady sideslip, wings level with no yaw rate or side acceleration, was demonstrated. The method lends itself to the high drag configurations normally used in dive bombing F.R.L.

A72-27521 **Pilot evaluation of the C-5 Category III weather operation** H B. Armitage (Lockheed-California Co , Burbank, Calif) *Society of Experimental Test Pilots, Technical Review,* vol 11, no. 1, 1972, p. 90-101

The C-5 automatic landing system demonstration program proved that the aircraft can be safely operated in Category III weather environment when equipped with the final configuration of the automatic flight control system (AFCS), flight directors, and associated systems The system is designed to provide safe automatic control throughout the approach, flare, runway alignment, touchdown, and roll-out until the loss of rudder effectiveness. The outstanding feature of the system is the 'soft ride' it provides F R L

A72-27522 **Helicopter automatic approach and hover coupler systems.** L Cotton and R Mills (United Aircraft Corp., Sikorsky Aircraft Div , Stratford, Conn) *Society of Experimental Test Pilots, Technical Review,* vol 11, no. 1, 1972, p. 102-111

Description of coupler systems which operate in conjunction with automatic flight control systems (AFCS) through limited-authority inner loop servos and full-authority limited-rate outer loop servos Basic hands-off stability and handling qualities of the helicopter are established by the AFCS, leaving for the coupler the task of positioning the stable aircraft according to the function selected by the pilot The various systems already developed are discussed F R L

A72-27545 # **A two-part boundary value problem for the potential of a harmonically oscillating rectangular wing with a semiinfinite span (Ein zweiteiliges Randwertproblem fur das Potential des harmonisch schwingenden, rechteckigen Flügels mit halbunendlicher Spannweite).** S Turbatu (Bucuresti, Universitatea, Bucharest, Rumania) *Bucuresti, Universitatea, Analele, Matematica - Mechanica,* vol 20, no 1, 1971, p 147-150 6 refs In German

Linearized treatment of a two-part boundary value problem for the potential of a harmonically oscillating rectangular wing of semiinfinite span in an unsteady transonic flow On the basis of a requirement set forth by Landahl (1961) a linear potential equation is obtained for the flow in the transonic range A boundary value problem is formulated in which it is required to determine a twice continuously differentiable function The solution of this boundary value problem is expressed in the form given by Williams (1962) and is solved with the aid of the Fourier transform convolution theorem A B K

A72-27658 # **An appraisal of an aeronautical satellite system. II - Communications aspects.** D C Mainhood *(European Space Symposium on Present and Future Space Activities in Europe, 10th, Paris, France, June 8-10, 1970) British Interplanetary Society, Journal,* vol 25, May 1972, p 287-297 5 refs

Part I of this paper discussed the overall operational and traffic requirements of an Aeronautical Satellite System, this part covers other important considerations which affect the system performance Due to the very rapid development of Aerosat, there has been some modification in thinking since this paper was presented In particular, several options have been examined in more detail and choices made This paper is therefore based upon the position at the time of the Tenth European Space Symposium (June 1970) (Author)

A72-27660 **Short-haul aircraft - The technology is nearly ready.** H. B. Faulkner (MIT, Cambridge, Mass.) *Technology Review*, vol. 74, May 1972, p. 12-21

Discussion of future short-haul transportation systems based on aircraft designed to carry 50 to 150 passengers over distances of less than 500 miles. Principal attention is given to the several forms which these new aircraft might take. They include turbofan, turboprop, and propfan (a new hybrid) powered fixed-wing aircraft, along with various kinds of helicopters and tilt rotors. Detailed emphasis is also placed on the problem of aircraft noise reduction. It is shown that the technological problems which have heretofore limited the potential of short-haul aircraft, notably noise and the need for long runways, are now being resolved. O.H.

A72-27661 * **S.T.O.L., V.T.O.L., and V/S.T.O.L. - Where do they fit in.** C. W. Harper and H. Mark (NASA, Ames Research Center, Moffett Field, Calif.) *Technology Review*, vol. 74, May 1972, p. 22-30

The problems and potential of V/STOL transportation are examined. A detailed review is given of the development, characteristics, and requirements of V/STOL, STOL, and VTOL systems. The problem of whether V/STOL is worth the effort is considered, and it is concluded that such aircraft have a role in meeting real transport requirements, and that their development should be pursued. Finally, a forecast of V/STOL economics is presented, and implementation problems are discussed. O.H.

A72-27686 **Studies on external ultrasonic combustion (Untersuchungen zur ausseren Uberschallverbrennung).** M. Kallergis (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur luftsaugende Antriebe, Braunschweig, West Germany) *VDI-Z*, vol. 114, no. 5, Apr. 1972, p. 343-346. 9 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

Discussion of the possibility of initiating and stabilizing a combustion process in a supersonic stream. The results of recently performed experiments using hydrogen, propane, and liquid fuel indicate that, in principle, external burning in supersonic streams can be obtained. However, its practical realization, particularly with respect to liquid fuel, is contingent upon prior removal of considerable difficulties. M.V.E.

A72-27709 # **A case study of a high level Canberra flight on 11 September 1968.** D. N. Axford (Meteorological Office, Farnborough, Hants., England) *Royal Meteorological Society, Quarterly Journal*, vol. 98, Apr. 1972, p. 420-430. 8 refs.

A case study is presented of a high level flight by the MRF Canberra showing most of the characteristic features of intermittent clear air turbulence, gravity waves and smooth flight. Winds and temperatures obtained from two 500 km runs across a sharp upper trough are used to calculate spectra and cross-spectra over a range of wavelengths from 250 m to 100 km. The spectra show clearly the important contribution of the gravity waves in the range 1 km to 10 km, and the negligible contribution of the total high frequency energy in the case of intermittent slight clear air turbulence. (Author)

A72-27748 **Turboméca's Astafan.** J. H. Stevens *Flight International*, vol. 101, Apr. 20, 1972, p. 553-555

The Astafan geared-fan powerplant is based on proven components (largely as assembled for the Astazou turboshaft engine) with the addition of a variable-pitch fan. This fan provides, in effect, a 'fluid drive' so that a free-turbine power takeoff is not necessary, while the size of the engine and the characteristics of the Turboméca axial-plus-centrifugal compressor make a flexible powerplant with ample surge margins. The compressed air intake is an annular diffuser formed by the front cover of the accessory mounting plate and the rear cover of the reduction gearbox. Particulars of the gears and fan, the fuel system, and engine control system are given. The noise level is remarkably low due both to the high bypass ratio and the low fan speed. F.R.L.

A72-27862 # **Hydraulic transmissions for driving tail rotors of helicopters I (Przekladnie hydrostatyczne do napedu smigiel ogonowych smiglowcow. I).** B. Bolinski *Technika Lotnicza i Astronautyczna*, vol. 27, Apr. 1972, p. 7-10. In Polish.

A feasibility study demonstrates the possibility of replacing the mechanical drive train of a helicopter tail rotor by a hydraulic transmission. The proposed system consists of a piston-pump gear driven from the main rotor, a piston-type hydraulic motor, and a constant-pitch tail propeller. In the event of engine failure, the torque of the autorotating main rotor is counterbalanced by thrust generated in the discharge of hydraulic fluid (fuel is used for this purpose) through a nozzle near the tail tip. T.M.

A72-27863 # **Gas-temperature regulator in the AI-24 turboprop engine (Regulator temperatury gazow turbinowego silnika smiglowego AI-24).** L. Gruchalski *Technika Lotnicza i Astronautyczna*, vol. 27, Apr. 1972, p. 11-15. In Polish.

The theoretical principles of operation of turbine inlet-gas temperature limiting systems in turboprop engines are explained together with factors necessitating the use of temperature regulation. Sensor deployment, design details, and operating principles of the thermal control unit in the AI-24 turboprop engine are described, including the blocking mechanism, the delaying element, and the altitude compensation system. T.M.

A72-28049 # **Measurement, in a duct, of the space-structure of the discrete-frequency noise generated by an axial compressor.** P. Harel and M. Perulli (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(University of Southampton, Symposium on Flow in Acoustic Ducts, Southampton, England, Jan. 10-14, 1972.) ONERA, TP* no. 1045, 1972. 29 p. 5 refs. Research sponsored by the Société Nationale d'Etudes et de Construction de Moteurs d'Aviation.

A method for measuring the spatially-coherent and incoherent structures of acoustic modes propagating in a duct, at a given frequency, is described. The first part deals with data acquisition in the laboratory, the second part concerns the analog processing of the signals, the third part describes the numerical processing of the analog information acquired, based on the Fast Fourier Transform. The method has been applied to the characteristic frequencies generated by a six-bladed fan in a cylindrical duct 6 meters long, 60 cm in diameter and carrying a low speed axial flow. The results show that in the near field of the fan, the azimuthal structure of the sound field is, in part, accounted for by Tyler and Sofrin's model. Other modes are also shown to exist and propagate in the duct, their azimuthal structure being compatible with the propagation properties of the duct. The degree of coherence decreases with axial distance from the source. The dispersion relation of the modes is discussed. (Author)

A72-28076 **Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif., April 11-13, 1972.** Symposium sponsored by the Society of Aerospace Material and Process Engineers. Azusa, Calif., Society of Aerospace Material and Process Engineers (Science of Advanced Materials and Process Engineering Series, Volume 17), 1972. 334 p. $35

Topics discussed include cocuring composite materials for primary aircraft components, a numerically controlled tape laying

machine, polymerization of adhesives by penetrating high-energy radiation, the effects of microstructural variations on the tensile and fracture properties of aluminum alloy plate, a low-cost automated technique for the fabrication of advanced composites, continuous production of reinforced thermoplastic materials, a high-performance low-cost graphite fiber, chemical vapor deposition of boron on a carbon substrate, the fabrication of three-dimensional reinforced carbon/carbon composites, surface nitriding of boron fibers, properties of two-phase particulate-filled epoxy resin compositions, a new class of polyimide binders, and many other subjects

A B K

A72-28077 **Cocuring advanced composite materials** R Casale (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) and D L Stansbarger (Northrop Corp, Hawthorne, Calif) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif, April 11-13, 1972 Azusa, Calif, Society of Aerospace Material and Process Engineers, 1972, p I-A-ONE-1 to I-A-ONE-35

Results of an Air Force funded study on the investigation and optimization of cocuring techniques for primary aircraft components Included are test data on the effects of dimpling on the physical and mechanical properties of both graphite and boron reinforced composite systems using various honeycomb cell sizes, laminate thicknesses, fiber orientations, and cure pressures Test data are also presented on mechanical and dimensional properties of cocured graphite-to-graphite, graphite-to-boron, and boron-to-boron composite panels Fabrication of boron and graphite cocured subscale assemblies to define shape limitation is presented and discussed Primary graphite and boron component (horizontal stabilizer spar-splice and horizontal stabilizer root end assemblies) fabrication utilizing cocuring techniques is reviewed and discussed Production cost analysis to demonstrate high cost centers and/or cost saving in tooling, manufacturing, and cure time by the utilization of cocuring operations in lieu of conventional manufacturing methods is presented with a projected view as to production cost for typical aircraft structures (Author)

A72-28081 **Plywrapping - A low cost fabrication method for composite structures** A L Price and V A Chase (Whittaker Corp, San Diego, Calif) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif, April 11-13, 1972 Azusa, Calif, Society of Aerospace Material and Process Engineers, 1972, p II-A-ONE-1 to II-A-ONE-14

The state-of-the-art of automated fabrication techniques for composites is reviewed The plywrap process for fabrication of fiber reinforced plastic composites is presented Past and present plywrapping activities at Whittaker Research and Development are presented, including the evolution of plywrapping machines from early laboratory table models to present-day 30-inch by 85-inch unit used for the fabrication of a 300-gallon composite aircraft fuel tank Conceptual studies for fabrication of plastic composite structures ranging from missile interstages to modular housing are presented A general review and recommendations concerned with future manufacturing of composite fuel tank and similar composite structures by plywrapping are presented (Author)

A72-28082 **Fabrication of advanced composites.** L E Meade (Lockheed-Georgia Co, Marietta, Ga) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif, April 11-13, 1972 Azusa, Calif, Society of Aerospace Material and Process Engineers, 1972, p II-A-TWO-1 to II-A-TWO-7

The critical performance requirements of each new program, in stressing the importance of high strength/stiffness to weight ratio structure, is promoting advanced composite materials as prime candidates for use in primary and secondary structures Many programs are generating manufacturing and process information for the fabrication of all types of advanced composite structures Vital processing information and production experience, by not being centrally acquired and presented, are being lost to the government and the industry Through the publication of the Fabrication Guide, a capability is being established for logically assimilating and presenting this information The Fabrication Guide will provide process selection techniques, production experience transfer, and up-to-date production, fabrication, and materials information A team approach will examine all available vital information for aircraft, helicopter, spacecraft, and engine advanced composite hardware, both resin and metal matrix utilizing boron and graphite reinforcements (Author)

A72-28093 **Carbon-carbon composite material - A new era in aircraft braking systems.** R L Trauger (Goodyear Aerospace Corp, Akron, Ohio) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif, April 11-13, 1972 Azusa, Calif, Society of Aerospace Material and Process Engineers, 1972, p IV-A-THREE-1 to IV-A-THREE-6

The carbon-carbon composite brake material is now completely developed into a marketable product for advanced, high-performance aircraft This material permits tremendous weight savings over conventional brake materials while providing significant improvements in thermal characteristics such as high specific heat, increased temperature limits, extremely high thermal shock resistance, and constant braking coefficient over a wide range of design loading conditions (Author)

A72-28096 **Application of advanced metal-matrix composites to aircraft structures** C R Maikish, W F Wennhold, and M D. Weisinger (General Dynamics Corp, Convair Aerospace Div, San Diego, Calif) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif, April 11-13, 1972 Azusa, Calif, Society of Aerospace Material and Process Engineers, 1972, p V-A-TWO-1 to V-A-TWO-4 5 refs

A program was conducted to expand the range of usefulness of metal-matrix composite materials as applied to primary aircraft structure Previous work with metal-matrix composites has shown the potential for significant weight savings and indicated the need for improvements in several areas The principal task accomplished during this program was the design, analysis, and fabrication of an aircraft bulkhead using boron/aluminum as the primary structural material In support of the task, subcomponent test specimens were built and tested Other supporting tasks included increasing the shear and transverse strength of the matrix by heat treatment, and the investigation of matrix materials other than aluminum (Author)

A72-28097 **Graphite/epoxy composites - A resume for 1969-72** A L Scow (Northrop Corp, Aircraft Div, Hawthorne, Calif) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif., April 11-13, 1972. Azusa, Calif, Society of Aerospace Material and Process Engineers, 1972, p V-A-THREE-1 to V-A-THREE-15 Contract No F33615-69-C-1490

Evaluation of over 80 graphite/epoxy material systems for application on the F-5 aircraft landing gear door, speed brake, leading edge flap, trailing edge flap, and horizontal stabilizer Different graphite/epoxy material systems were developed and selected for use in hand layup, filament winding, compression molding, and application at 350 F Experimental results and problems encountered in advancing these new material systems from laboratory status to prototype production requirements are reviewed F R.L.

A72-28099 **Advanced organic fibers for L-1011 interior structures.** R H. Stone (Lockheed-California Co , Burbank, Calif) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif , April 11-13, 1972 Azusa, Calif , Society of Aerospace Material and Process Engineers, 1972, p V-A-SIX-1 to V-A-SIX-19

Description of a high modulus, low density organic fiber, PRD-49, which has been evaluated as a replacement for fiberglass in L-1011 interior sandwich panels and laminates, and of Nomex fiber, now available in woven fabric, which has also been evaluated for this purpose The organic fabrics were impregnated with resin systems currently used on interior grade fiberglass prepregs, physical and mechanical tests were performed, and prototype L-1011 interior parts were fabricated Direct substitution of the organic fabrics for glass appears to be an effective and feasible means of obtaining substantial weight reduction in nonstructural, interior parts (Author)

A72-28100 **Composite vane fabrication development for gas turbine application.** R. A Whitaker and W H. Reinhart (TRW, Inc , Cleveland, Ohio) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif , April 11-13, 1972 Azusa, Calif , Society of Aerospace Material and Process Engineers, 1972, p V-B-ONE-1 to V-B-ONE-8

Composite materials have been applied to gas turbine fan guide vane fabrication where goals are improved performance at reduced weight and cost For prototype designs, a number of processing methods and material combinations were evaluated and used to produce test quantities of vanes Prototype vanes performed well in actual engine tests, however, costs are not yet competitive on a part-for-part substitution basis Present graphite fiber cost trends and innovative processing concepts offer promise for ultimate use of composites in this gas turbine engine component (Author)

A72-28102 **Blade development in the advanced composite engine /ACE/ program** H. Stargardter (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) In Materials review for '72, Proceedings of the National Symposium and Exhibition, Los Angeles, Calif , April 11-13, 1972 Azusa, Calif , Society of Aerospace Material and Process Engineers, 1972, p V-B-FIVE-1 to V-B-FIVE-13 7 refs

Composite fan blades were developed for high temperature applications The weight of the first-stage fan blades could be reduced by using boron-polyimide composite material in place of titanium It is pointed out that the use of graphite-polyimide would result in a further reduction of fan blade weight Other development work reported is concerned with the use of BORSIC-Aluminum composite material in place of titanium for the TF30 third-stage fan blades G R

A72-28111 **Heat generation in high-speed cylindrical roller bearings.** D G. Astridge and C F Smith (Rolls-Royce, Ltd , Derby, England) In Elastohydrodynamic lubrication, Proceedings of the Symposium, Leeds, England, April 11-13, 1972 London, Institution of Mechanical Engineers, 1972, p 83-94 12 refs

Study of the increasingly important problem in gas turbines of heat transferred to oil. This dictates the size of oil coolers and the rate of oil degradation In order to establish a logical design procedure and minimize heat generation, the physical properties at work must be clearly understood Several possible sources of heat generation are analyzed and their overall contribution is compared with test rig results This involves the application of elasto-hydrodynamic lubrication theory, particularly in evaluating surface traction forces in roller and track lubricant films, which are found to be a major source of heat generation F R L

A72-28122 # **Pressure measurements of wake vortices near the ground** J N Hallock (U S. Department of Transportation, Transportation Systems Center, Cambridge, Mass) *Journal of Aircraft*, vol 9, Apr 1972, p 311, 312 5 refs

A simple barocel electronic manometer, tested with respect to its capability to detect vortex wake turbulence at and near airports, is found suitable to replace in some cases the more complex and costly electromagnetic and acoustic sensors presently used Pressure sensors should be valuable for monitoring vortices between parallel runways where the vortices are well within ground effect Such a system would be limited by the ambient winds, they limit the maximum height at which a vortex can be detected But the problem should be minimal, since strong winds would quickly sweep away and/or dissipate the vortices M V E

A72-28123 # **Internal parachute flows** P C Klimas (U S Naval Academy, Annapolis, Md) *Journal of Aircraft*, vol 9, Apr 1972, p 313, 314

The use of a potential flow model is discussed for predicting some portion of the flowfield surrounding a porous parachute canopy in the particular case of steady incompressible flow internal to a porous canopy of arbitrary axisymmetric cross section It is found that these theoretical predictions of internal flow properties are only fair numerically, but that they represent general behavior fairly well There may be applications where results of this type are more desirable or more available than average or empirically derived quantities M V E

A72-28124 # **Study of rotating airfoil.** H M Jameel *Journal of Aircraft*, vol 9, Apr 1972, p 314-316 5 refs

Review of the performance and results of an experimental test program designed to verify previous rotating airfoil analyses by Himmelskamp (1950) and by Dwyer and McCroskey (1971). Various lengths of a NACA 0012, 2-in chord-length blade were tested for lift coefficient. Two-dimensional tests were also conducted in a closed-section wind tunnel using a 20-in long blade The findings of this test program confirm the results obtained by Himmelskamp and by Dwyer and McCroskey M.V E

A72-28125 # **Airplane yaw perturbations due to vertical and side gusts.** R R Rankine, Jr (USAF, Institute of Technology, Wright-Patterson AFB, Ohio) and C T Leondes (California, University, Los Angeles, Calif) *Journal of Aircraft*, vol 9, Apr 1972, p 316, 317

Critical study of the main causes of disturbance to lateral tracking to be taken into account in analysis of aircraft flight in continuous random turbulence It is shown that the yaw-rate effect of a side gust produces considerable low frequency attenuation of the airframe side-gust response which would be neglected by considering the sideslip effect alone Both of these effects must be considered simultaneously if the resultant airframe perturbation in a continuous random side gust is to be realistically determined M V E.

A72-28131 # **Investigation of turbulence intensity in the region of secondary-air jet inlet to the flame tube of a gas turbine engine (Issledovanie intensivnosti turbulentnosti v oblasti vtekaniia strui vtorichnogo vozdukha v zharovuiu trubu kamery GTD)** G M Gorbunov, A V. Peshkov, I L Khristoforov, and M V Emmil'. *Aviatsionnaia Tekhnika*, vol 14, no. 4, 1971, p 38-43 7 refs. In Russian

The intensity of mixing processes resulting from the crosswind injection of a system of circular jets is governed by the jet parameters, the depth of jet penetration, and the turbulence induced

by jet wakes Hot-wire anemometers were used to measure turbulence intensity near the inlet of a single jet and behind several jets of secondary air injected into the flame tube of a gas turbine engine. Results show that the use of optimally spaced transverse jets with a given depth of penetration makes it possible to attain a high level of turbulence that ensures active mixing of air and fuel T.M

A72-28132 # **Influence of the air flow rate through the swirl vane on the circumferential nonuniformity of the gas temperature field at the outlet of the combustion chamber in a gas turbine engine (Vliianie raskhoda vozdukha cherez zavikhritel' na okruzhnuiu neravnomernost' temperaturnogo polia gaza na vykhode iz kamery sgoraniia GTD).** Iu A Spiridonov, K. V Kakhovskii, and A. V Talantov *Aviatsionnaia Tekhnika,* vol 14, no 4, 1971, p. 50-55 In Russian.

Experimental study of the influence of the relative rate of airflow through a frontal swirl vale on the circumferential nonuniformity of the temperature field (local values exceeding the average temperature at a given radius) at the outlet of the combustion chamber It is shown that the circumferential nonuniformity of the outlet temperature field rises when the flow rate through the swirl vane exceeds a specified critical value. This effect is explained by substantial changes in the temperature field, velocity field, and twist angle of the flow at the outlet from the primary combustion zone. T M

A72-28142 # **Matrix of aerodynamic influence coefficients for a wing of arbitrary planform at supersonic speeds (Matritsa aerodinamicheskikh koeffitsientov vliianiia dlia kryla proizvol'noi formy v plane pri sverkhzvukovykh skorostiakh).** A Kh Karimov *Aviatsionnaia Tekhnika,* vol 14, no 4, 1971, p 107-110 In Russian

A method of calculating supersonic aerodynamic influence matrices for wings of arbitrary planform is proposed The wing is subdivided into trapezoidal areas whose bases are parallel to the symmetry plane of the wing No constraints are placed on the position and size of these areas The influence coefficients are calculated for each area A program for calculating matrices is constructed for the BESM-4 computer V P

A72-28147 # **Location of air bleeding for cooling the turbojet-engine turbine of supersonic aircraft (O meste otbora vozdukha na okhlazhdenie turbiny turboreaktivnogo dvigatelia dlia sverkhzvukovogo samoleta)** E. N Bogomolov *Aviatsionnaia Tekhnika,* vol 14, no 4, 1971, p 123-128 5 refs In Russian

It is shown analytically that air bleeding from an intermediate compressor stage has the effect of appreciably improving engine performance, as compared with air bleeding from behind the compressor, by eliminating (or greatly reducing) the drop-in ratio of the cooling-air flow rate to the flow rate through the compressor with increasing Mach number. The results of the computations are presented in graphical form V P

A72-28149 # **Analysis and optimization of gas-turbine units of complex design (K analizu i optimizatsii GTU slozhnykh skhem).** B Kh Perel'shtein and A P Tunakov *Aviatsionnaia Tekhnika,* vol 14, no 4, 1971, p 135-138 8 refs In Russian

The principles of developing a universal method for designing and optimizing the specific characteristics of gas-turbines with a constant-pressure cycle are outlined To achieve universality, it is proposed to reduce the calculation of the characteristics of multistream multishaft gas turbines to a nonlinear programming problem where the minimum of a certain function is associated with the solution of a system of nonlinear transcendental equations describing turbine operation under semistall conditions V P

A72-28151 # **Method of calculating the characteristics and influence coefficients of gas turbines (Metod rascheta kharakteristik i koeffitsientov vliianiia gazovykh turbin).** A. P Tunakov and V Z. Korabel'nikov *Aviatsionnaia Tekhnika,* vol 14, no 4, 1971, p 141-145 6 refs In Russian

A method is proposed which is suitable for calculating the characteristics of a gas turbine of any type with allowance for all the principal turbine losses The moment of flow choking is determined with allowance for the distribution of cascade losses. The method is programmed for the Ural-2 computer, together with a method for calculating the influence coefficients. V P

A72-28160 # **Shot peen forming of wing skins for the Boeing 747** D V Badger (Boeing Co., Seattle, Wash.) *American Society for Metals and Society of Manufacturing Engineers, Western Metal and Tool Exposition and Conference, Los Angeles, Calif , May 13-17, 1972, ASM Paper W 72-31,4* 10 p

Evaluation of shot peening forming for Model 747 wing skins The forming techniques developed had to be compatible with engineering fitup requirements, surface finish requirements, and a need for the final parts to be compression-peened all over to enhance their fatigue resistance A combination of incremental chip forming with overall shot peening was established as the optimum forming method Shot peen forming gave high quality parts with reproducible contours at lower cost, and higher production rates than other methods of forming that were studied (Author)

A72-28161 # **The fabrication and processing of long components for the DC-10 wing** A McMechan (Douglas Aircraft Company of Canada, Ltd , Malton, Ontario, Canada) *American Society for Metals and Society of Manufacturing Engineers, Western Metal and Tool Exposition and Conference, Los Angeles, Calif , May 13-17, 1972, ASM Paper W 72-31,3* 33 p

The manufacture of stringers for the DC-10 aircraft wing is described Each aircraft set contains a total of 88 such parts machined from 7075 alloy dual section stepped extrusions The raw extrusions, which are up to 83 feet in length, are stress relieved by specially developed double stretch or stretch/compression techniques The DC-10 gull wing configuration requires stretch form contouring of 80% of the stringers in an area located at approximately one-third wing span Following forming, the stringers are aged by a two-stage process which produces a double temper condition on each part, -T73 temper on the heavy section inboard ends and -T6 temper throughout the remaining length Flaw detection is performed in an automated spray penetrant inspection line and detail fabrication is completed by anodising and painting (Author)

A72-28163 # **Application of surface integrity to production of jet engines** G Bellows (General Electric Co , Evendale, Ohio) *American Society for Metals and Society of Manufacturing Engineers, Western Metal and Tool Exposition and Conference, Los Angeles, Calif., May 13-17, 1972, ASM Paper W 72-27,2.* 18 p 9 refs

Use of surface integrity machining practices as a means of reducing costs In addition to enhanced component integrity, manufacturing losses, rework, and scrap are reduced. Process and quality control are improved Manufacturing leeways can be defined, producibility data is better, value analysis is strengthened, and process selection is disciplined F.R L

A72-28170 # ***Investigation of the effectiveness of film cooling* under the actual conditions of some engines (Issledovanie effektivnosti plenochnogo okhlazhdeniia primenitel'no k real'nym usloviiam nekotorykh dvigatelei).** M. S Zolotogorov (Tsentral'nyi Nauchno-Issledovatel'skii Kotloturbinnyi Institut, Leningrad, USSR)

Inzhenerno-Fizicheskii Zhurnal, vol 22, Jan 1972, p. 46-49 In Russian.

A method for calculating film cooling for elements of the air-gas flow area of a gas turbine is proposed. It is based on the use of a film-cooling effectiveness curve plotted for idealized condition, together with a set of corrections which takes the difference between idealized and actual conditions into account. Data showing the influence of main-flow and coolant acceleration on the effectiveness of film cooling are presented V.P

A72-28180 The nature of friction in solid bodies; All-Union Symposium, Gomel, Belorussian SSR, June 24-27, 1969, Transactions (O prirode treniia tverdykh tel, Vsesoiuznyi Simpozium, Gomel, Belorussian SSR, June 24-27, 1969, Trudy). Edited by A. Iu Ishlinskii Minsk, Izdatel'stvo Nauka i Tekhnika 1971. 472 p. In Russian.

Results of theoretical and experimental studies of friction mechanisms and factors affecting friction properties of solids Topics examined include adhesion and seizure processes, effects of active lubricants on surface deformation, friction and wear in the presence of aviation fuels, effects of temperature, reduction of friction by resonant vibrations of contacting surfaces, effects of oxide films and metallic coatings, role of surface structure, acting mechanisms of lubricants, simulation of friction mechanisms, composition of wear products, and quantitative description of relevant effects Materials considered include pure metals, alloys, ceramics, and polymers. T.M.

A72-28183 # Certain features of the metal friction process in an aviation-fuel environment (Nekotorye osobennosti protsessa treniia metallov v srede aviatsionnykh topliv). A F Aksenov, Iu I. Korolenko, A A Litvinov, V N Turchak, and V E. Vishnevskii In The nature of friction in solid bodies, All-Union Symposium, Gomel, Belorussian SSR, June 24-27, 1969, Transactions. Minsk, Izdatel'stvo Nauka i Tekhnika, 1971, p 45-48 In Russian.

Analysis of certain physicochemical processes taking place in the surface layers of metals (steel and armco iron) subject to contact friction in the presence of aviation fuels It is shown that intense formation of secondary compounds occurs on metal surfaces under these conditions, simultaneous acceleration of thermal oxidation process rates in the fuel itself also takes place T M

A72-28205 Air transportation /3rd edition/. R M Kane and A. D. Vose Dubuque, Iowa, Kendall/Hunt Publishing Co , 1971 423 p $6 25

The development, regulation, and administration of air transportation are described. Following a historical review, the roles of the Department of Transportation, the Federal Aviation Administration, and the Civil Aeronautics Board are outlined, and the procedures by which safety is maintained are described Air carrier economic regulations, domestic air carriers, and international and foreign air transportation are treated. Air carrier management and organization, the economics of air carrier routes, air carrier accounting and financial analysis, and legal aspects of air transportation receive attention An appendix consists of reproductions of the Federal Aviation Act, the Department of Transportation Act, the Airport and Airway Development Act, and the Airport and Revenue Act F R L.

A72-28243 # Duration of equivalent tests (O dlitel'nosti ekvivalentnykh ispytanii). M A Porter *Problemy Prochnosti,* vol 4, Feb 1972, p 96-98. 5 refs In Russian

Description of a method of determining the duration of equivalent tests of the hot part of a gas turbine engine An analytical method of determining this duration is proposed which is based on the principle of linear accumulation of damage and the equivalence of regimes with equal strength reserves. The method is based on the use of the Larson-Miller parametric description of the stress-rupture strength with a linear approximation of the stress-rupture strength curve A B K.

A72-28244 # Fatigue strength of materials and structural elements of gas turbine engines under conditions of contact friction corrosion (Ustalostnaia prochnost' materialov i elementov konstruktsii GTD v usloviiakh kontaktnoi korrozii treniia). A N Petukhov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR) *Problemy Prochnosti,* vol 4, Feb 1972, p 99-103 5 refs In Russian

Study of the effect of various factors which intensify the process of contact friction corrosion on the fatigue strength of AK4-1 and VT3-1 alloys and EI961 steel The fatigue strength of these materials under conditions of contact friction corrosion is determined as a function of various values of the specific pressures in the contact zone The role of the process of contact friction corrosion in the formation of the fatigue strength of a scarf joint of a dovetailed gas turbine engine compressor blade is considered A B K

A72-28340 # Combustion and mixing processes in jet engines (Protsessy smeseobrazovaniia i goreniia v vozdushno-reaktivnykh dvigateliakh). A G Prudnikov, M S Volynskii, and V N Sagalovich Moscow, Izdatel'stvo Mashinostroenie, 1971 357 p 174 refs In Russian

The physics of liquid and solid particle interactions with gas flows in the presence of heat and mass transfer is reviewed in the context of jet engine operation, covering the characteristics of fuel injection systems, fuel atomization spectra in supersonic flows, fuel flame length and vaporization, and the boundary conditions of turbulent mixing Expressions are given for turbulent mixing parameters in free jets, in nozzles and near a wall, with and without heat production, for jet dispersion as a function of injection parameters, for temperature and velocity profiles in a turbulent flame, and for fuel burnout rates Combustion chamber prototype designs for direct-flow single-jet or multijet rocket engines are also discussed The book is addressed to aviation industry scientists and engineers and to advanced students in the field V Z

A72-28343 # Practical aerodynamics of the An-12 aircraft (Prakticheskaia aerodinamika samoleta An-12). I M Varukha, V D Bychkov, and E L Smolenskii. Moscow, Izdatel'stvo Transport, 1971 180 p 10 refs In Russian

A description is given of the structural and aerodynamic features of the An-12 turboprop transport aircraft The characteristics and operating modes of the power plant are discussed, as well as the special features of takeoff, landing, climbing, horizontal flight, and descent The effect of longitudinal and lateral stability on aircraft controllability is considered, and some special features of piloting the aircraft during landing and takeoff are noted The behavior and controllability of the aircraft after failure of one or more engines are discussed A B K

STAR ENTRIES

N72-19992# Royal Aircraft Establishment, Farnborough (England)
MEASUREMENT OF THE DRAG ASSOCIATED WITH RECESSED SURFACES. CUTOUTS OF RECTANGULAR AND ELLIPTICAL PLANFORM
H Friesing Oct 1971 21 p Transl into ENGLISH from German report FB-628
(RAE-Lib-Trans-1614, FB-628, BR-28184) Avail NTIS

Little is known about the drag associated with recessed surfaces or cut-outs on the wings and fuselage of an aircraft Systematic drag measurements have been carried out on eight cut-out models, of rectangular and elliptical planform with aspect ratios between 1 6 and 1 1 for various depths of the cut-outs Pressure distributions on the walls of the cut-outs were also measured The measurements described were carried out on fairly small models They were designed to serve only as a first guide, as it is proposed to carry out tests on larger models
Author

N72-19993*# Scientific Translation Service, Santa Barbara, Calif
UNSOLVED PROBLEMS OF AIRPLANE AERODYNAMICS
J Barche Washington NASA Mar 1972 51 p Transl into ENGLISH of Offene Probleme der Flugzeug-Aerodynamik Presented at 4th Ann Meeting of DGLR, Baden-Baden, W Germany, 11-13 Oct 1971
(Contract NASw-2035)
(NASA-TT-F-14208) Avail NTIS CSCL 01A

Problems inherent in current and future aircraft design which still lack a solution as a result of gaps in the theoretical and experimental description of flow patterns are discussed Both civil and military aircraft in the subsonic and transonic range are considered Problems arising in different phases of aerodynamic design are examined first Next, special flow problems encountered during different flight phases, such as takeoff and landing, during transonic flight, and during flight maneuvers, are characterized and explained
Author

N72-19994*# Scientific Translation Service, Santa Barbara, Calif
THE SUPERCRITICAL WING
D Seidl Washington NASA Mar 1972 14 p Transl into ENGLISH from Flug-Rev Int (West Germany), no 2, Feb 1972 p 40, 42, 44, and 46
(Contract NASw-2035)
(NASA-TT-F-14242) Avail NTIS CSCL 01A

Flow phenomena encountered in the vicinity of Mach 1 are discussed The application of the supercritical wing to this flight regime are discussed Research work and flight tests performed by various American companies are detailed
Author

N72-19995# Aeronautical Research Inst of Sweden, Stockholm Aerodynamics Dept
CALCULATION OF BODY INTERFERENCE LOADS FOR WING-BODY COMBINATIONS AT MACH NUMBERS 1.59 TO 7 15 WITH SUPERSONIC LINEAR THEORY, PART 1
S Anders and L Gustavsson 1971 29 p refs
(FFA-AU-635-Pt-1) Avail NTIS

Loads on slender bodies with wings of small aspect ratios were computed with Woodwards panel method, based on linearized theory for supersonic flow The calculations are made for Mach numbers between 1 59 and 7 15 The obtained total loads and body interference loads due to the wing compare well with experimental values The largest difference obtained for the interference load was less than 25% Even for this extreme case the center of pressure position was well predicted As the interference load itself was only some 20% of the total load for these configurations, it was concluded that the computations of the body interference load are sufficiently accurate for design purposes
Author

N72-19996# Max-Planck-Institut fuer Stromungsforschung, Gottingen (West Germany)
EXPERIMENTAL STUDY OF TRANSONIC POTENTIAL FLOW AROUND A SYMMETRICAL WING PROFILE [EXPERIMENTELLE UNTERSUCHUNG EINER TRANSSONISCHEN POTENTIALSTROEMUNG UM EIN SYMMETRISCHES TRAGFLUEGELPROFIL]
W J Hiller and G E A Meier Nov 1971 25 p refs In GERMAN
(Rept-10/1971) Avail NTIS

The transonic potential flow around a symmetric quasi-elliptical wing profile is investigated, in order to determine whether shockless compression is physically realizable The experiment was carried out in a wind tunnel using a Mach-Zehnder interferometer and photographic equipment to record the interference patterns Pressure distribution along the profile are computed from the interferograms The results, compared with theoretical calculations, generally agree, but a detailed consideration differs in that the compression shock coming from the profile's leading edge prevents the expected underpressure scale to build up, and thus the formation of the calculated flow field
ESRO

N72-19997# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Abteilung Aeroelastik
CALCULATION OF THE UNSTEADY PRESSURE DISTRIBUTION ON HARMONICALLY OSCILLATING SLENDER WING FUSELAGE CONFIGURATIONS
K Chao Cologne DGLR Aug 1971 34 p refs In GERMAN, ENGLISH summary Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger , 11-13 Oct 1971
(AVA-FB-7126) Avail NTIS

Based upon the slender-body-theory, the pressure distribution on harmonically oscillating wing-fuselage configurations is calculated numerically The configurations consist of a circular cylindrical fuselage body with a conical nose and a delta wing of various leading edges (straight, cubic, and sinusoidal) The influences of the fuselage, wing geometry, and the reduced frequency are investigated For three delta wings with straight leading edges, the results are compared with the corresponding results obtained from three dimensional lifting surface theory
Author (ESRO)

N72-19998# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Abteilung Gasdynamik
FORCE AND PRESSURE DISTRIBUTION MEASUREMENTS ON A WING-BODY COMBINATION WITH WING OF LOW ASPECT RATIO IN COMPRESSIBLE FLOW
W Stahl, K Hartmann, and W Schneider Cologne DGLR Aug 1971 39 p refs In GERMAN, ENGLISH summary Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger , 11-13 Oct 1971
(AVA-FB-7129) Avail NTIS

Transonic wind tunnel experimental investigations were carried out on a wing-body combination, with a delta wing of low aspect ratio (lambda = 0 52) The wing extended along most of the length of the body, which was a circular cylinder with an ogival nose Mach numbers ranged from M infinity = 0 5 to 2 2, covering the transonic regime Normal forces and pitching moments were measured, as well as spanwise pressure distributions in several sections on the pressure and suction sides Oil flow and smoke pictures gave some insight into the flow field The Reynolds number, formed with 2/3 of the length of the wing, was held constant at Re = 2,700,000 for all Mach numbers The influence of the Reynolds number was investigated at Mach numbers M infinity = 0 5, 1 0, and 1 8

Author (ESRO)

N72-20001# Dornier-Werke G m b H, Friedrichshafen (West Germany)
EXPERIMENTAL INVESTIGATIONS OF THE AERODYNAMIC COEFFICIENTS OF A BODY-WING COMBINATION AND COMPARISON WITH RESULTS OF LINEAR AND NONLINEAR THEORIES FOR SUBSONIC SPEEDS [EXPERIMENTELLE UNTERSUCHUNGEN AERODYNAMISCHER BEIWERTE EINER FLUEGEL-RUMPF-KOMBINATION UND VERGLEICH MIT DEN RESULTATEN LINEAR ER UND NICHTLINEARER THEORIEN BEI UNTERSCHALLGESCHWINDIGKEITEN]
E Herpfer and J T Heynatz 1971 66 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger, 11-13 Oct 1971
Avail NTIS

A comparison is made of different methods to calculate the most important aerodynamic coefficients of the longitudinal, lateral, and rolling motion of a wing-body combination with large angle of attack and small sideslip angle Using results of experiments in compressible and incompressible flow, the applicability and reliability of the methods are discussed While linear theories are only applicable for angles of attack less than 5 deg, the nonlinear methods give good results for angles of attack up to 12 deg For larger angles the other theories fail to be applicable In order to discuss the wing-body combination, the wing and the body, including their vortex models, are separately treated

ESRO

N72-20002+ Rheinstahl A G, Dortmund (West Germany)
TOW PLANE FOR GLIDERS [SCHLEPPFLUGZEUG FUER SEGELFLUGZEUGE]
K Mink Cologne DGLR 1971 6 p In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger, 11-13 Oct 1971
Avail NTIS

The design of a propeller driven light aircraft for the towing of gliders is discussed The elevators are front mounted, and the propeller is tail mounted, in push fashion The tow cable protrudes through the aircrew shaft The propeller drive is an automobile engine

ESRO

N72-20003# Seagram (Joseph E) and Sons, Inc, New York
THE MAINTENANCE DEPARTMENT INSPECTION PROGRAM
Jon M Rives [1971] 6 p Presented at the 7th Ann FAA Intern Aviation Maintenance Symp
Avail NTIS

The establishment of a continuous inspection and maintenance schedule for determining the airworthiness of aircraft is discussed in terms of changes to current FAR that direct the operators to follow the manufacturer's recommended procedures It is concluded that the proposed FAR change allows maintenance managers to actually manage the maintenance to suit their requirements and still have an airworthy aircraft

F O S

N72-20004# Eastern Air Lines, Inc, Miami, Fla
B747 PERSONALIZED MAINTENANCE APPROACH
Frederick J Lind 7 Dec 1971 8 p
Avail NTIS

The Eastern Airlines maintenance program for the Boeing 747 aircraft is described along with personnel training The personalized approach is illustrated by showing the activities of maintenance personnel on the JFK-SJU turn around flight

F O.S

N72-20005*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
GROUND NOISE MEASUREMENTS DURING FLYOVER HOVER, LANDING, AND TAKE-OFF OPERATIONS OF A STANDARD AND A MODIFIED HH-43B HELICOPTER
David A Hilton, Herbert R. Henderson, and Robert J Pegg
Washington Feb 1971 40 p refs
(NASA-TM-X-2226, L-7237) Avail NTIS CSCL 01B

A field noise measurement program has been conducted on a standard HH-43B helicopter and one that had been modified by reducing the rotor speed, altering rotor tip shape, and treating the engine exhaust and inlet to reduce the external noise levels The modifications were limited to those which could easily be made on a standard helicopter, consequently, only modest noise reductions were expected The ground noise characteristics of each helicopter during flyby, hover, landing, and take-off operations are presented Based on an analysis of the measured results, the average of the overall on-track noise levels of the modified helicopter was approximately 3 dB lower than for the standard helicopter Narrow-band-spectra data of the hovering helicopter show a reduction in the overall noise due to the engine exhaust and a general reduction in harmonic content throughout the spectrum for the modified helicopter The noise results of the test program are found to correlate generally with previous noise measurements on this type of aircraft, and the noise reductions are within a range expected from the modifications which were incorporated

Author

N72-20006*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
DEFINITION AND APPLICATION OF LONGITUDINAL STABILITY DERIVATIVES FOR ELASTIC AIRPLANES
William B Kemp, Jr Washington Mar 1972 119 p refs
(NASA-TN-D-6629, L-8050) Avail NTIS CSCL 01A

A set of longitudinal stability derivatives for elastic airplanes is defined from fundamental principles allowing perturbations in forward speed Application of these derivatives to longitudinal stability analysis by use of approximate expressions for static stability and control parameters as well as the dynamic equations of motion is illustrated One commonly used alternative formulation for elastic airplanes is shown to yield significant inaccuracies because of inappropriate interpretation of inertial effects Author

N72-20007*# Research Triangle Inst, Durham, N C.
INVESTIGATION OF THE PERFORMANCE CHARACTERISTICS OF DOPPLER RADAR TECHNIQUE FOR AIRCRAFT COLLISION HAZARD WARNING, PHASE 3
Washington NASA Mar 1972 151 p refs
(Contract NAS1-7537)
(NASA-CR-2020) Avail NTIS CSCL 01B

System studies, equipment simulation, hardware development and flight tests which were conducted during the development of aircraft collision hazard warning system are discussed The system uses a cooperative, continuous wave Doppler radar principle with pseudo-random frequency modulation The report presents a description of the system operation and deals at length with the use of pseudo-random coding techniques. In addition, the use of mathematical modeling and computer simulation to determine the alarm statistics and system saturation characteristics in terminal area traffic of variable density is discussed

Author

N72-20008*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

OPTIMAL CRUISE TRAJECTORIES FOR SUPERSONIC AIRPLANES

Fred Teren and Carl J Daniele Washington Mar 1972 32 p refs

(NASA-TN-D-6707, E6506) Avail NTIS CSCL 01B

Equations are derived for maximizing range for specified initial and final values of mass and altitude Constant-velocity flight is assumed, and normal acceleration is neglected. The problem is solved by using the maximum principle Optimal trajectories are obtained and uniqueness is demonstrated Results are obtained for a supersonic airplane Curves are presented which can be used to obtain the optimal trajectory and maximum range for a range of initial and final mass and altitude The optimal range is compared to the range obtained by using the standard cruise trajectory profile (consisting of a Bereguet cruise plus maximum- and minimum-thrust connecting segments) and to the range obtained at constant-altitude cruise Author

N72-20009# Grumman Aerospace Corp , Bethpage, N Y Fluid Dynamics Section

REDUCTION OF HYPERVELOCITY HEATING WITH ELLIPTICAL LEADING EDGES

D Weiss Feb 1972 29 p refs

(RE-422) Avail NTIS

Elliptical shapes are considered for use on wing and fin leading edges and fuselage chines in hypervelocity flight Calculated distributions of heating rates and radiation equilibrium temperatures are presented for a family of ellipses at 0 and 60 degree angles of attack Heating rates were obtained with a finite difference solution to the laminar compressible boundary layer equations combined with an empirically derived inviscid pressure law for two dimensional flow around elliptical cylinders The assumption implied by this pressure law of perpendicularity between a straight stagnation streamline and the local surface of the ellipse, is discussed Reduction of peak heating rates from circular values is shown up to 17 percent with a blunt ellipse of axis ratio 0 6 at zero angle of attack, and 14 percent with a sharp ellipse of axis ratio 1 6 at 60 degree angle of attack for the reentry condition studied This represents a 140 R drop in the radiation equilibrium wall temperature (with 0 8 emissivity) for zero attack angle, and 100 R drop for 60 degree attack angle The calculated temperature distributions are also used to find shapes having minimum surface area requiring protection above certain temperatures Author

N72-20010# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Dynamik der Flugsysteme

SIMULATION STUDY OF THE FLYING QUALITIES OF A REMOTE CONTROLLED LIFTING BODY

W Schattenmann Oct 1971 36 p refs In GERMAN, ENGLISH summary

(DLR-FB-71-82) Avail NTIS, DFVLR Porz-Whan 11,80 DM

A simulation was carried out in order to prove the remote control concept of the lifting body model Bumerang For this purpose a display was developed showing the contours of the lifting body in a simplified manner The remote controller was to read five motion variables It was found that the pilot encountered certain difficulties in roll control It was possible to reduce these by diminishing the control effectiveness The characteristics of the control loop roll angle to aileron were analyzed theoretically Author

N72-20011*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

NOISE MEASUREMENTS OF MODEL JET-AUGMENTED LIFT SYSTEMS

Frederick W Gibson Washington Apr 1972 36 p refs

(NASA-TN-D-6710, L-8187) Avail NTIS CSCL 01B

Noise measurements were obtained on models of jet-augmented lift systems which are currently being considered for use on proposed short takeoff and landing vehicles These configurations included a conventional internally blown flap, an augmenter wing, an externally blown flap, and modifications of these basic concepts The tests were conducted in the Langley anechoic noise facility at zero forward speed with cold air jets The conventional internally blown flap exhibited lower noise levels than the augmenter wing and the externally blown flap at the same pressure ratios, being of the order of 8 dB or more at the lowest pressure ratio and of the order of 20 dB at the highest pressure ratio of the tests The data also indicated that for the conventional internally blown flap, there may be an optimum gap size (other than zero) between the turning lip and the flap leading edge from the standpoint of minimum noise generation or admittance Increasing the trailing-edge thickness of the plain internally blown flap produced no appreciable change in the overall sound pressure level or frequency spectral content in the range of the tests The data indicated that at a position on the ground directly under the jet exit, the externally blown flap and the augmeter-wing overall noise levels are comparable to each other throughout the pressure range of the tests Author

N72-20012*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

A FLIGHT EVALUATION OF VTOL JET TRANSPORT UNDER VISUAL AND SIMULATED INSTRUMENT CONDITIONS

Curt A Holzhauser, Samuel A Morello, Robert C Innis, and James M Patton, Jr Washington Mar 1972 95 p refs

(NASA-TN-D-6754, A-4023) Avail NTIS CSCL 01B

A flight investigation was performed with the Dornier DO-31 VTOL to evaluate the performance, handling qualities, and operating characteristics that are considered to be important in the operation of a commerical VTOL transport in the terminal area The DO-31, a 20,000 kilogram transport, has a mixed jet propulsion system, main engines with nozzles deflect from a cruise to a hover position, and vertical lift engines operated below 170 knots This VTOL mode incorporates pitch and roll attitude and yaw rate stabilization The tests concentrated on the transition, approach, and vertical landing The mixed jet propulsion system provided a large usable performance envelope that enabled simulated IFR approaches to be made on 7 deg and 12 deg glide slopes In these approaches management of thrust magnitude and direction was a primary problem, and some form of integrating the controls will be necessary The handling qualities evaluation pointed out the need for additional research of define flight path criteria The aircraft had satisfactory control and stability in hover out of ground effect The recirculation effects in vertical landing were large below 15 meters Author

N72-20013# Royal Aircraft Establishment, Farnborough (England)

DEVELOPMENT OF THE FA-200XS EXPERIMENTAL AIRCRAFT

Jiro Terao Dec 1972 42 p refs Transl into ENGLISH from Natl Aerospace Lab , Japan, report TR-229

(RAE-Lib-Trans-1606, TR-229, BR-28319) Avail NTIS

The FA-200XS is an experimental plane being developed to investigate the operational problems of STOL type airplane The plane is generally similar to the original FA-200 (Aerobatic Category Certification) light airplane, but is equipped with full span slats and flaperons, as well as a boundary layer control system using distributed area suction located on the leading edges of flaps and ailerons The experiments for the developments consisted of two and three-dimensional wind tunnel tests, and several series of flight tests to investigate the aerodynamic characteristics of the FA-200X and FA-200XS Author

N72-20014*# Scientific Translation Service, Santa Barbara, Calif
REFLECTIONS ON THE SOVIET SUPERSONIC AIRLINER TU 144
P Bork Washington NASA Mar 1972 23 p Transl into ENGLISH from Tech -Okonomische Inform der Zivilen Luftfahrt, v 7, no 9, 1971 p 397-410
(Contract NASw-2035)
(NASA-TT-F-14206) Avail NTIS CSCL 01B

The problems encountered during the design of the Tu 144 are considered The cruising speed was limited to a range from 2300 to 2500 km/hr in order to avoid the great expenses inherent in the development of an aircraft based entirely on titanium alloys The selection of the jet engine type is discussed together with the aerodynamic characteristics, stabilization and control, the aerodynamic design of the propulsion system, the wing structure, the landing gear, and the operation of the aircraft Author

N72-20015*# Scientific Translation Service, Santa Barbara, Calif
CURLING OF AN UNSTABLE DISCONTINUITY SURFACE Ph.D Thesis
H Kaden Washington NASA Mar 1972 51 p refs Transl into ENGLISH from Ing -Arch (Berlin), v 2, 1931 p 140-168
(Contract NASw-2035)
(NASA-TT-F-14230) Avail NTIS CSCL 20D

The unstable vortex layer behind a wing is analyzed using conformal mapping techniques A plane discontinuity model is developed and the rolling-up process of the surface is studied Applications to airfoil wing theory are given A corresponding flow visualization experiment in a water tank is described Author

N72-20017# Transportation Systems Center, Cambridge, Mass
VORTEX SENSING TESTS AT NAFEC Technical Report, 15 Jun. - 15 Jul 1971
D Burnham, J Hallock, R Kodis, and T Sullivan Jan 1972 70 p
(DOT-TSC-FAA-72-2) Avail NTIS

Tests to determine and evaluate some of the characteristics of three experimental techniques for the remote sensing of wing tip vortices generated by heavy commercial and military aircraft are described The techniques involved (1) a pulsed, bistatic acoustic detection and ranging system, (2) a ground level pressure sensor, and (3) a ground level hot-wire anemometer Results in the form of altitudes and times of tower hits and vortex tracks are presented Author

N72-20018# Transportation Systems Center, Cambridge, Mass
REAL-TIME SIMULATION PROGRAM FOR DEHAVILLAND (CANADA) BUFFALO AND TWIN OTTER STOL TRANSPORTS
R A MacDonald (Serv Technol Corp , Cambridge, Mass), Mel Garelick (Serv Technol Corp , Cambridge, Mass), and J Haas 25 Jun 1971 56 p refs
(DOT-TSC-FAA-71-14) Avail NTIS

Simulation models of two representative STOL aircraft, the DeHavilland Buffalo and Twin Otter transports have been generated The aircraft are described by means of non-linear equations that will accomodate gross changes in angle of attack, pitch angle, flight path angle, velocity, and power setting Aircraft motions in response to control inputs and external disturbances are related to Earth-fixed coordinates The equations are programmed to run in real time so that they can be used in conjunction with a manned cockpit simulator Provisions are made for pilot control inputs to the simulation, and conventional panel display parameters are generated Representative simulation results which demonstrate that the simulation is an adequate representation of the two STOL aircraft being modeled are provided Author

N72-20019# Transportation Systems Center, Cambridge, Mass
SIMULATION MODEL FOR THE PIPER PA-30 LIGHT MANEUVERABLE AIRCRAFT IN THE FINAL APPROACH
Joseph S Koziol, Jr Jun 1971 29 p refs
(DOT-TSC-FAA-71-11) Avail NTIS

The PA-30 aircraft and a representative autopilot during the final approach configuration are discussed for simulation purposes The aircraft is modeled by linearized six degree of freedom perturbation equations referenced to the aircraft stability axis Other equations are presented which derive the body axis rates, velocities and accelerations, and ground referenced velocities The autopilot is a representative system for automatic instrument landing system approaches from initial localizer track down to decision height Requirements for an instrument landing system and a generalized set of equations for aircraft approach under instrument conditions were developed Author

N72-20020# Federal Aviation Administration, Washington, D C
REVIEW OF AVIATION ACTIVITY IN 1971 AND THE OUTLOOK FOR 1972
14 Dec 1971 7 p
(Rept-72-00207) Avail NTIS

The FAA Office of Aviation Economics has , reviewed aviations activity for the year 1971 and forecasts an optimistic trend in domestic and international air traffic operations, passenger utilization, and general aviation aircraft production for 1972 A special summary is included covering year end activities for the National Capital Airports of Dulles and National A L

N72-20021# National Transportation Safety Board, Washington, D C
AIRCRAFT ACCIDENT REPORTS. BRIEF FORMAT US CIVIL AVIATION ISSUE NO 2· 1970 ACCIDENTS
Oct 1971 524 p
(NTSB-BA-71-3-Issue-2) Avail NTIS HC $6 00/MF $0 95

Selected aircraft accident reports, in brief format, which occurred in United States civil aviation operations during calendar year 1970 are presented The accidents were randomly selected and consist of 896 general aviation and 17 air carrier reports The format presents the facts, conditions, circumstances, and probable cause for each accident Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors Author

N72-20022# Aeronautical Research Inst of Sweden, Stockholm
LIFTING-LINE THEORY FOR A ROTOR IN VERTICAL CLIMB
B C A Johansson 1971 120 p refs Sponsored partly by Swed Board for Tech Develop
(FFA-118) Avail NTIS, Almqvist and Wiksell, Stockholm Sw Kr 50

The problem of a helicopter rotor in vertical climb, hovering or slow descent (or a lightly loaded propeller in forward flight or operating statically) is treated with the method of matched asymptotic expansions The fluid is assumed to be compressible, and the maximum velocities occurring are assumed to be subsonic Two perturbation parameters are used one, denoted by epsilon, is the ratio of a typical blade chord to the rotor diameter, the other, denoted by delta, is the ratio of the climb (or flight) velocity to the tip velocity of the rotor (or propeller) If the climb (or flight) velocity is small, zero or negative, delta is instead defined as the ratio of the sum of the climb velocity and the mean value of the normal induced downwash velocity through the rotor to the tip velocity Besides epsilon and delta, also the ratio epsilon/delta is assumed to be small Series solutions in epsilon and delta are obtained in the form of a two-term expansion in epsilon, where the first term is exact in delta, while the second term is a two-term expansion in delta The solutions break down for delta = 0 As a numerical example, a two-blade rotor with constant blade chord and geometrical angle of attack is considered The ratio of the tip speed of the rotor to the speed of sound is 1/square root of 2 Author (ESRO)

N72-20023# Aeronautical Research Inst of Sweden, Stockholm
TROPOSPHERIC AND TURBULENT CONTRIBUTIONS TO SONIC BOOMS
Robert F Dressler 1970 31 p refs
(FFA-121) Avail NTIS, Almqvist and Wiksell, Stockholm Sw Kr 25

A proof is presented, based upon an analysis of experimental measurements, that the large-scale tropospheric winds produce a significant portion, relative to the contribution from ground-layer turbulence, of the total sonic-boom magnification The analysis uses Oklahoma City A-flight measurements, resolving them into contributions from ground-layer effects and from large-scale tropospheric effects It is shown that ground-layer intensity varied over a 7 to 1 range during the 92 test days, demonstrating how critically the interpretation of any test must depend upon full knowledge of turbulence intensity during each test day Since the statistical method produces first a biased estimate, analysis-of-variance is employed for an unbiased comparison The result for 30,000 ft mean altitude shows that the standard deviation of the tropospheric log M-distribution is 40% as large as sigma of the ground-layer distribution If the assumed linear extrapolation of sigma to SST altitudes is reasonable, this indicates that tropospheric contribution would increase to become equal to ground-layer effect at SST altitudes, implying that double magnifications would occur four times more often with SST's than in the 30,000 ft Oklahoma tests Author (ESRO)

N72-20025# National Aerospace Lab , Amsterdam (Netherlands) Div of Flight Dynamics
ON THE USE OF PANEL METHODS FOR PREDICTING SUBSONIC FLOW ABOUT AEROFOILS AND AIRCRAFT CONFIGURATIONS
W Loeve and J W Slooff 6 Oct 1971 22 p refs Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger , 11-13 Oct 1971
(NLR-MP-71018-U) Avail NTIS

The possibility for accurate prediction of aerodynamic characteristics had been widely increased by the development of panel methods These are based on the construction of numerical solutions of the Laplace equation by means of discretized surface distributions of source, doublet and vortex singularities The flexibility of such methods, especially those for subsonic flow, enables the application to a wide variety of flow problems ranging from simple two-dimensional airfoils to complicated aerodynamic interference problems By introduction of appropriate, semi-empirical compressibility corrections it is further possible to obtain accurate results up to the critical Mach number A developed subsonic panel method is applied to a number of flow problems including two-dimensional transonic airfoil design and three-dimensional interference effects on wing-pylon-store and wing-body-tail arrangements Author (ESRO)

N72-20026# Vereinigte Flugtechnische Werke-Fokker G m b H , Bremen (West Germany)
ADAPTATION OF A NONLINEAR ATTITUDE REGULATOR DEVELOPED FOR A V/STOL AIRCRAFT, TO A HELICOPTER [ANPASSUNG EINES LAGEREGLERS NICHTLINEARER CHARAKTERISTIK, ENTWICKELT FUER EIN VSTOL-FLUGZEUG, AN EINEN HUBSCHRAUBER]
H Schmidtlein Cologne DGLR Oct 1971 72 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger , 11-13 Oct 1971
Avail NTIS

The adaptation of a nonlinear attitude controller developed for the VAK 191B V/STOL aircraft and the flying test bed SD-1262, to a Bell 47-G helicopter, is described It was found necessary to damp the rotor vibrations with a low pass filter The optimal transient response of the helicopter-nonlinear regulator system was somewhat slower than the optimum reached with the test bed, due to the time response lag of the helicopter The pilot maneuverability of the helicopter with nonlinear regulator was found to be good, especially at night and in bad weather ESRO

N72-20027# Bodenseewerk Geraetetechnik G m b H , Ueberlingen (West Germany)
ANGLE OF ATTACK AND THRUST CONTROL OF STEEP APPROACH AIRCRAFT [ANSTELLWINKEL- UND SCHUBREGELUNG FUER STEILANFLIEGENDE FLUGZEUGE]
G Schaenzer 1971 32 p refs In GERMAN Presented at the 4th DGLR Annual Meeting Baden-Baden, West Ger , 11-13 Oct 1971
Avail NTIS

An integrated STOL approach control system is proposed, which reduces angle of attack and altitude control as well as all essential position variables, to aerial rudder and thrust control, and improves approach preciseness, passenger comfort, and noise problems The design of the system was carried out using modern optimization methods, and has been flight tested More than 200 automatic landings, including non-rectilinear steep approaches with path angles up to 9 deg have been performed, and these are reported on ESRO

N72-20028# Army Test and Evaluation Command, Aberdeen Proving Ground, Md
BUILT-IN TEST EQUIPMENT Final Report
1 Nov 1971 18 p refs
(AMCR Proj 310-6)
(AD-734853, MTP-7-3-058) Avail NTIS CSCL 01/3

The report describes a method for evaluation of aircraft built-in test equipment performance characteristics It provides procedures for inspection, physical characteristics, electrical power requirements, compatibility with related equipment, operational performance, electromagnetic interference, durability, maintenance evaluation, maintainability, reliability, achieved availability, safety, human factors, and personnel training requirements Author (GRA)

N72-20029# Cornell Aeronautical Lab , Inc , Buffalo, N Y
ANALYSIS OF AIRCRAFT EXHAUST EMISSION MEASUREMENTS: STATISTICS
H T McAdams 19 Nov 1971 182 p
(Contract EPA-68-04-0040)
(PB-204869, CAL-NA-5007-K-2, APTD-0848) Avail NTIS CSCL 21B

The purpose is to isolate the causes or sources of both fixed and random contributions to the variability observed in the data and to estimate, wherever possible, the magnitudes of these contributions Specific questions of broad interest are addressed, and statistical inferences drawn with respect to these questions Author

N72-20030# Cornell Aeronautical Lab , Inc , Buffalo, N Y
ANALYSIS OF AIRCRAFT EXHAUST EMISSION MEASUREMENTS Technical Report, Jun. - Sep 1971
Leonard Bogdan and H T McAdams 15 Oct 1971 643 p
(Contract EPA-68-04-0040)
(PB-204879, CAL-NA-5007-K-1, APTD-0851) Avail NTIS CSCL 13B

Pollutant mass emissions for carbon monoxide (CO), hydrocarbons (HC), and the oxides of nitrogen (NO (x)) are computed for an aircraft operational cycle comprised of the following modes taxi/idle, take-off, climb out, and approach The calculations are for specific engine power (or thrust) settings for each mode, as well as for specified times in mode Numerical results are tabulated for each individual engine tested, together with summaries obtained by aggregating engine data on a model basis Data are presented for turboprop/turbine engines, light-utility piston engines, and auxiliary power units Author (GRA)

N72-20099# International Business Machines Corp , Philadelphia, Pa Data Processing Div
A TECHNIQUE FOR THE SOLUTION OF MASSIVE SET

COVERING PROBLEMS, WITH APPLICATION TO AIRLINE CREW SCHEDULING
Jerrold Rubin Sep 1971 29 p refs
(TR-320-3004) Avail NTIS

Recent set covering algorithms were able to solve problems for which the constraint matrix has as many as 10,000 columns In certain applications, the number of columns is combinatorially dependent on the number of rows, and can reach many orders of magnitude greater, for 500-1000 rows For these problems, the constraint matrix cannot be generated, unless severe ad hoc limitations are imposed One method of attack is to repeatedly use a set covering algorithm on much smaller matrices extracted from the overall problem, generating columns as needed Such an approach was used on an airline crew scheduling problem, with excellent practical success on test cases involving close to 1000 rows It utilizes some techniques which are more generally applicable, and some which make use of the structure of the crew scheduling problem Author

N72-20100# International Business Machines Corp , Philadelphia, Pa Data Processing Div
AIRLINE CREW SCHEDULING THE NON-MATHEMATICAL PROBLEM
Jerrold Rubin Sep 1971 18 p refs
(TR-320-3006) Avail NTIS

Methods of overcoming some difficulties for airline crew scheduling are reviewed Several generalizations and analogies are drawn which may be applied to other areas Author

N72-20107# Joint Publications Research Service, Washington, D C
HIGH ALTITUDE EQUIPMENT FOR CIVIL AVIATION AIRCRAFT
N G Grishanov 16 Mar 1972 274 p refs Transl into ENGLISH of the book "Vysotnoye Oborudovaniye Samoletov Grazhdanskoy Aviatsii" Moscow, Transport Publishing House, 1971 264 p
(JPRS-55454) Avail NTIS

The physiological effects of high altitude flight and the development of life support systems for civil aircraft are discussed Subjects presented are (1) pressurized aircraft cabins, (2) aircraft cabin air conditioning systems, (3) aircraft oxygen systems, (4) aircraft cabin temperature and humidity control systems, and (5) servicing and maintenance of pressurized cabins and high altitude equipment Line drawings of various items of equipment and systems are provided for clarification P N F

N72-20165# Transportation Systems Center, Cambridge, Mass
MONOPULSE AZIMUTH MEASUREMENT IN THE ATC RADAR BEACON SYSTEM
Bernard Kulke, Bruce Rubinger, and George G Haroules Dec 1971 133 p refs
(DOT-TSC-FAA-72-6) Avail NTIS

A review is made of the application of sum-difference beam techniques to the ATC radar beacon system A detailed error analysis is presented for the case of a monopulse azimuth measurement based on the existing beacon antenna with a modified feed network Without beam sharpening, single reply *monopulse accuracy is less than that of the existing system* With beam sharpening and/or by using multiple reply information, the azimuth error is estimated to be as little as 1 or 2 azimuth change pulses, compared to 3 for the common digitizer Monopulse modification implies a considerable increase in system cost and complexity A monopulse modification for azimuth measurement in the radar beacon system studied is not recommended Author

N72-20189# Transportation Systems Center, Cambridge, Mass
A SURVEY TO DETERMINE FLIGHT PLAN DATA AND FLIGHT SCHEDULING ACCURACY
John R Coonan Jan 1972 121 p
(DOT-TSC-FAA-72-10) Avail NTIS

Operational Flight Plan Data and Flight scheduling accuracy vs published schedules and/or stored flight plan data are discussed This accuracy was determined by sampling tracer flights of varying lengths, selected terminals, and high altitude sectors, then comparing this data with stored computer data, *thus, revealing average delay areas This information will aid* operational analysts and programmers to construct flow control software programs Author

N72-20196# Technische Hochschule Stuttgart (West Germany) Inst fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen
APPLICATION OF INTERACTIVE COMPUTER GRAPHICS TO THE CALCULATION OF AIRCRAFT STRUCTURES [*DIE ANWENDUNG VON INTERAKTIVER COMPUTER-GRAPHIK BEI DER BERECHNUNG VON TRAGWERKEN*]
J H Argyris and I Grieger Cologn DGLR 1971 36 p refs In GERMAN Presented at the 4th DGLR Annual meeting, Baden-Baden, West Ger , 11-13 Oct 1971
Avail NTIS

The effective use of display devices for a man-machine dialog requires that both man and the computer should have the possibility to generate and to modify graphic and alphanumerical data This concept of interactive computer graphics is discussed and applied to the computations of structures The ASKA program for automatic analysis of dynamic systems using the finite element method and its complement the INGA program for interactive graphic analysis are presented and discussed ESRO

N72-20216# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Abteilung Instrumentierung und anthropotechnik
MICROMESH FILTERS FOR CONTRAST ENHANCEMENT OF ELECTRONIC DISPLAYS
Josef Thomas 1971 42 p refs In GERMAN, ENGLISH summary
(DLR-FB-71-73) Avail NTIS, DFVLR, Porz 11 DM

The possibilities of cockpit cathode ray tube display contrast enhancement are investigated, and a choice is made of the screen mounted micromesh optical filter The loss of contrast in cockpit electronic displays by high ambient light conditions necessitates the application of contrast enhancing filters A survey is given of thin media, neutral gray filters, circularly polarized filters, fiber optical filters, and micromesh filters Two different micromesh filters are photometrically evaluated, and point to usefulness in practical operation The results suggest the necessity of quantitative data with respect to the CRT beam luminance to achieve an adequate contrast range and sufficient contrast under given conditions ESRO

N72-20248# National Academy of Engineering, Washington, D C Environmental Studies Board
JAMAICA BAY AND KENNEDY AIRPORT: A MULTIDISCIPLINARY ENVIRONMENTAL STUDY. VOLUME 1: CONCLUSIONS, RECOMMENDATIONS, SUMMARY
1971 41 p
(ISBN-0-309-01871-4-Vol-1, LC-78-610437-Vol-1) Avail NTIS

Several possible runway configurations extending into Jamaica Bay from Kennedy Airport were studied, one of which was suggested by the Port of New York Authority These were considered in relation to the natural ecosystem of the bay, existing or proposed programs for water quality improvement, recreation, and conservation, and present and expected land usage patterns near the airport It was concluded that any runway construction will damage the natural environment of the

bay and reduce its potential use for conservation, recreation, and housing The degree of this impairment will be dependent upon the amount of bay area taken for the airport extension It is possible to improve the bay environment by technological means Such improvements may be made independently of any airport expansion scheme, but any expansion would increase the economic costs or dilute the benefits of these improvements
Author

N72-20249# National Academy of Engineering, Washington, D C Environmental Studies Board
JAMAICA BAY AND KENNEDY AIRPORT: A MULTI-DISCIPLINARY ENVIRONMENTAL STUDY, VOLUME 2
1971 162 p refs
(ISBN-0-309-01871-4-Vol-2, LC-78-610437-Vol-2) Avail NTIS
The task of improving the environment is considered in relation to competing needs of air and ground transportation The future of Jamaica Bay, the Kennedy Airport and community development, and the national air transportation policy are discussed Among the topics studied are the needs and alternatives of air transportation for the New York region, Jamaica Bay as a resource for the people of New York City and the surrounding area, present effects of aviation in the environs of Kennedy Airport, effects of improved technology and of runway extensions, and national issues raised by the Jamaica Bay study
K P D

N72-20250*# Tracor, Inc , Austin, Tex
PRELIMINARY EVALUATION OF THE EFFECT OF A DYNAMIC PREFERENTIAL RUNWAY SYSTEM UPON COMMUNITY NOISE DISTURBANCE
Harrold P Patterson, Richard P Edmiston, and William K Connor 7 Feb 1972 91 p refs
(Contract NASw-2293, TRACOR Proj 076-163-01)
(NASA-CR-125821, T-72-AU-9016-U) Avail NTIS CSCL 01E
A dynamic preferential runway system (DPRS) was developed for John F Kennedy International Airport for the purpose of controlling short term noise exposure in the neighboring communities The DPRS is a computer-aided procedure for optimum selection of runways from the standpoint of noise and is based upon a community disturbance model which takes into account flyover levels, size of exposed populations, time of day and week, and persistence of overflights A preliminary evaluation of the DPRS is presented on the basis of social survey data and telephone complaint records, for the trial period of August and September, 1971 Comparative use is made of data taken in a previous survey of the same community areas in 1969 Author

N72-20254# Transportation Systems Center, Cambridge, Mass
CHARACTERISTICS OF A SIGNAL DATA CONVERTER FOR A MULTI-RUNWAY VISIBILITY MEASURING SYSTEM Technical Report, Jun - Nov. 1971
H C Ingrao and J R Lifsitz Oct 1971 35 p refs
(DOT-TSC-FAA-72-1) Avail NTIS
The signal data converter (SDC) is discussed in the context of an evolutionary growth of the visibility measuring system stemming from the present FAA RVR measuring technique Included in outputs will be simultaneous signals from as many as nine transmissometers distributed three each along three runways In addition, ground illuminance sensors will provide more background discrimination than the present day-night switch The system will be expected to handle inputs from several kinds of target lights and to calculate several specialized visibility values (RVR,SVR,TVR) The SDC will be capable of modular expansion
Author

N72-20255# Transportation Systems Center, Cambridge, Mass
PRELIMINARY SURVEY OF POTENTIAL STOL TERMINAL AREA OPERATIONAL REQUIREMENTS Interim Report
Lloyd E Stevenson Jun 1971 44 p refs
(DOT-TSC-FAA-71-9) Avail NTIS
A preliminary survey of potential operational requirements for STOL in the terminal area has been made The presentation of this survey is in three sections The first section presents the motivation for the survey, which can be summarized as the necessity for the Federal Government to have a knowledge of the potential operational requirements of STOL The second section discusses the markets in which STOL may be found viable This discussion is limited to those aspects which are necessary to determine the effects of these markets on shaping future STOL operations The final section consists of a description of terminal area operations as they currently exist, of possible operational changes that may occur exclusive of the introduction of STOL, and then of potential operational requirements of STOL in the terminal area
Author

N72-20256# Transportation Systems Center, Cambridge, Mass
AN INVESTIGATION OF MICROWAVE LANDING GUIDANCE SYSTEM SIGNAL REQUIREMENTS FOR CONVENTIONALLY EQUIPPED CIVILIAN AIRCRAFT
Maurice H Lanman, III Jun 1971 184 p refs
(DOT-TSC-FAA-71-24) Avail NTIS
Efforts are described leading to the determination of minimum suitable scan rates for the azimuth and elevation of a microwave landing guidance system (LGS), based on performance requirements of two conventionally equipped civilian aircraft Two complementary methods are used, one involving a full nonlinear digital simulation, the other involving direct covariance matrix propagation Wind and turbulence models, aircraft models and LGS models are described in detail Safety and pilot acceptability criteria for performance evaluation are developed Results are presented in terms of minimum scan rate maximum beam noise constraints Limitations of the methods and data are also discussed
Author

N72-20268# Naval Civil Engineering Lab , Port Hueneme, Calif
AIRFIELD PAVEMENT CONDITION SURVEY, USNAS BARBER'S POINT, HAWAII
H Tomita and L J Woloszynski Oct 1971 94 p refs
(AD-735105, NCEL-TN-1198) Avail NTIS CSCL 13/2
The results of a condition survey of the airfield pavements at the USNAS Barbers Point, Hawaii are presented The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and Portland cement concrete pavement coverage of defect tapes, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts
Author (GRA)

N72-20272*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
A STUDY OF INTERNAL DRAG OF SMALL-SCALE DUCTS AT MACH NUMBER 4
Lawrence A Graham and Lynn W Hunton Mar 1972 64 p refs
(NASA-TM-X-62143) Avail NTIS CSCL 20D
An experimental investigation was made to examine the applicability of methods used to determine internal drag of small ducts and to study some of the problems encountered in assessing momentum losses in such ducts Test Mach numbers ranged from 3 7 to 4 4 at angles of attack of 0 and 5 degrees and at a constant Reynolds number of 4 3 million per foot The configurations represented small ducts used to simulate external aerodynamics of air breathing propulsion systems and consisted of wing nacelle models of ducts with circular, square, and rectangular inlets and with a two-dimensional inlet
Author

N72-20331# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Abteilung Aerodynamik

CALCULATION OF THE POTENTIAL FLOW AROUND AXISYMMETRIC BODIES, COWLS, AND INLETS [BERECHNUNG DER POTENTIALSTROEMUNG UM ROTATIONSSYMMETRISCHE RUEMPFE, RINGPROFILE UND TRIEBWERKSEINLAEUFE]

W Geissler Cologne DGLR Aug 1971 22 p refs In GERMAN, ENGLISH summary Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct 1971

(AVA-FB-7131) Avail NTIS

The potential flow around bodies of revolution (closed body inlets, cowls) is calculated using surface distributions of sources, sinks, and vortices This method deals with an arbitrary flow about the body Besides axisymmetric flows and flows at incidence to the body axis, it is possible to take care of flow field induced by another body (interference problem) A panel method is used for the numerical solution of the problem In an axisymmetric body the surface elements are frustrums of cones of small axial length Author (ESRO)

N72-20333# Lockheed Missiles and Space Co., Huntsville, Ala Research and Engineering Center

APPLICATION OF THE VORTEX DISTRIBUTION TECHNIQUE TO THREE-DIMENSIONAL BODIES MOVING THROUGH AN INCOMPRESSIBLE FLUID Independent Research Report, Feb - Jul 1971

Robert A Lott Aug 1971 30 p refs

(AD-732953, LMSC/HREC-D225334) Avail NTIS CSCL 20/4

The report presents results of a study to develop a method for evaluating the forces on three-dimensional shapes in steady subsonic flow The technique is developed by formulating a mathematical model which approximates the various aspects of the physical features of the flow The mathematical model is constructed around the use of vortex elements which simulate the effects of the body and satisfy the governing equation Author (GRA)

N72-20409# Danish Meteorological Inst., Charlottenlund

BIBLIOGRAPHY OF FLUXGATE MAGNETOMETERS

F Primdahl 1971 16 p refs Reprinted from Publ of the Earth Phys Branch, v 41, no 1, of the Dept of Energy, Mines, and Resources, Canada

(DMI-Geophys-Papers-R-22, ISBN-87-7478-039-5) Avail NTIS

Papers on fluxgate magnetometers and closely related devices are listed Most of the references include a short description of the contents under the following headings type of sensor, theoretical calculations,experimental data, and instrument design and description The major developments in the field from the early 1930's to the present are covered Author

N72-20437# Technische Univ., Berlin (West Germany) Inst fuer Flugfuehrung und Luftverkehr

STABILIZATION AND GUIDANCE OF VEHICLES USING INDICATING INSTRUMENTS PART 2 ABOVE THE GROUND INDICATION AND ARTIFICIAL HORIZON [STABILISIERUNG UND LENKUNG VON FAHRZEUGEN MIT HILFE DER VORANZEIGE. TEIL 2: UEBERGRUNDANZEIGE UND KUENSTLICHER HORIZONT]

Dieter Dey and Gunnar Johannsen Feb 1971 93 p refs In GERMAN

(Rept-61) Avail NTIS

An indicating instrument, the main part of which is the display of an extrapolated trajectory element, has been developed, simulated and investigated for the above-the-ground motion of a VTOL aircraft The improvements acquired from using this pre-indication are depicted by spectral density and power density functions The results show that the indicator simplifies manual control of the above-ground motion of a hovering aircraft In addition, an artificial horizon indicating extrapolated position, has been developed for manual position control of a hovering VTOL aircraft The results show that the extrapolated horizon line simplifies control, shortens learning time, and augments control quality ESRO

N72-20452*# Naval Postgraduate School, Monterey, Calif

SPIN TEST OF TURBINE ROTOR

Michael H Vavra, James E Hammer, and Lawrence E Bell Feb 1972 147 p refs

(NASA Order C-10836)

(NASA-CR-1967, NPS-57VA71061B) Avail NTIS CSCL 14D

Experimental data are presented for the tangential and radial stresses in the disks of the 36,000 horsepower, 4000 rpm turbine for the M-1 engine oxidizer turbopump The two-stage Curtis turbine is a special light-weight design utilizing thin conical disks with hollow sheet metal blades attached by electron-beam welding techniques The turbine was fabricated from Inconel 718, a nickel-chromium alloy The stresses were obtained by strain-gage measurements using a slip-ring assembly to transmit the electrical signals Measurements were made at different rotative speeds and different thermal loads In addition to presenting test data, the report describes test equipment, design of associated hardware, test procedures, instrumentation, and tests for the selection and calibration of strain gages Author

N72-20492*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

CYCLIC FURNACE OXIDATION OF CLAD WI-52 SYSTEMS AT 1040 C AND 1090 C

Michael A Gedwill Washington Apr 1972 31 p

(NASA-TN-D-6730, E-6399) Avail NTIS CSCL 11F

Cyclic furnace oxidation studies were conducted on the cobalt alloy WI-52 clad with Ni-30Cr, Fe-25Cr-4Al, and Ni-20Cr-4Al foils (0.051 to 0.254 mm thick) Tests as long as 400 hours using 1- and 20-hour cycles showed that the Ni-Cr- and Fe-Cr-Al claddings were about equally protective at both temperatures The protective ability of these alloys was influenced by exposure temperature and cladding thickness At both temperatures, they protected WI-52 about as well as, or better than, a widely used commercial aluminide coating The Ni-Cr-Al claddings did not protect WI-52 nearly as well Interdiffusion generally influenced the oxidation behavior of all clad WI-52 systems Author

N72-20508*# TRW Equipment Labs., Cleveland, Ohio

RESIN/GRAPHITE FIBER COMPOSITES

P J Cavano, R J Jones, and R W Vaughan 1 Mar 1972 166 p refs

(Contract NAS3-13203)

(NASA-CR-72983, TRW-ER-7396-F) Avail NTIS CSCL 11D

High temperature resin matrices suitable for use in advanced graphite fiber composites for jet engine applications were evaluated A series of planned, sequential screening experiments with resin systems in composite form were performed to reduce the number of candidates to a single A-type polyimide resin that repetitively produced void-free, high strength and modulus composites acceptable for use in the 550 F range for 1000 hours An optimized processing procedure was established for this system Extensive mechanical property studies characterized this single system, at room temperature, 500 F, 550 F and 600 F, for various exposure times Author

N72-20519# Research Association of British Paint, Colour and Varnish Manufacturers, Teddington (England)

MECHANICAL PROPERTIES OF PAINT FILMS IN

RELATION TO THEIR USE ON AIRCRAFT
J L Prosser London Dept of Trade and Ind 1971 88 p refs (Contracts PD/23/058/ADM, KS/1/0629/CB43(A)2)
(D-MAT-165) Avail NTIS

The mechanical properties of paint films and the changes occurring in them caused by accelerated weathering, are measured The films were examined with reference to their use on aircraft A sonic pulse method was used to measure the glass transition temperature of the films These measurements indicate a rise in Tg (transition temperature) upon weathering which rapidly becomes higher than ambient in all cases The brittle point was determined from measuring the extensibility at various temperatures The significance of transition temperatures is discussed and some hypotheses are given for their deviation from glass transition temperatures Cooling and internal stress effects on cracking are also discussed Weight losses and their relation to Tg were determined No changes were observed for adhesion during exposure tests Preliminary examination of paints under vibration indicate the possibility of extensibility failure at low values due to a fatigue mechanism

Author (ESRO)

N72-20554# Transportation Systems Center, Cambridge, Mass
CLEAR AIR TURBULENCE RADIOMETRIC DETECTION PROGRAM Annual Report, 1 Jul 1970 - 30 Jun. 1971
George W Wagner, G G Haroules, and W E Brown Jul 1971 62 p
(DOT-TSC-FAA-71-19) Avail NTIS

Accomplishments for the Clear Air Turbulence Detection Program are discussed The objectives, instrumentation, supporting hardware and interfaces leading up to and including the test flights for the reporting period are given The ultimate goal of this program is the development of a remote method for detecting and thereby alerting high-altitude, high-speed aircraft in sufficient time to avoid the hazards associated with clear air turbulence, CAT

Author

N72-20577# Toronto Univ (Ontario) Inst for Aerospace Studies
A REVIEW OF AIR TRAFFIC CONTROL
Lothar Steigerwald Jul 1971 266 p refs Sponsored by Natl Res Council of Can
(UTIAS-34) Avail NTIS

A broad outline and understanding of the basic facts and problems of air traffic control are presented Congestion and capacity problems are discussed in the light of present ATC organization in North America and Europe Planning and proposed ATC concepts are presented outlining the different approaches several countries have taken to solve the air traffic congestion problems In addition, research in air traffic control is being reviewed to determine its impact on future ATC solution Author

N72-20578# *Transportation Systems Center, Cambridge, Mass*
KEYBOARD AND MESSAGE EVALUATION FOR COCKPIT INPUT DATA LINK Technical Report, FY 1971
Edwin H Hilborn Nov 1971 40 p refs
(DOT-TSC-FAA-71-21) Avail NTIS

Some methods for implementation of the man-machine interface of Digital Data Link for Air Traffic Control are discussed An analysis of information transfer requirements indicated that a vocabulary of less than 200 words could yield meaningful messages for all routine ATC transactions Keyboard configurations suitable for one-handed operation to yield alphanumeric outputs were studied and a ten-key character selection layout based upon sequential keying of the first two letters of the phonetic alphabet was developed Tests with experimental subjects indicated that training time was no longer and keying proficiency at least as good as that achieved with a larger keyset A second-order mnemonic coding scheme based upon key letters of messages was proposed as a means for reducing the number of required keystrokes to generate such messages

Author

N72-20579# Transportation Systems Center, Cambridge, Mass
PATH CHANGING METHODS APPLIED TO THE 4-D GUIDANCE OF STOL AIRCRAFT
Robert J Hynes, Lloyd E Stevenson, and Edward B Capen (Service Technol. Corp., Cambridge, Mass.) Nov 1971 41 p refs
(DOT-TSC-FAA-72-5) Avail NTIS

Proposed terminal area operations may require that large-scale commercial STOL aircraft be capable of accurately flying complex flight paths, and in some situations, maintaining a time of arrival envelope at waypoints along these paths (4-D guidance capability) Problems that arise in performing 4-D guidance, and the results of an initial investigation of two candidate 4-D guidance schemes that are based on the aircraft having a limited amount of protected airspace for maneuvering, are discussed Preliminary analysis and simulation results are presented and future work on the 4-D guidance of STOLS is outlined The results, although presented for STOLS, are applicable also to the 4-D guidance of any RNAV equipped aircraft Author

N72-20580# Transportation Systems Center, Cambridge, Mass
COLLISION RISK MODEL FOR NAT REGION
Ronald M Hershkowitz May 1971 55 p refs
(DOT-TSC-FAA-71-6) Avail NTIS

The essential features of the collision risk model used to analyze the effects of separation standards on safety for the parallel tracking system employed for airline operations in the North Atlantic Ocean are presented The derivation of the model is traced from a set of basic assumptions to formulation of various philosophies A set of conclusions and recommendations is included

Author

N72-20581# Transportation Systems Center, Cambridge, Mass
THE IMPACT OF INERTIAL NAVIGATION ON AIR SAFETY
R M Hershkowitz, D Oathuna, and K R Britting (MIT) May 1971 26 p refs
(DOT-TSC-FAA-71-5) Avail NTIS

An analysis of inertial navigation system performance data was carried out to assess the probable impact of inertial navigation on the aircraft collisions risk in the North Atlantic region These data were used to calculate the collisions risk between two aircraft flying at the same nominal flight level on adjacent tracks The inertial system's error sources are treated in a statistical sense to infer the en route error behavior from the terminal error data Collision risk estimates are derived for easterly and westerly transatlantic flights There is strong evidence to support the concept that the widespread use of inertial navigators will lead to reduced separation standards in the North Atlantic region while maintaining present safety standards

Author

N72-20582# Transportation Systems Center, Cambridge, Mass
LARGE SCALE SYSTEMS· A STUDY OF COMPUTER ORGANIZATIONS FOR AIR TRAFFIC CONTROL APPLICATIONS
John Dumanian and David Lapp Jun 1971 155 p refs
(DOT-TSC-FAA-71-15) Avail NTIS

Based on current sizing estimates and tracking algorithms, some computer organizations applicable to future air traffic control computing systems are described and assessed Hardware and software problem areas are defined and solutions are outlined System evaluation criteria are presented The objectives, approach, and definitions of computer hardware and software are given The ATC data processing requirements, the anticipated traffic, the computer processing rates, and the methods for analyzing computer performance are discussed Current computing systems with capabilities for usage in near future ATC applications described The algorithms which are to be used in the projected ATC programs are outlined

Author

N72-20583# Transportation Systems Center, Cambridge, Mass
COMPUTER SYSTEMS PERFORMANCE MEASUREMENT TECHNIQUES
Judith Gertler, Herbert Glynn, Vivian Hobbs, and Frederick Woolfall Jun 1971 71 p refs
(DOT-TSC-FAA-71-23) Avail NTIS

Computer system performance measurement techniques, tools, and approaches are presented as a foundation for the instrumentation of air traffic control data processing equipment to measure and evaluate effectiveness Several computer system measurement approaches, event-monitoring, and statistical sampling software techniques are discussed Diverse computing environments and the fundamental operational concepts of executive systems are examined The characteristics of simulation languages and packages are summarized to provide guidelines for evaluation and selection of simulation capability Author

N72-20584# Transportation Systems Center, Cambridge, Mass
A CONCEPTUAL NETWORK MODEL OF THE AIR TRANSPORATION SYSTEM· THE BASIC, LEVEL 1 MODEL
Aurel N deHollan and Arthur S Priver Apr 1971 49 p
Original contains color illustrations
(DOT-TSC-FAA-71-3) Avail NTIS

A basic conceptual model of the entire air transportation system to serve as an analytical tool for studying the interactions among the system element is described The model is designed to function in an interactive computer graphics environment which permits rapid alteration of rules and parameters, as well as continuous real-time graphical monitoring of system operations The model described is the first member in an evolving hierarchy of increasingly complex models, progressing in the direction of closer approximation to the real-world air transportation system Author

N72-20587# National Aviation Facilities Experimental Center, Atlantic City, N J
EVALUATION OF STOL INSTRUMENT LANDING SYSTEM (TALAR 4) Final Report, Jul. 1970 - Jul. 1971
Glen D Adams Apr 1972 45 p
(FAA Proj 320-114-05X)
(FAA-RD-72-15, FAA-NA-72-27) Avail NTIS

The evaluation of two TALAR 4 systems for use on short takeoff and landing (STOL) tests is discussed TALAR 4 operates at 15 5 GHz (Ku-band magnetron output), providing localizer and glide slope signals for approach guidance for aircraft equipped with a receiver The units were modified to provide glide slope angles between 6 deg and 9 deg to include a transmitter monitor, and to transmit an identification code The magnetron life is about 500 hours The monitor is inadequate because of drift, but overall, the TALAR has been a reliable and useful tool The guidance signals are generally of good quality The transmitter location, in relation to the runway, affects the pilot's ability to set the aircraft down at the desired touchdown point Author

N72-20595# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Abteilung Systemanalysen
AIR TRAFFIC PLANNING WITH METHODS OF LINEAR PROGRAMMING
Otto W Pfeifer and Hartmut Wolff 1971 72 p refs In GERMAN, ENGLISH summary
(DLR-FB-71-60) Avail NTIS, DFVLR Porz 16,50 DM

To give survey on various mathematical models for air traffic planning, those tasks were chosen and analyzed which yield linear set-ups It was found that many of the air transportation problems may be represented as linear models, whereas comprehensive tasks such as the establishing of a real, optimum flight scheme cannot be treated purely linearly In case of real problems, difficulties often occur with the numerical evaluation of the mathematical set-up to be optimized Author

N72-20596# Litton Systems, Inc, Woodland Hills, Calif Aero Products Div
LIGHT EVALUATION OF INERTIAL/DME/DME MAP DISPLAY SYSTEM Final Report
R J Holm Aug 1971 216 p refs
(Contract DOT-FA70WA-2379)
(AD-735015, FR-11, FAA-RD-71-46) Avail NTIS CSCL 17/7

A map display driven by an INS/DME/DME navigation system was flown in a Convair 580 over the United States area for evaluation of map presentation, map film content, cockpit navigation use, ATC interface, and Area Nav in departure, enroute and approach operations The map display was demonstrated and evaluated Map film content included high altitude, low altitude, area charts, Jeppesen charts, R Nav, JNC topography plus VOR and ILS approach plates GRA

N72-20763*# Pratt and Whitney Aircraft, East Hartford, Conn
TWO STAGE FAN 1. AERODYNAMIC AND MECHANICAL DESIGN
H E Messenger and E E Kennedy Jan 1972 138 p refs
(Contract NAS3-13494)
(NASA-CR-120859, PWA-4148) Avail NTIS CSCL 21E

A two-stage, highly-loaded fan was designed to deliver an overall pressure ratio of 2 8 with an adiabatic efficiency of 83 9 percent At the first rotor inlet, design flow per unit annulus area is 42 lbm/sec/sq ft (205 kg/sec/sq m), hub/tip ratio is 0 4 with a tip diameter of 31 inches (0 787 m), and design tip speed is 1450 ft/sec (441 96 m/sec) Other features include use of multiple-circular-arc airfoils, resettable stators, and split casings over the rotor tip sections for casing treatment tests Author

N72-20764# Council for Scientific and Industrial Research, Pretoria (South Africa)
WANKEL ENGINES FOR AIRCRAFT
J Falecki Feb 1971 10 p refs Transl into ENGLISH from Tech Lotnicza i Astronaut (POLAND), v 24, no 6, 1969 p 12-15
(Rept-908) Avail NTIS

The Wankel engine is compared with conventional and jet aircraft engine for application to light aircraft propulsion The characteristics of the engines for light aircraft and helicopters are presented The advantages of the Wankel engine from the standpoint of simplicity, smooth operation, power output, and fuel consumption are examined Graphs are presented to show the comparative performance of the engines for power output, specific fuel consumption, cost and effects of altitude on power output Author

N72-20765# Council for Scientific and Industrial Research, Pretoria (South Africa)
CRITICAL EXAMINATION OF THE PULSE-JET
Rodolfo Pallabazzer Nov 1970 35 p refs Transl into ENGLISH from Monografie Sci E Tech (Italy), no 27, 1966 p 1-29
(Rept-891) Avail NTIS

A reexamination of the pulsejet from the thermodynamical and geometrical standpoint is presented Several suggestions are given for the study of new geometries by means of the theory of characteristics Ideas are considered for the definition and improvement of two kinds of pulsejets with afterburner and double exhaust Author

N72-20767*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
FLEXIBLE FIRE RETARDANT FOAM Patent Application
John A Parker and Salvatore R Riccitiello, inventors (to NASA) Filed 21 Apr 1971 12 p
(NASA-Case-ARC-10180-1, US-Patent-Appl-SN-136253) Avail NTIS CSCL 11D

A lightweight fire resistant plastic foam has been developed to provide thermal protection to reentry vehicles and aircraft structures Neoprene-isocyanate foams were modified by the addition of from 10 to 30% by weight of a polymeric alkyl halide The solid foam can be made by conventional systems and it is only necessary to add finely dispersed alkyl halide to the neoprene latex during normal processing NASA

N72-20770*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
SUPERSONIC FAN BLADING Patent Application
Arthur W Goldstein, inventor (to NASA) Filed 21 Jan 1972 9 p
(NASA-Case-LEW-11402-1, US-Patent-Appl-SN-219806) Avail NTIS CSCL 21E

A transonic propulsion fan for a turbofan engine is described which was designed to propagate a minimum noise distribution in a forward direction The fan consists of radially extended rotor blades mounted on a hub so that the peripheral spacing of the blades prevents the formation of a channel or passageway between adjacent blades Each blade has a flat trailing surface extending for the leading edge at least as far to the rear as to cause any pressure waves which might originate on the blade surface to strike the leading surface of the following blade rather than propagate upstream of the blade row The flat trailing surface of each blade makes an angle with the axis of rotation such that the blade is parallel to a gas inflow into the blades NASA

N72-20851*# Lockheed Missiles and Space Co, Palo Alto, Calif
FLOW FIELD PREDICTIONS FOR A SLAB DELTA WING AT INCIDENCE c12
R J Conti, P D Thomas, and Y S Chou *In* NASA Langley Res Center Space Shuttle Aerothermodyn Technol Conf, vol 1 Feb 1972 p 93-114 refs
Avail NTIS CSCL 20D

Theoretical results are presented for the structure of the hypersonic flow field of a blunt slab delta wing at moderately high angle of attack Special attention is devoted to the interaction between the boundary layer and the inviscid entropy layer The results are compared with experimental data The three-dimensional inviscid flow is computed numerically by a marching finite difference method Attention is concentrated on the windward side of the delta wing, where detailed comparisons are made with the data for shock shape and surface pressure distributions Surface streamlines are generated, and used in the boundary layer analysis The three-dimensional laminar boundary layer is computed numerically using a specially-developed technique based on small cross-flow in streamline coordinates In the rear sections of the wing the boundary layer decreases drastically in the spanwise direction, so that it is still submerged in the entropy layer at the centerline, but surpasses it near the leading edge Predicted heat transfer distributions are compared with experimental data Author

N72-20904# Technische Univ, Berlin (West Germany)
CONTRIBUTION TO THE THEORY OF THE ITERATION METHOD FOR THE NONLINEAR CALCULATION ON STATIC LOADED WINGS USING THE SHALLOW ARCH EXAMPLE [BEITRAG ZUR THEORIE DER ITERATIONSVERFAHREN FUER DIE NICHTLINEARE BERECHNUNG STATISCH BELASTETER TRAGWERKE AM BEISPIEL EBENER BOEGEN]
Carl-Hellmut Wagemann Sep 1970 65 p refs In GERMAN
Avail NTIS

Nonlinear calculations of statically loaded wings using an iteration method and its theoretical convergence are presented Two different methods for solving the convergence relationship are shown The first method requires the altering of the iterations variables with the load and leads to the result in which convergence is expected when the terms are handled according to Theory 2 In the second method, an artificial problem is introduced, which examines certain points lying on the load difference curves If the relation of the previously given load to the lowest ideal buckling load of the artificial problem is less than one, the iteration converges Mathematical models and graphs are included to support the theoretical considerations Transl by P N F

N72-20956# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro
COMMUNITY NOISE SOURCES AND DIFFERENT SOCIETY-DEVELOPMENT IMPLICATIONS
L X Nepomuceno Nov 1971 40 p refs In Portugese, ENGLISH summary Presented at 1st Brasilian Noise Pollution Symp, Rio de Janeiro, 21-27 Nov 1971
Avail NTIS

A study of annoying urban noise sources is presented The sources are identified as traffic, industrial, aviation, and domestic The need for unified legislation covering all noise sources, and based on actual measurements is discussed Author

N72-20970*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
EXPLORATORY INVESTIGATION OF FACTORS AFFECTING THE WING TIP VORTEX
James Scheiman, James L Megrail, and James P. Shivers Washington Apr. 1972 52 p refs Film supplement L-1113 available on request
(NASA-TM-X-2516; L-8104) Avail: NTIS CSCL 01B

An investigation was conducted in the Langley full-scale tunnel to study some factors affecting the tip vortex of a wing. It was found that there was a pronounced effect of Reynolds number on the tip-vortex core size An attempt was made to determine what aerodynamic parameters, such as lift, drag, or induced drag, influence the size of the vortex core, but no particular function of the parameters was found to be superior to all others. Various spoilers placed on the upper and lower surfaces of the wing to increase the boundary-layer thickness resulted in a reduction in the vorticity as determined from the tuft grid. Various solid objects placed in the vortex core downstream of the wing tip seemed to decrease the vorticity within the vortex core. Author

N72-20972# National Aerospace Lab, Amsterdam (Netherlands).
LIFTING AEROFOILS WITH SUPERCRITICAL SHOCK-FREE FLOW
J W. Boerstoel and R. Uijlenhoet Oct. 1971 9 p refs Submitted for publication
(NLR-MP-70015-U) Avail. NTIS

Several Nieuwland lifting quasi-elliptical airfoils having supercritical shock-free flow were computed. These profiles appear to have only nose camber The pressure distribution is of the peak type, and the major part of the loading is applied to the front half of the profiles Tests on one of the profiles in the NLR Pilot Windtunnel show, that the flow is practically shock-free in the design condition. Due to viscous effects at the trailing edge the lift coefficient was reduced to about 80% of its theoretical value. Creep drag was not observed at Mach numbers and incidences below the design values. By deflecting a trailing edge flap, the lift loss could be reduced to about 10% without worsening the drag characteristics Author

N72-20973# Army Foreign Science and Technology Center, Charlottesville, Va.
AERODYNAMIC CALCULATION FOR HELICOPTER

LIFTING ROTORS IN STEEP DESCENT (VORTEX RING METHOD)
V. I Shaidakov Oct. 1971 15 p refs Transl into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), v. 10, no. 2, 1967 p 35-40
(FSTC Proj. T7023012301)
(AD-735439; FSTC-HT-23-707-71) Avail: NTIS CSCL 01/3

The report describes calculations of the aerodynamic characteristics of a helicopter rotor at any angle of attack in a flow with comparatively high velocity. The study is concerned with the sloping descent of a helicopter and should be regarded as a first attempt to establish a theory of the aerodynamics of steep descent for helicopters. It is based upon the vortex ring method of aerodynamic calculation for lifting systems in steep descent. Author (GRA)

N72-20974# Air Force Armament Lab., Eglin AFB, Fla Armament Configuration Div
MUTUAL AERODYNAMIC INTERFERENCE EFFECTS FOR MULTIPLE BODIES BY THE CROSS-FLOW CORRECTIONS METHOD Final Report, 15 Jun. - 15 Sep. 1970
Fred W. Martin Jun. 1971 58 p refs
(AF Proj. 2567)
(AD-735655; AFATL-TR-71-69) Avail. NTIS CSCL 01/3

The complexity of the flow field beneath an aircraft with external stores is examined analytically. Equations are produced for computing store separation trajectories, based on mutual interference flow fields between the aircraft and the store. The circle theorem and the small disturbances theory are used in establishing the perturbations responsible for the flow field interference. Author (GRA)

N72-20975# Virginia Polytechnic Inst., Blacksburg Coll. of Engineering.
NONEQUILIBRIUM BOUNDARY LAYER FLOW ON HIGHLY-SWEPT HYPERSONIC WINGS
G. R Inger Nov. 1971 22 p refs Presented at the 22nd Astronautical Congr., Brussels, 20-25 Sep 1971
(PB-204710, VPI-E-71-23) Avail NTIS CSCL 01A

As a first step toward dealing with nonequilibrium effects in general three-dimensional flows, these effects are analyzed for the simple, important case of laminar flow at the leading edge of a swept hypersonic infinite span wing with a highly-cooled surface, including finite surface catalycity effects. Two different types of approximate closed form solutions are developed that provide a clear physical picture and rapid estimates of the major nonequilibrium boundary layer properties in terms of the basic gas dynamic parameters Author (GRA)

N72-20976# Advisory Group for Aerospace Research and Development, Paris (France)
FLIGHT TEST TECHNIQUES Agard Conference Proceedings
Feb. 1971 239 p refs Papers presented at the 38th Meeting of the Flight Mechanics Panel of AGARD, Toulouse, 10-13 May 1971
(AGARD-CP-85) Avail. NTIS

The proceedings of a conference on aircraft flight test techniques are presented Subjects discussed are (1) stability and control tests with emphasis on supersonic and V/STOL aircraft, (2) performance measurements of extremely fast aircraft, (3) gliding reentry vehicle tests, (4) aircraft carrier operational suitability tests, and (5) evaluation of air breathing propulsion systems Data reduction for determining the aerodynamic characteristics of aircraft and comparison with wind tunnel test results are emphasized The views of personnel from test pilot schools regarding flight test procedures are included For individual titles,

N72-20977# Boeing Co., Seattle, Wash Flight Test Engineering - Operations.
STABILITY AND CONTROL 747 FLIGHT TESTING
D. D. Archer *In* AGARD Flight Test Tech Feb 1972 12 p
Avail NTIS

The basic development and FAA certification flight test program of the 747 aircraft was conducted using five test airplanes in an intensive program involving 1443 flight hours and a total of 10-2/3 months of flight testing. Each airplane was instrumented to perform assigned tasks, and sufficient duplication in instrumentation was provided to allow flexibility in re-assigning tests for schedule changes due to development contingencies Stability and control tests were conducted on four of the airplanes and consisted of 90 hours of development tests and 72 hours of FAA tests for a total of 162 hours. In addition, airplane handling characteristics have since been evaluated by certification authorities of Great Britain, France, and Germany All pilots who have participated in the test programs have judged the flight handling characteristics as excellent Author

N72-20978# Aerospatiale Usines de Toulouse (France).
METHODS OF UTILIZING THE RESULTS OF FLIGHT TESTS FOR THE STUDY OF FLIGHT PERFORMANCE OF THE CONCORDE SUPERSONIC TRANSPORT [METHODES D'UTILISATION DES RESULTATS D'ESSAIS EN VOL POUR L'ETUDE DES QUALITES DE VOL DE L'AVION DE TRANSPORT SUPERSONIQUE CONCORDE]
R Deque and C Pelagatti *In* AGARD Flight Test Tech. Feb. 1972 16 p In FRENCH
Avail NTIS

The classic parameters of flight mechanics recorded onboard the Concorde are compared to those obtained by simulation Data cover aerodynamic limitations, stability and control systems, and instrument performance Also given are the flight parameters used to study the flight qualities and the mathematical models used to determine them Results show small differences in form and precision accuracy of the two methods Transl by E H W

N72-20979# Air Force Flight Test Center, Edwards AFB, Calif.
AN APPROACH TO STALL/SPIN FLIGHT TEST OF MANEUVERING-TYPE AIRCRAFT
Collet E. McElroy *In* AGARD Flight Test Tech Feb 1972 6 p refs
Avail NTIS

Procedures for modifying the conventional stall and spin type of flight tests on high performance aircraft are presented Specific aspects of the stall and spin tests are (1) evaluation of natural/artificial stall warning that indicates the approach of maximum usable lift, (2) determination of the angle of attack for maximum usable lift, (3) evaluation of natural/artificial loss-of-control warning and tests of departure prevention device, and (4) determination of all possible out-of-control events and effective recovery techniques Examples of the control application and stall/departure entry conditions for four conditions are detailed Author

N72-20980# Hawker Siddeley Aviation, Ltd., Kingston upon Thames (England)
THE HARRIER - SOME ASPECTS OF V/STOL STABILITY AND CONTROL FLIGHT TESTING
R J Balmer *In* AGARD Flight Test Tech Feb 1972 11 p refs
Avail NTIS

The dynamic stability of V/STOL aircraft in general and a description of the aerodynamic characteristics of the P-1127 aircraft are presented The techniques used for the initial hovering and transition flights of the P-1127 are described. The development of the Harrier aircraft from the P-1127 configuration is discussed Examples are given of some of the

special stability and control techniques used during development of the Harrier aircraft. Special cockpit instruments and onboard flight data recorders are described Author

N72-20981# Dornier-Werke G m b H, Friedrichshafen (West Germany)
FLIGHT TESTS OF THE PERFORMANCE OF THE DO-31 AIRCRAFT [ESSAIS SUR LES QUALITES DE VOL DU DO 31]
R Draganow *In* AGARD Flight Test Tech Feb 1972 9 p In FRENCH
Avail NTIS

A description is given of the program used to analyze the flight characteristics of the VOTOL aircraft DO-31. Studies were made of the principles of control and stability and the traits of large and small flying seats Tests for a prototype DO-31E, are included Transl by E.H W

N72-20982# Aerospatiale Usines de Toulouse (France)
MEASURE OF PERFORMANCE. METHODS OF ANALYSIS AND APPLICATION TO THE CONCORDE [MESURE DES PERFORMANCES. METHODES D'ESSAIS EN VOL APPLIQUEES A CONCORDE]
J Tourraille and R Langlade *In* AGARD Flight Test Tech Feb 1972 19 p In FRENCH
Avail. NTIS

The principle test methods utilized in aerospace to measure the performance of the Concorde aircraft are presented. Data cover operational performance, takeoff and landing trajectories, and the precision of instruments necessary to calculate performance Transl by E H W

N72-20983*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif
TECHNIQUES FOR THE EVALUATION OF AIR-BREATHING PROPULSION SYSTEMS IN FULL-SCALE FLIGHT c28
Donald R. Bellman, Frank W Burcham, Jr., and Norman V. Taillon *In* AGARD Flight Test Tech Feb 1972 15 p refs

(NASA-TM-X-68305) Avail: NTIS CSCL 21A

Techniques for evaluating air breathing propulsion systems in full scale flight are discussed Examples of flight test techniques being used to measure the performance of turbojet propulsion systems are presented Included are the determination of jet engine thrust, the study of inlet pressure phenomena, the measurement of exhaust nozzle characteristics, and the use of tufts at supersonic speeds A flow diagram of a gas generator method of thrust calculation is illustrated. Author

N72-20984# Centre d'Essais en Vol, Bretigny-sur-Orge (France)
SOME ASPECTS OF FLIGHT MEASUREMENTS AND CALIBRATIONS
J. F. Renaudie *In* AGARD Flight Test Tech Feb 1972 12 p

Avail NTIS

The calibration, application, and limitations of instruments used for flight tests are discussed The various aspects of flight testing which are presented are (1) airspeed measurement, effects of atmospheric pressure at supersonic speed, (3) errors introduced by pitot-static boom location, (4) atmospheric calibration curves for high and low altitude, and (5) correlation of flight test and wind tunnel test data The main source of errors in various aspects of flight testing are examined and corrective actions are recommended. Author

N72-20985# Air Force Flight Test Center, Edwards AFB, Calif *Performance and Flying Qualities Branch*
CRUISE PERFORMANCE TESTING OF ADVANCED AIRCRAFT
Richard R. Hildebrand *In* AGARD Flight Test Tech Feb 1972 12 p ref
Avail: NTIS

The expanded performance capabilities of modern, high performance aircraft have necessitated the development of flight test techniques and methods of data analysis and presentation which differ from those traditionally employed The variable-geometry wing of the F-111 presented the flight test engineer with the problem of defining and presenting cruise performance for a potentially infinite number of differently configured airplanes The introduction of aircraft specifically designed to cruise at high supersonic Mach numbers presented still other problems Some of the problems encountered and solutions developed during flight testing of such aircraft as the F-111, B-58, and SR-71 are presented Author

N72-20986*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif
LIFTING BODY FLIGHT-TEST TECHNIQUES
Garrison P Layton, Jr and Milton O Thompson *In* AGARD Flight Test Tech Feb 1972 9 p refs

(NASA-TM-X-68306) Avail. NTIS CSCL 01B

Specific techniques and procedures for conducting flight tests of lifting body type aircraft are presented The characteristics of the aircraft in transonic and supersonic flight regions were investigated The data collection and analysis techniques with which the flight results were analyzed are outlined Included are analog and digital matching techniques for derivative extractions and a method for extracting lift and drag data Problems encountered in the flight test program and methods for solving these problems are discussed Author

N72-20987# Aerospace Engineering Test Establishment, Ottawa (Ontario)
ACCEPTANCE FLIGHT TESTING OF MILITARY AIRCRAFT
E J Sinnett and L V. P Galvin (USABPA, Ft Worth, Tex) *In* AGARD Flight Test Tech Feb 1972 4 p

Avail NTIS

The acceptance flight test procedures developed and used by the Canadian Armed Forces are presented The techniques are applied to all aircraft on initial delivery and following repair and overhaul to ensure proper operation of all aircraft systems by logical functional checks and quality control procedures Crew requirements for performing the flight tests are outlined Author

N72-20988# Naval Air Test Center, Patuxent River, Md Carrier Suitability Branch
CARRIER SUITABILITY TESTS
Roger M Decker *In* AGARD Flight Test Tech Feb 1972 16 p
Avail NTIS

A resume of tests performed to determine the suitability of an airplane for launching and recovery operations in aircraft carriers is presented Carrier suitability testing involves for the most part the blending of the pilot/airframe combination with special equipment in this unique environment Flight test methods utilized to define the performance and handling qualities of an airplane are not unique and are given only cursory treatment Criteria which should be considered in the design of carrier-based aircraft so as to most advantageously match an airplane to the carrier environment are presented Author

N72-20989# Air Force Flight Test Center, Edwards AFB, Calif
FLIGHT TESTING FOR TURNING PERFORMANCE
Roger C Crane *In* AGARD Flight Test Tech. Feb 1972 10 p refs
Avail NTIS

The types of performance test maneuvers used for evaluating the turning capability of military aircraft are presented. The application of the turning performance techniques to F-104, F-4, F-4E, and F-111D aircraft is discussed The techniques for determining the turning limitations imposed by airframe lift and engine thrust production are described Author

N72-20990# Royal Aircraft Establishment, Bedford (England)
STABILITY AND CONTROL TESTS ON A SLENDER WING RESEARCH AIRCRAFT
P. L Bisgood *In* AGARD Flight Test Tech Feb. 1972 13 p refs
Avail NTIS

A variety of flight test techniques has been used to measure the stability and control characteristics of a slender-wing research, aircraft as part of a program aimed at comparing wind tunnel and flight measurements. Derivatives obtained by alternative methods in flight usually showed satisfactory agreement Conventional methods of derivative extraction proved adequate in areas where minor non-linearities occurred in the aerodynamic coefficients. Where more pronounced non-linearities exist, as in the longitudinal case, the results indicate that conventional techniques may not be entirely adequate Author

N72-20991# Fiat S.p A., Turin (Italy) Flight Mechanics Engineering
AN INTEGRAL METHOD FOR EXTRACTION OF AERODYNAMIC COEFFICIENTS FROM FLIGHT-TEST DATA c19
G P Foroni *In* AGARD Flight Test Tech Feb 1972 6 p refs
Avail NTIS

The application of the equations of motion methods, which in the praxis are the most advantageous, shows some difficulties and failures in the effectiveness and generality of employment. In order to overcome these deficiencies, after a short review of the principal methods, an integral procedure has been developed, which is a synthesis of the Fourier Transform and Shinbrot's methods, and it has also all the advantages of them. The method accuracy has then been improved by applying an optimization process of the mathematical model, based on the O H Gerlach correlation-coefficients Author

N72-20992# Technische Hogeschool, Delft (Netherlands).
THE DETERMINATION OF STABILITY DERIVATIVES AND PERFORMANCE CHARACTERISTICS FROM DYNAMIC MANOEUVRES
O H. Gerlach *In* AGARD Flight Test Tech Feb 1972 23 p refs
Avail NTIS

Three frequency ranges of interest to the flight dynamicist are distinguished (1) the low-frequency or phugoid and spiral mode frequency range, (2) the intermediate or short-period and Dutch roll frequency range, and (3) the high-frequency or elastic modes frequency range. Until today most flight tests for the determination of stability derivatives have been directed towards the intermediate frequency range Since for various reasons the frequency ranges show an increasing trend to overlap for several classes of modern aircraft, flight test techniques suitable for more than one frequency range may well receive more attention Flight tests to determine derivatives in the combined low and intermediate frequencies are described The importance of accurate measurements and of an adequate frequency content of the input signal in the flight tests is stressed The rationale behind the choice of the shape of the input signal used in the flight tests is given. The application of the derivatives, not only for stability and control purposes, but also for the determination of performance characteristics, is discussed Author

N72-20995# Royal Air Force, Farnborough (England)
TRAINING PILOTS TO ASSESS FLIGHT SYSTEMS AT THE EMPIRE TEST PILOTS' SCHOOL c11
A A Clark *In* AGARD Flight Test Tech Feb 1972 6 p
Avail. NTIS

The syllabus and training curriculum for the Empire Test Pilot School in England is presented. One aspect of the training, which is identified as assessment of flight systems, is emphasized. Features of the system are (1) a ground training program in systems and control engineering, (2) an autopilot investigation exercise, (3) two simulator exercises, (4) an inflight autopilot assessment, and (5) a flight path control system assessment Author

N72-20997# Transportation Systems Center, Cambridge, Mass.
THE CALCULATION OF AIRCRAFT COLLISION PROBABILITIES
Juan F Bellantoni Oct 1971 43 p refs
(DOT-TSC-FAA-71-27) Avail NTIS

A method for calculating the aircraft collision probability due to reduced separations of commercial aircraft is discussed The statistical-probabilistic method of collision probability calculation, which has been limited to parallel, straight line flight paths, is extended to arbitrary flight paths and vehicle shapes The general formula is specialized to cases of large relative velocity, non-zero relative velocity, zero relative velocity, and spherical collision surface The formulas are applied to indpendent curved landing approaches to parallel runways Author

N72-20998# Transportation Systems Center, Cambridge, Mass
VISIBILITY CONCEPTS AND MEASUREMENT TECHNIQUES FOR AVIATION PURPOSES Final Report
G T. Schappert Jul. 1971 109 p refs
(DOT-TSC-FAA-71-25) Avail NTIS

Present techniques for measuring atmospheric transmittance and its conversion to runway visual range are reviewed. The response of the pilot to visual cues used in determining the visibility is discussed as a function of his cockpit environment The lights utilized by the FAA as targets for visibility determinations are discussed and used in the computations New techniques for visibility measurements and new concepts and definitions are discussed and analyzed The emphasis is on techniques for measuring slant visual range by means of optical remote sensing devices Various problems relating to atmospheric modeling, signal processing, and eye safety aspects are discussed Author

N72-20999# Transportation Systems Center, Cambridge, Mass.
AIRCRAFT WAKE VORTEX SENSING SYSTEMS
D Burnham, M Gorstein, J Hallock, R Kodis, I. McWilliams, and T Sullivan Jun 1971 70 p refs
(DOT-TSC-FAA-72-13) Avail NTIS

Active and passive techniques for detecting and measuring air movements such as those associated with wingtip vortices within an area or throughout a volume of terminal airspace are presented. Usable techniques, with an appraisal of expected performance and inherent limitations, are described Results of preliminary feasibility tests employing available technology are presented. The major effort is directed toward the location of wake vortex hazards and the generation of monitoring requirements for safe operation in the airport terminal environment. Author

N72-21000# Transportation Systems Center, Cambridge, Mass
PROPOSED CONTROL TOWER AND COCKPIT VISIBILITY READOUTS BASED ON AN AIRPORT-AIRCRAFT INFORMATION FLOW SYSTEM

Hector C. Ingrao and J. R Lifsitz Jul. 1971 47 p refs
(DOT-TSC-FAA-71-18) Avail. NTIS

The problem of displaying visibility information to both controller and pilot is discussed in the context of visibility information flow in the airport-aircraft system The optimum amount of visibility information, as well as its rate of flow and display, depends both on the needs of the pilot during landing and on the air traffic control philosophy (tactical or strategic) chosen A rationale is provided to assist in the selection of flow rates and readouts The relationship of visibility information to the magnitude of terminal information handled by the pilot is discussed Several display formats are proposed, including one for the traffic controller and three different options for the pilot
Author

N72-21001*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
PEAK AXIAL-VELOCITY DECAY WITH MULTI-ELEMENT RECTANGULAR AND TRIANGULAR NOZZLES
D. E Groesbeck, U H. vonGlahn, and R G Huff Mar. 1972 28 p refs
(NASA-TM-X-68047) Avail NTIS CSCL 01B

The aircraft noise created by the impingement of engine exhaust jet of STOL aircraft with exterally blown flaps is discussed. It was determined that the jet-flap interaction noise can be lowered by reducing the impinging velocity of the jet The reduction must occur at a specific distance from the flap to be effective The peak axial-velocity decay obtained with rectangular and triangular single element mixer nozzles is presented Equations are developed for estimating the peak axial velocity decay curves for a wide range of nozzle configurations
Author

N72-21002# National Transportation Safety Board, Washington, D C.
AIRCRAFT ACCIDENT REPORT: MONMOUTH AIRLINES, INCORPORATED, SCHEDULED AIR TAXI, BEECH 99, N986MA, ALLENTOWN-BETHLEHEM-EASTON AIRPORT, ALLENTOWN, PENNSYLVANIA, 24 OCTOBER 1971
29 Dec 1971 18 p
(NTSB-AAR-72-3) Avail NTIS

The crash of a Beechcraft Model 99 aircraft engaged in air taxi service at Allentown, Pennsylvania on 24 October, 1971 is reported The accident occurred during an instrument approach to the Allentown-Bethlehem-Easton airport The accident was believed to be due to the pilot's nonadherence to approved approach procedures for executing a nonprecision instrument approach in instrument flight conditions
Author

N72-21003# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: ALOHA AIRLINES, INCORPORATED, VICKERS VISCOUNT MODEL 745D, N7415, HONOLULU INTERNATIONAL AIRPORT, HONOLULU, HAWAII, 8 AUGUST 1971
29 Dec 1971 17 p
(NTSB-AAR-72-2) Avail NTIS

Vickers Viscount 745D, N7415 was operating between Hilo and Honolulu, Hawaii After landing at Honolulu and during taxi to the terminal, smoke was detected coming from below the passenger cabin floor The aircraft was stopped on the taxiway, the engines were shut down and all passengers and crewmembers evacuated without incident The fire was extinguished by airport emergency equipment The probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery, which resulted in the absorption of an increasing amount of heat energy over an unknown period of time, and progressed to a state of thermal runaway
Author

N72-21004*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va
LIGHTWEIGHT, VARIABLE SOLIDITY KNITTED PARACHUTE FABRIC Patent Application
Frederick R Matthews, Jr and Erskine C White, inventors (to NASA) Filed 23 Dec 1971 14 p
(NASA-Case-LAR-10776-1; US-Patent-Appl-SN-221332) Avail NTIS CSCL 11E

A parachute fabric for aerodynamic decelerator applications is discussed The fabric will permit deployment of the decelerator at high alitudes and low density conditions The fabric consists of lightweight, highly open, circular knitted parachute fabric with ribbon-like yarns to assist in air deflection
NASA

N72-21005*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif
WIND-TUNNEL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF THE M2-F2 LIFTING-BODY ENTRY CONFIGURATION AT TRANSONIC AND SUPERSONIC MACH NUMBERS
Earl R Keener and Jack J Brownson Washington Apr 1972 135 p refs
(NASA-TM-X-2511, A-4131) Avail NTIS CSCL 01B

Results are presented for wind tunnel tests of a one to twelve scale model of the M2-F2 lifting body entry configuration at transonic and supersonic speeds The Mach number was varied from 0 6 to 2 0 Reynolds numbers ranged from 4 to 13 million Angles of attack and sideslip varied from minus 8 degrees to plus 20 degrees and minus 4 degrees to plus 6 degrees respectively A brief history of the development of the configuration is included
Author

N72-21006*# Scientific Translation Service, Santa Barbara, Calif
STABILITY AND CONTROL OF HYPERSONIC AIRCRAFT
R Ceresuela Washington NASA Apr 1972 33 p refs
Transl. into ENGLISH from "Stabilite et Controle d'Avions Hypersoniques", Office National d'Etudes et de Recherches Aerospatiales, report TP-1014
(Contract NASw-2035)
(NASA-TT-F-14235) Avail NTIS CSCL 01B

Problems in the aerodynamics of sustained hypersonic flight including maximal lift/drag ratios and longitudinal and lateral stabilities related to large volume engines are discussed The compatibility of internal and external flows is examined for highly deformed intakes and exhausts.
F.O S

N72-21007# Air Force Flight Test Center, Edwards AFB, Calif
EXPERIMENTAL DETERMINATION OF THE MOMENTS OF INERTIA, PRODUCT OF INERTIA, AND THE INCLINATION OF THE PRINCIPAL AXIS OF CONVENTIONAL AIRCRAFT BY THE SPRING OSCILLATION METHOD
Edward N Bradfield Jun 1971 63 p refs
(FTC-TIM-71-1001) Avail NTIS

The equipment and techniques for conducting moment of inertia tests on A-37 and P-1127 aircraft are discussed The manner in which the tests can be conducted simply, safely, and with Air Force Flight Test Center facilities and personnel is described Data reduction and analysis methods are explained
Author

N72-21008*# National Aeronautics and Space Administration Electronics Research Center, Cambridge, Mass
AN INDICATING SYSTEM FOR AIRCRAFT Patent Application
Anne W Story, inventor (to NASA) Filed 16 Mar 1971 18 p

(NASA-Case-ERC-10226-2, US-Patent-Appl-SN-124909) Avail NTIS CSCL 01B

A pilot warning indicator system is disclosed which includes a flashing beacon, a detector, and an indicating panel on each aircraft. The detector responds to radiant energy from another aircraft's beacon by energizing particular signal lamps positioned in the periphery of the pilot's normal field of view Since the positions of the energized lamps are related to the direction from which radiant energy is received by the detector, the pilot is apprised of the relative position of an intruder aircraft without any shift in visual fixation NASA

N72-21009*# National Academy of Sciences-National Research Council, Washington, D C

SUPPRESSION OF FLUTTER Patent Application

Eliahu Nissim, inventor (to NASA) Filed 25 Mar 1971 24 p Sponsored by NASA

(NASA-Case-LAR-10682-1, US-Patent-Appl-SN-127915) Avail NTIS CSCL 01B

An active aerodynamic control system is described for controlling flutter over a large range of oscillatory frequencies unaffected by mass, stiffness, elastic axis, or center of gravity location of the system, mode of vibration, or subsonic Mach number It consists of one or more pairs of leading edge and trailing edge, hinged or deformable control surfaces, each pair operated in concert by a stability augmentation system Torsion and bending motions or deflections of the fluttering member are sensed and converted by the stability augmentation system into leading and trailing edge control surface deflections which produce lift forces and pitching moments to suppress flutter NASA

N72-21010*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

DUAL FUSELAGE AIRCRAFT HAVING YAWABLE WING AND HORIZONTAL STABILIZER Patent Application

Robert T Jones, inventor (to NASA) Filed 9 Dec 1971 34 p (NASA-Case-ARC-10470-1; US-Patent-Appl-SN-206279) Avail NTIS CSCL 01B

An aircraft has been designed that consists of a pair of fuselages arranged in parallel and coupled together by a main wing and a horizontal stabilizer which are pivotally attached to the fuselages The pivotal attachment allows the airfoils to be yawed relative to the fuselages for high speed flight while at the same time spreading the weight and volume distribution of the aircraft along the direction of flight The main wing is upwardly curved at the ends to compensate for any roll tendency caused by its yawed positioning NASA

N72-21011# Messerschmitt-Boelkow-Blohm G m b H., Munich (West Germany)

AERODYNAMIC NOISE REDUCTION BY CONTROLLED INTERFERENCE [VERMINDERUNG DES FLUGLAERMS DURCH GESTEUERTE INTERFERENZ]

Oskar Bschorr Cologne DGLR 1 Jan 1971 28 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger , 11-13 Oct 1971

(MBB-BB-55-71-O) Avail NTIS

The possibilities and limits of controlled sound-sound interference to realize engine and aerodynamic noise reduction were investigated In particular, noise extinction was studied for aircraft piston engines, propellers, rotors, and jet engines Engine and rotor noise are essentially periodic and determined sound fields which can be extinguished using a forced synchronous, programmed, anti-sound generator For jet noise, a feedback loop consisting of sound sensor and anti-sound source is necessary ESRO

N72-21013# AAI Corp , Cockeysville, Md

LOW ALTITUDE AIRDROP SYSTEM INVESTIGATION EMPLOYING INFLATION-AIDED RECOVERY PARACHUTES FOR EXTRACTION Final Technical Report

Bruce W Jezek and Kenneth E Mueller Natick, Mass. Army Natick Labs Oct 1971 185 p refs

(Contract DAAG17-68-C-0036, DA Proj. 1M1-21401-D-195) (AD-735375, TR-72-15-AD) Avail NTIS CSCL 15/5

The report presents results of study of an airdrop system utilizing the recovery parachutes to extract as well as to recover the airdrop load The goal was to achieve a low altitude capability by minimizing the altitude loss from the time that the load clears the aircraft until an acceptable impact velocity is achieved. Mathematical models were developed and programmed for computer solution which simulated the operation of an airdrop system. This analytical tool, coupled with experimental data derived from a limited flight test program, was utilized to conceptualize a configuration for an airdrop system and predict its theoretical performance From these studies emerged an understanding of possible configurations for a low altitude airdrop system employing the recovery parachutes for extraction Author (GRA)

N72-21014# National Aeronautical Establishment, Ottawa (Ontario)

A FLIGHT INVESTIGATION OF LATERAL-DIRECTIONAL HANDLING QUALITIES FOR V/STOL AIRCRAFT IN LOW SPEED MANOEUVRING FLIGHT

K-H Doetsch, Jr , D. G Gould, and D. M McGregor Oct. 1971 153 p Sponsored by the AF

(AD-735420, NAE-LR-549, NRC-12285) Avail NTIS CSCL 01/3

An investigation to determine the ranges of various lateral-directional characteristics required to provide adequate flying qualities for turning manoeuvres at low speed was undertaken using an airborne V/STOL aircraft simulator Five parameters were varied in a systematic manner the damping ratio, the frequency and the ratio of the roll-angle to the sideslip-angle in the Dutch roll mode, together with the damping ratio and frequency of the numerator quadratic of the roll-angle to aileron-control-input transfer function The pilots performed a low speed, visual manoeuvring task and documented their assessment of the characteristics through extensive comments and a numerical rating Author (GRA)

N72-21015# Naval Air Development Center, Johnsville, Pa. Aero Structures Dept

STATISTICAL METHODS AND THEIR APPLICATION TO ESTABLISHING FLIGHT MANEUVER LOADS DESIGN CRITERIA FOR FIGHTER AIRCRAFT Summary Report

Thomas A DeFiore and William C Stewart 1 Sep 1971 54 p refs

(AD-735472, NADC-ST-7101) Avail NTIS CSCL 20/11

The report provides statistical methods for use in establishing positive maneuver loads design criteria for fighter aircraft These methods are applied to counting accelerometer data and comparisons between operational loads data and military specifications are presented Author (GRA)

N72-21016# Naval Aerospace Medical Inst., Pensacola, Fla.

ORIENTATION ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1968: RELATIVE INCIDENCE AND COST

Jorma I Niven, W Carroll Hixson, and Emil Spezia 15 Oct. 1971 36 p refs

(MF Proj 12 524 005)

(AD-735457, NAMRL-1145, USAARL-72-5) Avail NTIS CSCL 01/2

The report is the second in a longitudinal series of reports dealing with the magnitude of the pilot disorientation/vertigo accident problem in Regular Army UH-1 helicopter operations. Incidence and cost data presented for fiscal year 1968 include a total of 53 major and minor orientation-error accidents (17 of which were fatal), resulting in 74 fatalities, 60 nonfatal injuries, and $8,224,607 aircraft damage. Author (GRA)

N72-21017# Northern Research and Engineering Corp., Cambridge, Mass.
ASSESSMENT OF AIRCRAFT EMISSION CONTROL TECHNOLOGY
E. K. Bastress, R. C Baker, C F Robertson, R D Siegel, and G E Smith Sep 1971 206 p refs
(Contract EPA-68-04-0011)
(PB-204878; NREC-1168-1, APTD-0850) Avail NTIS CSCL 13B

The results are presented of an investigation which was aimed at providing information for establishing standards on emissions from aircraft activities The program consisted of independent investigation of the following topics emission control by engine modification, emission control by ground operations modification, emission control by fuel modification; and emission measurement. Engine modification control methods were identified through reviews of earlier work and through discussions with engine manufacturers. A list of specific control methods was formulated on the basis of preliminary analyses in which feasibility was indicated The preliminary list of control methods was then subjected to more detailed analysis of control effectiveness and implementation costs Ground operations modification control methods were evaluated in a similar manner. GRA

N72-21018# AiResearch Mfg. Co., Phoenix, Ariz
EXHAUST EMISSIONS TEST AIRESEARCH AIRCRAFT PROPULSION AND AUXILIARY POWER GAS TURBINE ENGINES
10 Sep 1971 420 p refs Sponsored by Environ Protection Agency
(PB-204920, GT-8747-R, APTD-0849) Avail NTIS HC $6 00/MF $0 95 CSCL 13B

The test setup, procedure, and analysis are described of exhaust emissions measurement conducted on 32 commercial gas turbine engines comprised of both on-board aircraft auxiliary power and aircraft propulsion production, overhaul, and development units The units selected are currently active in commercial airline service and thus contribute to aircraft related pollution levels The purpose of the test was to measure exhaust emissions from auxiliary power and small aircraft propulsion gas turbine engines to establish base levels of unburned hydrocarbons, carbon monoxide, carbon dioxide and oxides of nitrogen in current existing engine designs In addition, a survey of engine duty cycles as related to normal customer operation in the field was made to determine a typical duty cycle and the corresponding estimated level of exhaust emissions produced Author (GRA)

N72-21019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOVIET AERONAUTICAL ENGINEERING
A. N. Tupolev and L A Gilberg 20 Nov. 1971 253 p refs Transl. into ENGLISH of the Publ. "Sovetskaya Aviatsionnaya Tekhnika" Moscow, Mashinostr., 1970, p 1-176
(FTD Proj 20906391)
(AD-735204, FTD-HT-23-21-71) Avail: NTIS CSCL 01/1

The book traces the development of Soviet aviation from pre-Revolution days to 1970. It includes many photographs of the latest model Soviet aircraft. Author (GRA)

N72-21020# National Transportation Safety Board, Washington, D.C
AIRCRAFT ACCIDENT REPORT DELTA AIRLINES, INCORPORATED DOUGLAS DC-9-32, N3329L LOUISVILLE, KENTUCKY, 8 SEPTEMBER 1970
17 Nov. 1971 17 p
(PB-205250, NTSB-AAR-71-15) Avail NTIS CSCL 01B

Delta Air Lines Flight 439, touched down 156 feet short of Runway at 2114,e.d.t., while making a visual landing approach. The National Transportation Safety Board determines that the probable cause of this accident was the pilot's misjudgment of altitude due to the absence of sufficient lights in the approach area, misleading information producted by deceptive sloping terrain, and that the pilot did not position the aircraft on the ILS glide slope while he was establishing the final approach profile Author (GRA)

N72-21021# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING MISSING AIRCRAFT, US GENERAL AVIATION 1969
Dec. 1971 102 p
(PB-205097, NTSB-AMM-71-11) Avail NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving missing aircraft and missing aircraft, later recovered, 1969 Author (GRA)

N72-21022# National Transportation Safety Board, Washington, D.C Bureau of Aviation Safety.
BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING AIR TAXI, US GENERAL AVIATION, 1969
Dec 1971 106 p
(PB-205096, NTSB-AMM-71-10) Avail NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving air taxi during 1969 Author (GRA)

N72-21023# National Transportation Safety Board, Washington, D C Bureau of Aviation Safety
BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING ALCOHOLIC IMPAIRMENT OF EFFICIENCY AND JUDGEMENT AS A CAUSE/FACTOR, US GENERAL AVIATION, 1969 Special Study, Calendar Year 1969
Dec 1971 37 p
(PB-204991; NTSB-AMM-71-12) Avail. NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the Briefs of Accidents involving Alcoholic Impairment of Efficiency and Judgement as a Cause/Factor - 1969 Author (GRA)

N72-21024# National Transportation Safety Board, Washington, D C.
BRIEFS OF ACCIDENTS INVOLVING ROTORCRAFT. US GENERAL AVIATION 1969
Oct 1971 127 p
(PB-204812; NTSB-AMM-71-8) Avail NTIS CSCL 01B

The publication contains statistical cause/factor and injury tables, accident rates and the briefs of accidents involving Rotorcraft during calendar year 1969 Author (GRA)

N72-21025# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety
BRIEFS OF ACCIDENTS INVOLVING AERIAL APPLICA-

TION OPERATIONS. US GENERAL AVIATION 1969
Oct 1971 220 p
(PB-204811, NTSB-AMM-71-7) Avail NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving aerial application operations during calendar year 1969 Author (GRA)

N72-21026# National Transportation Safety Board, Washington, D.C Bureau of Aviation Safety
BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING WEATHER AS A CAUSE/RELATED FACTOR. US GENERAL AVIATION 1969
Dec. 1971 202 p refs
(PB-204926, NTSB-AMM-71-9) Avail NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and briefs of accidents involving weather. GRA

N72-21027# Illinois Univ., Urbana Aviation Research Lab
THE FREQUENCY SEPARATED DISPLAY PRINCIPLE, PHASE 3 Annual Summary Report, 1 Oct. 1970 - 30 Sep. 1971
Stanley N. Roscoe, David C Denney, and Steven L Johnson Dec 1971 33 p refs
(Contract N00014-67-A-0305-0014, NR Proj 196-092)
(AD-735915; ARL-71-15, ONR-71-1) Avail NTIS CSCL 01/4

The report includes brief reviews of the display motion relationship problem and the principle of frequency separation; a summary of the work accomplished during Phases I and II, work accomplished during Phase III; results to date, research plans for Phase IV, and personnel involved in the research Author (GRA)

N72-21028# Boeing Co , Philadelphia, Pa Vertol Div
WIND TUNNEL TEST OF THE CONVERSION PROCESS OF A FOLDING TILT ROTOR AIRCRAFT USING A SEMISPAN UNPOWERED MODEL VOLUME 4, PART 2: BLADE STRESS ANALYSIS, BENCH TESTS, AND WIND TUNNEL MODEL DETAILS Final Report
John Magee and Robert Taylor Aug 1971 91 p
(Contract F33615-69-C-1577)
(AD-735733, D213-10000-Vol-4-PT-2,
AFFDL-TR-71-62-Vol-4-Pt-2) Avail NTIS CSCL 01/3

The document presents the detailed results of the blade stress analysis and the bench tests, as well as a description of the wind tunnel and the model Mathematical findings are given in developed equations and in voluminous tabular data. Additional information is provided in the form of engineering graphs and curves, schematic diagrams, and photographs of the model and test setup. This volume is actually an appendix to Part I, Analysis and Results Author (GRA)

N72-21029# Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Engineering.
A COST/DECISION MODEL FOR THE DEFERRED PROCUREMENT OF AN AIR FORCE DEPOT MAINTENANCE CAPABILITY WITH A COMPUTERIZED APPLICATION TO THE F-15 INS M.S. Thesis
Michael S. Clark and Robert E Johnson Nov 1971 230 p refs
(AD-735351; GSM/SM/71-2) Avail NTIS CSCL 01/3

The report presents a decision model to aid decision-makers in evaluating the costs of establishing an Air Force depot maintenance capability at different points in time The cost elements of depot maintenance are identified and defined in denotative terms. The model incorporates techniques for the explicit treatment of uncertainty, converting dollar requirements into expenditures, and the considerations of inflation and discounting (present value) Author (GRA)

N72-21030# Cornell Aeronautical Lab , Inc , Buffalo, N.Y.
A FLIGHT TEST INVESTIGATION OF DIRECT SIDE FORCE CONTROL Final Technical Report
G Warren Hall Wright-Patterson AFB, Ohio AFFDL Sep 1971 121 p refs
(Contract F33615-71-C-1240, AF Proj 8219)
(AD-735294, CAL-BM-3053-F-1, AFFDL-TR-71-1906) Avail NTIS CSCL 01/3

The concept of developing a controllable side force by deflecting the rudder and utilizing asymmetrical drag to cancel the resulting yawing moment was flight tested using the USAF/CAL variable stability T-33 airplane. Primary objectives of the investigation were to mechanize a system that allowed direct control of side force, qualitatively evaluate the usefulness of direct side force control and evaluate the type of controller that might be useful in its employment Three methods for the pilot to control side force were provided a thumb controller mounted on the stick, the aileron stick and the rudder pedals The method of generating and controlling side force studied in the investigation is feasible and lends itself to the high drag configurations normally used in dive bombing. It was concluded that direct side force control significantly improved the pilot's ability to acquire and maintain a target, and therefore should be further investigated as a method of improving weapons delivery accuracy and general flight path control Author (GRA)

N72-21031# Center for Naval Analyses, Arlington, Va
DYNAMIC PROGRAMMING APPROACH TO THE OPTIMIZATION OF NAVAL AIRCRAFT REWORK AND REPLACEMENT POLICIES
Arnold Neil Schwartz, James A Sheler, and Carl R Cooper *(Naval Air Sys Command)* 1971 21 p *refs Rept from Nav* Res Logistics Quart., v 18, no 3, Sep 1971 p 395-414 Revised
(AD-736094) Avail NTIS CSCL 15/5

The paper describes a method for determining optimal repair and replacement policies for aircraft, with specific reference to the F-4. The objective of the analysis is to choose the set of policies from all possible alternatives over a finite planning horizon which minimizes the cost of operations A dynamic program is presented which seeks an optimal path through a series of decision periods, when each period begins with the choice of keeping an aircraft, reworking it before further operation, or buying a new one The authors, do not consider changes in technology Therefore, when a replacement does occur, it is made with a similar aircraft Multivariate statistical techniques are used to estimate the relevant costs as a function of age, and time since last rework. Author (GRA)

N72-21032# Naval Postgraduate School, Monterey, Calif
PROGRAMMED PILOTAGE AS A MEANS OF IMPROVING ROTORCRAFT PERFORMANCE IN LEVEL FLIGHT M.S. Thesis
Robert Alan Wildman Sep. 1971 48 p refs
(AD-736537) Avail NTIS CSCL 01/3

Airframe drag reduction and engine duct design, while necessary to the improvement of performance, cannot alone offset the aerodynamic limitations inherent in rotary wing flight The latter, which have become predominant with the advent of high output turboshaft engines must then be overcome by other means discussed in this paper Programmed pilotage techniques which utilize real-time flight data to vary aerodynamic parameters are investigated and incorporated in the preliminary

design of a high-speed rotor craft. The rotor speed and the contribution of lift from a fixed wing are thus optimized throughout the flight envelope, thereby greatly enhancing level flight speed characteristics. Author (GRA)

N72-21077# Federal Aviation Administration, Washington, D C. Office of Aviation Medicine.
THE BENEFITS OF THE USE OF SHOULDER HARNESSES IN GENERAL AVIATION AIRCRAFT
Joseph A. Sirkis Feb. 1972 7 p refs
(FAA-AM-72-3) Avail NTIS

The installation and use of shoulder harnesses is a practical and relatively inexpensive solution to the problem of maintaining separation between man and machine during an aircraft crash sequence The addition of shoulder harness to the tiedown chain of the general aviation aircraft occupant will increase the probability of the user surviving a severe crash and minimize injuries resulting from light-to-moderate crashes It is concluded that if shoulder harnesses were installed in all general aviation aircraft, considerable benefit to the users of these harnesses would accrue The user-occupant of older general aviation aircraft would realize a level of safety approaching that enjoyed by the user-occupant of normal utility, or acrobatic category airplanes manufactured under Approved Type Certificates applied for after September 14, 1969 Author

N72-21078# Federal Aviation Administration, Washington, D.C.
EFFECTIVENESS OF RESTRAINT EQUIPMENT IN ENCLOSED AREAS
D L Lowrey, E D Langston, W Reed, and John J Swearingen Feb 1972 30 p refs
(FAA Proj AM-A-71-PRS-37)
(FAA-AM-72-6) Avail NTIS

A series of 20-g decelerations of a crash sled was conducted to determine the magnitude of head impact decelerations while wearing various types of restraint equipment in small confined areas Restraint webbing loads and head impact decelerations are presented for three directions of impact (straight forward, and 90 degrees to left and right) Restraint webbing undoubtedly reduces head impact velocities, especially in the forward direction However, this study shows that, in most instances, head strikes may be expected even while using upper and lower torso restraint because of the close proximity of surrounding structure in general aviation aircraft Introduction of upper torso restraint along with lap belts in general aviation aircraft will not relieve the need for delethalizing surrounding structures Author

N72-21165# *Transportation Systems Center, Cambridge, Mass*
A REVIEW OF AVAILABLE L-BAND AND VHF AIRCRAFT ANTENNAS FOR AN AIRCRAFT SATELLITE COMMUNICATIONS LINK
May 1971 93 p refs
(PB-204799, DOT-TSC-OST-71-8) Avail NTIS CSCL 09E

One of the problems encountered in designing an aircraft to use a satellite system for communications (and for surveillance and navigation) is that of finding a suitable aircraft antenna There is, at present, no antenna which will satisfy all requirements. The characteristics of some of the L-Band and VHF antennas which have been proposed for an aircraft-satellite link are reviewed Author (GRA)

N72-21171# Pennsylvania Univ., Philadelphia Moore School of Electrical Engineering
PENNSYLVANIA-PRINCETON ARMY AVIONICS RESEARCH PROGRAM: ANTENNA RESEARCH TASK Final Technical Report
Richard F Schwartz, Frank Klusek, Dennis L Knepp, and Julius Goldhirsh Oct 1971 186 p refs
(Contract DA-28-043-AMC-02411(E), DA Proj 1H1-62202-A-219)
(AD-735346, ECOM-02411-24, Rept-72-08) Avail NTIS CSCL 09/5

The principal results of the work were the development of numerical-analytical techniques for predicting the radiation patterns and impedance of given antennas when mounted on aircraft and the detailed study of the effects of outboard members of the aircraft structure on radiation patterns Extensions of the numerical-analytical techniques developed are suggested Conclusions are drawn about the spacing of antennas from obstacles to minimize interaction and a possible new antenna interaction is proposed Various studies peripheral to the main effort are also described Author (GRA)

N72-21176# Naval Air Development Center, Johnsville, Pa Aero-Electronic Technology Dept
EFFICIENCY STUDY OF ELECTRICALLY SHORT H-F ANTENNAS
Gerald Palatucci 17 Nov 1971 54 p refs
(AD-735886, NADC-AE-7112) Avail NTIS CSCL 09/5

The requirements for h-f communication systems are becoming more stringent especially for small aircraft such as the F-14 and S-3 To optimize the transmitter power budget, the relative efficiency of various antenna configurations including the coupling circuits required to match the antenna to the transmitter has been compared in this analytic study Author (GRA)

N72-21211# Advisory Group for Aerospace Research and Development, Paris (France)
COMPUTERS IN THE GUIDANCE AND CONTROL OF AEROSPACE VEHICLES
C T Leondes, ed (Calif Univ., Los Angeles) Feb 1972 265 p refs
(AGARDograph-158, AGARD-AG-158) Avail NTIS

The utilization of computer technology in aerospace systems is examined in detail Three major areas are considered, (1) system design techniques, (2) systems hardware techniques, and (3) guidance and control computer systems applications

N72-21216# Singer-Librascope, Glendale, Calif
PROGRAMMING CHARACTERISTICS OF FUTURE G AND C COMPUTERS
Austin J Maher *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb 1972 p 57-63 refs

Avail NTIS

The types of difficulties encountered in developing and maintaining airborne computer programs are reviewed These include problems encountered in the initial development of the system program and the significant changes to the original program based on laboratory and flight tests of the over-all system By assimilating results of previous system development experience and predicting the trends in airborne computer hardware development, characteristics are proposed for future airborne Guidance and Control computers The proposed computer characteristics would minimize significant programming difficulties while retaining desirable hardware features (e g, protected memory, small size, etc) The features covered include word length tradeoffs, type of arithmetic, addressing techniques, subprogram linkages, etc , and in summary represent a functional specification for a class of future airborne computers using MSI or LSI techniques Finally, the specific characteristics are presented of an airborne computer designed to meet these functional specifications Author

N72-21220# Bendix Corp., Teterboro, N.J. Navigation and Control Div

FAULT ISOLATION IN A DIGITAL GUIDANCE AND CONTROL COMPUTER

David H. Blauvelt *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb 1972 p 93-98

Avail: NTIS

The possibility is examined of a general purpose digital computer being able to realize an optimum fault isolation capability in a guidance and control application. It is shown that if proper attention is given to the functional partitioning of the computer, self-test and self-diagnostic programs can be written which will determine that faults have occurred and will isolate them to the replaceable card level. It is also demonstrated that this can be accomplished with virtually no additional flight hardware and a relatively simple test console which allows maintenance personnel to communicate with the computer in question. Author

N72-21221# Hughes Aircraft Co., Culver City, Calif. Aerospace Group

GUIDANCE AND CONTROL COMPUTER ACTUATED DISPLAY SYSTEM TECHNIQUES

G. K. Slocum, J. W. Gunvordahl, M. Weihrauch, and J. W. Weber *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb 1972 p 99-115 ref

Avail: NTIS

The airborne computer is discussed in its relationship to the display systems it drives, and to the part that the crew plays in the management and control processes. These relationships are considered for current and near-term tactical aircraft systems with an outlook to the possibilities for the future. Author

N72-21223# Teledyne Systems Co., Northridge, Calif.

HELICOPTER GUIDANCE AND CONTROL COMPUTER SYSTEMS

Lawrence A. Kaufman *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb 1972 p 131-155

Avail: NTIS

The use of central digital computers for helicopter avionic system functions is examined and it is shown how the use of such techniques has evolved as a consequence of the application of helicopters in increasingly more complex missions. The first of these new helicopter digital systems to be developed, the U.S. Marine Corps Integrated Helicopter Avionic System (IHAS), is described in terms of the conceptual design approaches used. The system syntheses problems which are experienced using digital computation techniques are analyzed. Future trends for the application of central digital computers for both helicopters and VTOL aircraft are indicated. Author

N72-21225# ITT Avionics, Nutley, N.J.

COMPUTERS FOR LORAN C/D AND OMEGA NAVIGATION AND GUIDANCE SYSTEMS

James P. VanEtten and Gerald P. Zemlin *In* AGARD Computers in the Guidance Control of Aerospace Vehicles Feb 1972 p 175-228 refs

Avail: NTIS

A synopsis is given of geometry fundamentals pertinent to position-accuracy assessment, the fundamentals of both the loran C/D and Omega systems (including technical summaries of low-frequency and very-low-frequency propagation), and the general effects of vehicle dynamics on system implementation. The application of the modern airborne digital computer to radio navigation signal processing tasks such as signal acquisition and signal tracking is described for both loran C/D and Omega, using advanced radio navigation sensor design approaches as a basis. The more common application of computers to the task of converting from hyperbolic radio coordinates to geographic coordinates of latitude and longitude, and from these to UTM northing and easting, is treated, and the problems entailed in correcting these geographic coordinates for variations in radio propagation are also addressed. Simplified techniques for application of hyperbolic radio navigation data to guidance functions are discussed. Finally, the implications of loran C/D and Omega processing tasks toward establishment of efficient architecture for airborne computers, are discussed, and short tables of desired instructions listed in order of importance are presented. Author

N72-21226# TRW Systems Group, Redondo Beach, Calif. Guidance and Navigation Lab

COMPUTERS FOR SATELLITE BASED NAVIGATION AND GUIDANCE SYSTEMS

T. L. Rodrick and T. I. Fine *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb 1972 p 229-245 refs

Avail: NTIS

The considerations involved in selecting a computer for an airborne navigation satellite user are examined. The software is described which will be used by navigation satellite users and which determines the user's computer requirements. The navigation satellite systems which are treated, are ranging or range differencing systems in which the user is passive (does not transmit to the satellite). The software is described in modular fashion to illustrate how a variety of user needs can be satisfied by different combinations of the same modular components. A description of the Kalman filter design considerations for a combined navigation satellite/inertial system is included which shows how computer speed and memory requirements depend upon the filter state vector size. Author

N72-21227# International Business Machines Corp., Owego, N.Y. Electronics Systems Center

COMPUTERS FOR THE GUIDANCE AND CONTROL OF TACTICAL AIRCRAFT

W. J. Bernhart *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb 1972 p 247-268

Avail: NTIS

The navigational and guidance function provided a typical tactical application by utilization of a digital computer mechanization is analyzed. A brief description is given of the methods utilized to accomplish these functions and the sensors utilized in displaying pilot information and system configuration. The capabilities afforded the tactical vehicle by using digital devices for computation of navigational and guidance algorithms are summarized. Author

N72-21231# Army Electronics Command, Fort Monmouth, N.J.

IHAS-4 SOFTWARE REPORT

M. J. Fisher, C. Galanti, and D. Haddon Dec 1971 36 p (DA-Proj. 1F1-62202-AA-91) (AD-765681, ECOM-3516) Avail: NTIS CSCL 09/2

A brief description is given of a complementary software package developed for in-house use of the IHAS-4 computer. The package insists of a basic two-pass assembler and a simulator that stimulates the computer to a functional level. Author (GRA)

N72-21234# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group

SECURITY OF THE TACC DATA BASE STUDY (DESCRIP-

TION OF AUTOMATIC DATA BASE SECURITY TECHNIQUES)
Bedford, Mass. ESD Sep 1970 152 p refs 5 Vol
(Contract F19628-70-C-0185)
(AD-735728, ESD-TR-71-370-Vol-1) Avail NTIS CSCL 09/2

The report presents the results of a study which surveyed the various aspects of system security hardware, software and procedural techniques in use in current and proposed automated systems Thirty-four systems were considered, including 20 government and 14 commercial systems The security requirements, system environment and function, and techniques employed are described for each system A total of 95 techniques are identified, of which 41 are software, 34 are hardware, and 20 are procedural techniques The total number of techniques found as a result of this survey is a considerably larger number than known to exist prior to initiation of the survey Some quantitative data detailing the relative costs involved in developing, using, and maintaining these techniques was obtained and is provided in this report Qualitative estimates of cost are made in the remaining cases An initial approach to categorizing systems by their security requirements and categorizing techniques by their application to security requirements was devised and applied to the raw data obtained from the survey Author (GRA)

N72-21235# Hughes Aircraft Co, Fullerton, Calif Ground Systems Group
ANALYSIS OF DATA BASE SECURITY AND ACCESS LIMITATION REQUIREMENTS FOR THE POST 1975 AUTOMATED TACC COMPLEX: TABULATION OF TACC SECURE DATA
Bedford, Mass ESD Oct 1971 356 p refs 5 Vol
(Contract F19628-70-C-0185)
(AD-735729, ESD-TR-71-370-Vol-2) Avail NTIS HC $6 00/MF $0 95 CSCL 09/2

The purpose of this study titled "Analysis of Data Base Security and Access Limitation Requirements for the Post-1975 Automated TACC Complex" is to establish a TACC data base baseline from which a clear understanding of security and access requirements can be obtained Author (GRA)

N72-21290# Institute for Defense Analyses, Arlington, Va Science and Technology Div
AN ESTIMATE OF THE POWER REQUIRED TO ELIMINATE TRAILING VORTICES BY SUCTION
J Menkes and F A Abernathy (Harvard Univ, Cambridge, Mass) May 1970 47 p refs
(IDA-Log-HQ-69-10164, P-514, Res-Paper-P-514) Avail NTIS

The use of suction devices in controlling the trailing vortex hazard for closely spaced parallel runways is examined The feasibility of this proposal is examined by means of a computer simulation It is established conclusively that the scheme has merit and that the power required to bring the hazard to acceptable levels is of the order of 2,000 hp per runway Author

N72-21307# National Aeronautical Establishment, Ottawa (Ontario)
HIGHER ORDER THEORY OF TWO DIMENSIONAL SUBSONIC WALL INTERFERENCE IN A PERFORATED WALL WIND TUNNEL
M Mokry Oct 1971 33 p refs
(AD-735967, NAE-LR-553, NRC-12370) Avail NTIS CSCL 14/2

The analytic solution for the interference velocity potential due to a source and a vortex between perforated wind tunnel walls has been extended to higher-order singularities This allows a more accurate construction of the primary perturbation potential at the walls produced by the tested airfoil The solution for the interference velocity at the position of the model is presented in the form of a series expansion, with Bernoulli polynomials of a suitably chosen function of wall porosity as coefficients The discussion is limited to subsonic flow and a thin airfoil of small camber and incidence, placed midway between the perforated walls GRA

N72-21392# Stanford Research Inst, Menlo Park, Calif
TRIGGERED LIGHTNING AND SOME UNSUSPECTED LIGHTNING HAZARDS
Edward T Pierce Jan 1972 25 p refs Presented at Ann Meeting of the Am Assoc for the Advan of Sci, 138th, Philadelphia, 27 Dec. 1971
(Contract N00014-71-C-0106, SRI Proj 4454)
(AD-735917, SN-15) Avail NTIS CSCL 04/1

The paper considers instances of lightning initiated by man's activities These include the triggering of lightning by high-rise buildings and other tall structures, by rockets trailing wires, by the column of water thrown up by a depth-charge, by the large Apollo 12 rocket, by aircraft, and by thermonuclear explosions All the incidents occur when the ambient electric field is some 10,000 volts per meter, and the voltage discontinuity between the conductor initiating the lightning and the adjacent atmosphere is about a million volts It is pointed out how solid-state devices and microcircuitry, computers, plastics, and electrically composite materials, are all quite vulnerable to the effects of lightning These components are being increasingly used in aircraft construction and operation Also, as aircraft become bigger and faster they have a greater propensity to trigger lightning Therefore it is concluded that the lightning hazard to aircraft operation is increasing Author (GRA)

N72-21394# Air Force Cambridge Research Labs, L G Hanson Field, Mass
AFCRL'S EXPERIMENTAL AERIAL GRAVIMETRY PROGRAM Environmental Research Papers, Dec 1965 - Mar 1968
David Anthony and Robert M Perry 27 Jul 1971 40 p refs
(AF Proj 7600)
(AD-735266, AFCRL-71-0411, AFCRL-ERP-366) Avail NTIS CSCL 08/5

Between December 1965 and March 1968 AFCRL conducted a series of experimental aerial gravity measurements to determine the feasibility of large scale aerial gravity surveys This report gives the results of the program and includes a program background, instrumentation description including the four gravimeters tested, upward continuation of gravity methods and evaluation in the test area, data processing procedures including corrections and smoothing methods applied, representative sample profiles, accuracy achieved in terms of profile and mean anomalies, and other aerial gravity tests and studies including helicopter gravity tests, a systems analysis of aerial gravimetry, and gravimetry by means of gradient measurements Author (GRA)

N72-21398# Army Engineer Waterways Experiment Station, Vicksburg, Miss
DESIGN OF UNSURFACED SOIL FACILITIES FOR *OPERATIONS OF C-5A AIRCRAFT Final Report*
Donald M Ladd and Victor C Barber Dec 1971 56 p refs
(AD-735344, AEWES-Misc-Paper-S-71-27) Avail NTIS CSCL 08/13

The purpose of the study reported was to obtain data to validate or modify, if necessary, existing criteria for the operation of the C-5A aircraft on unsurfaced airfields Two specially prepared test sections were constructed and trafficked Test section 1 consisted of a three-item test lane designed for evaluation of surface strength requirements and was trafficked with a 12-wheel C-5A gear arrangement loaded to 25,200 lb Test section 2 consisted of two traffic lanes (lanes 1 and 2) of four items each designed for evaluation of thickness requirements Lane 1 was trafficked with a 35,000-lb single-wheel load, and

lane 2 was trafficked with the 12-wheel C-5A gear arrangement An analysis of the test data showed that existing criteria could be used to design unsurfaced airfields for operations of C-5A aircraft Author (GRA)

N72-21431*# North American Rockwell Corp , Downey, Calif
AIRCRAFT CRASH LOCATOR APPARATUS Patent Application
Robert Manoli and Bertram R Ulrich, inventors (to NASA) Filed 20 Oct 1970 12 p Sponsored by NASA
(NASA-Case-MFS-16609, US-Patent-Appl-SN-82279) Avail NTIS CSCL 14B

An aircraft crash locator apparatus mounted on the tail of an aircraft in a round sealed case held by a shear pin which releases under crash impact of 7 to 8 G's is described The transmitter is powered by a battery which is kept charged by a trickle charge from the navigational light on the tail The battery has a button actuated meter to test the battery condition while the apparatus is installed on the aircraft At the time of the crash, the transmitter is released and ejected, the yoyo antenna wound around the case unwinds, and the transmitter starts emitting on emergency frequencies 121 5 MHz and 243 MHz The transmitter, which is shock mounted in a double plastic case, lands and continues transmitting for about 48 hours NASA

N72-21471*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
PRESSURE-TIGHT SEAL FOR SUPER ALLOY Patent Application
Robert E Little, inventor (to NASA) Filed 12 Jan 1972 12 p
(NASA-Case-LAR-10170-1, US-Patent-Appl-SN-217213) Avail NTIS CSCL 11A

A method that provides a pressure tight seal for abutting edge joints in hypersonic aircraft fuel tanks is described The seal is formed by flame spraying a powdered super alloy, usually 4 5% aluminum and 95 5% nickel, on the tank surface E H W

N72-21496# Sperry Rand Corp , Troy, Mich Aerospace Div
DEVELOPMENT OF A VARIABLE DELIVERY POSITIVE DISPLACEMENT FUEL PUMP Final Report, 6 Jan. 1969 - 4 Mar. 1971
N F Pederson Wright-Patterson AFB, Ohio AFAPL Sep 1971 83 p
(Contract F33615-69-C-1288, AF Proj 3066)
(AD-735259, AFAPL-TR-71-71) Avail NTIS CSCL 13/11

A Research and Development Program was conducted to produce a variable, positive displacement pump for application to the fuel systems of turbine engines A variable positive displacement pump complete with an electrical input signal actuation system was designed and developed to physically fit and supply the flow requirements of the J-85-7 turboject engine. Author (GRA)

N72-21590# Advisory Group for Aerospace Research and Development, Paris (France)
ATMOSPHERIC POLLUTION BY AIRCRAFT ENGINES AND FUELS, A SURVEY
Robert F. Sawyer (Calif Univ , Berkeley) Mar 1972 40 p refs
(AGARD-AR-40) Avail. NTIS

A survey of atmospheric pollution by aircraft engines, aircraft fuels, and related research work was conducted among several European nations and the United States Twenty-seven current or potential problem areas are described Of these areas, the five most pressing are: (1) engine emission characteristics, (2) test procedures; (3) nitric oxide formation, (4) carbon monoxide and hydrocarbons at low power, and (5) effect of high altitude emissions It was recommended that research be encouraged in all 27 areas, although in some cases only a better definition of the nature of the problem as opposed to a solution may be required A selected but extensive bibliography is provided in the appendix Author

N72-21592# Transportation Systems Center, Cambridge, Mass
SURVEY OF AIRCRAFT EMISSIONS AND RELATED INSTRUMENTATION Technical Report, 1 Jul. 1970 - 31 Mar. 1971
Anthony J. Broderick, Walter F Harriott, and Robert A. Walter 31 Mar 1971 37 p refs
(PB-204794; DOT-TSC-OST-71-5) Avail NTIS CSCL 13B

The report presents the preliminary results of a survey of transportation systems emissions monitoring requirements Emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and particulates from aircraft power plants, with emphasis on gas turbine engines, are considered. Measurement rationale for various types of aircraft is summarized. Instrumentation available for measuring these emissions is reviewed and a tabulation made of those techniques in current use Instrumentation requiring further engineering development is briefly discussed. Author (GRA)

N72-21604# National Weather Service, Silver Spring, Md Techniques Development Lab
DEVELOPING TECHNIQUES FOR AUTOMATED FORECASTING OF CLEAR AIR TURBULENCE Final Report
Frank Lewis, Douglas R Greene, Robert E Saffle, and Benjamin W Helmick Nov 1971 39 p
(Contract DOT-FA69WA-155)
(AD-735941, FAA-RD-71-102) Avail NTIS CSCL 04/1

The work reported is directed toward adapting the scheme developed by the Stanford Research Institute for automated forecasting of Clear Air Turbulence (CAT) An important element of the scheme is the relation of CAT occurrence to meteorological parameters Multi-dimensional contingency tables are developed for specifying the probability of occurrence of CAT from values of meteorological parameters The table generating procedure will require modification to solve the problem of the sparsity of data which occurs in some of the cells of the tables Nevertheless, the reductions of variance obtained with the developmental set of data suggest that multi-dimensional contingency tables may produce effective specification of the probability of CAT from meteorological parameters in an automated system. Author (GRA)

N72-21622# Applied Physics Lab , Johns Hopkins Univ , Silver Spring, Md
METEOROLOGICAL APPLICATIONS OF THE BIDIRECTIONAL THERMISTOR MASS FLOW RATE SENSOR
J R Rowland Jun 1971 48 p refs
(Contract N00017-62-C-0604)
(AD-736152, APL-TG-1165) Avail NTIS CSCL 04/2

A thermistor mass flow rate sensor has been applied to a number of meteorological sensing instruments These instruments include an aircraft airspeed indicator, an aircraft angle of attack meter, a wind velocity indicator, an atmospheric gravity wave meter, an accelerometer, and a momentum raindrop disdrometer Included are the basic design details and sample calibrations for each device. Author (GRA)

N72-21625*# Sierra Research Corp , Buffalo, N Y
DESIGN STUDY OF GENERAL AVIATION COLLISION AVOIDANCE SYSTEM
M. R Bates, L D Moore, and W V Scott Mar 1972 243 p refs

(Contract NAS1-10653)
(NASA-CR-112023, TR-0913A) Avail NTIS CSCL 17G

The selection and design of a time/frequency collision avoidance system for use in general aviation aircraft is discussed The modifications to airline transport collision avoidance equipment which were made to produce the simpler general aviation system are described The threat determination capabilities and operating principles of the general aviation system are illustrated Author

N72-21626# Transportation Systems Center, Cambridge, Mass
EVALUATION OF AIR TRAFFIC CONTROL MODELS AND SIMULATIONS
L O Higgins and P Mpontsikaris (MIT) Jun 1971 317 p refs
(Contract DOT-TSC-77)
(DOT-TSC-FAA-71-7) Avail NTIS HC $6 00/MF $0 95

A bibliography of air traffic control models and simulations is presented A summary of the models which may be of value for air traffic control concept evaluation, with emphasis on traffic flow, safety, and system loading aspects, is included The models are divided into seven categories as follows (1) airport surface traffic, (2) runway, departure/arrivals, (3) terminal area, (4) enroute, (5) air traffic control systems models, (6) cost effectiveness models, and (7) safety related models Approximately 200 reports are identified Author

N72-21627# Transportation Systems Center, Cambridge, Mass
MICROWAVE SCANNING BEAM APPROACH AND LANDING SYSTEM PHASED ARRAY ANTENNA *Annual* **Report, Jul. 1970 - Jul. 1971**
R M. Kalafus, G J. Bishop, G G Haroules, P Harris, F J. LaRussa, P J. Pantano, B Rubinger, and R S Yatsko Sep 1971 314 p refs
(DOT-TSC-FAA-71-29) Avail NTIS HC $6.00/MF $0 95

The feasibility of the use of phased arrays for the proposed microwave landing guidance system (MLGS) is discussed The effects of the use of planar and conical beam guidance on the choice of system configurations is investigated The design of an experimental antenna to demonstrate feasibility is given. Author

N72-21628# Transportation Systems Center, Cambridge, Mass
ACCURATE SURVEILLANCE IN THE TERMINAL AREA Final Report
Bernhard Kulke, Robert T Minkoff, and George G Haroules Sep. 1971 41 p refs
(DOT-TSC-FAA-71-26) Avail NTIS

The problem of deriving surveillance information from the Microwave Landing System (MLS) has been analyzed in terms of the available air-to-ground communication links The results of this study indicate that the use of this approach is feasible, and it is recommended that the configuration based on the Discrete Address Beacon System (DABS) data link be included in the upgraded third-generation design to meet the high-density terminal-area surveillance requirements Author

N72-21629# Transportation Systems Center, Cambridge, Mass
OCEANIC SURVEILLANCE AND NAVIGATION ANALYSIS, FY 71 Final Report
Ronald M Hershkowitz Jun 1971 83 p refs
(DOT-TSC-FAA-71-13) Avail NTIS

The results of an oceanic surveillance and navigation analysis for improved commercial aircraft operation over the North Atlantic Ocean are presented Subjects discussed are (1) the North Atlantic Systems Planning Group collision risk model, (2) the impact of inertial navigation on air safety, and (3) modeling techniques required to assess the effect of air traffic control by satellite surveillance on separation standards Author

N72-21630# Transportation Systems Center, Cambridge, Mass.
EVALUATION OF THE FAA ADVANCED FLOW CONTROL PROCEDURES
J. F Bellantoni, J. R Coonan, and M F. Medeiros Jan 1972 213 p refs
(DOT-TSC-FAA-72-8) Avail: NTIS

An evaluation of the present Federal Aviation Administration Flow Control Procedures is presented The evaluation is based on fast-time digital simulation of traffic feeding into the New York City airports. The effectiveness of the flow control procedures is discussed in theory The following recommendations are made: (1) retain the concept, (2) modify the procedures, (3) modify the computer program, and (4) conduct further research. Author

N72-21631*# National Aeronautics and Space Administration Electronics Research Center, Cambridge, Mass
IMPROVED SATELLITE AIDED VEHICLE AVOIDANCE SYSTEM Patent Application
Ernest R. Steele, inventor (to NASA) Filed 21 Jan 1972 31 p
(NASA-Case-ERC-10419, US-Patent-Appl-SN-219722) Avail. NTIS CSCL 17G

An improved satellite aided vehicle avoidance system (SAVAS) is described The exact range from a protected vehicle to an intruding vehicle with mutual-collision heading and velocity is derived without signal transmission by the protected vehicle or use of synchronized time reference devices Additional steps of measuring time-to-collision from the delay and Doppler measurements, establishing ordered time-slots from the form of the satellite signal may be included NASA

N72-21632*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif
TERMINAL GUIDANCE SYSTEM Patent Application
Shu W Gee, inventor (to NASA) Filed 6 Mar 1972 27 p
(NASA-Case-FRC-10049-1, US-Patent-Appl-SN-232021) Avail NTIS CSCL 17G

The guidance system is composed of a heading command subsystem and a glide slope command subsystem The heading subsystem is responsive to certain input data and continuously develops command signals for use in directing the aircraft from a remote location to a terminal point The glide slope command subsystem is responsive to certain other input data and continuously develops command signals for use in controlling the rate of descent of the aircraft at the terminal point NASA

N72-21634# Transportation Systems Center, Cambridge, Mass
AN AIRPORT AIRSIDE SYSTEM MODEL
Irwin Englander Jun 1971 55 p refs
(PB-204802, DOT-TSC-OST-71-12) Avail NTIS CSCL 17G

The model of an airport airside system simulates aircraft operations and controller functions in the terminal area, both in the air and on the ground The model encompasses all operations between the terminal gate and the point of handoff between the enroute controller and the terminal controller Author (GRA)

N72-21641# Federal Aviation Administration, Washington, D.C. Office of Management Systems
AIR TRAFFIC PATTERNS FOR IFR AND VFR AVIATION, CALENDAR YEAR 1970
Nov 1971 154 p
(AD-735970) Avail NTIS CSCL 17/7

The report presents a detailed record of flight plans filed at flight service stations and combined station/towers as collected in a 2-percent random sample of all Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) flight plans filed in the 50 states and the ARTC area of San Juan, Puerto Rico These data

furnished the various Offices and Services of the Federal Aviation Administration with Terminal and en route air traffic activity for use in planning and management of the air traffic control system Author (GRA)

N72-21642# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.
NORTH ATLANTIC SATELLITE ATC-CENTER STUDY Final Report, 18 Aug. 1970 - 19 Apr. 1971
C E. Bading, A W Brownfield, W D. Coulopoulos, R. P Davis, and W. L. Dunham 19 Apr 1971 292 p refs
(Contract DOT-TSC-50)
(PB-204862) Avail: NTIS CSCL 17G

A study of present oceanic ATC methods leads to the conclusion that ATC in the North Atlantic should continue to be based on an organized track concept in those areas where traffic densities are high. However, there is clearly a need to improve communications in the North Atlantic area, and a satellite system can provide both communications and surveillance services. The Satellite Oceanic Control Center (SOCC) described is highly automated In implementing such a system it appears desirable initially to use surveillance data derived from the Inertial Navigation System (INS) and transmitted via data link to the control center Subsequently, independent surveillance data could be implemented by a two-satellite tone ranging scheme, with the aircraft transponding encoded pressure altitude
Author (GRA)

N72-21813# Southwest Research Inst., San Antonio, Tex
INVESTIGATION OF THE EFFECTS OF TRACE METALS ON THE THERMAL STABILITY OF JP-7 FUELS Technical Report, 1 Dec 1970 - 30 Nov. 1971
Larry W Schenk, Robert K Johnston, and Charles M. Monita Wright-Patterson AFB, Ohio AFAPL Dec 1971 38 p refs
(Contract F33615-69-C-1231, AF Proj. 3048)
(AD-736475, SWRI-RS-579, AFAPL-TR-71-98) Avail. NTIS CSCL 21/4

Experimental studies have shown that trace amounts of fuel-soluble metal compounds can be very detrimental to JP-7, a high-quality jet fuel Adverse effects on fuel thermal stability have been demonstrated by gas-drive fuel coker tests on JP-7 fuels containing as little as 15 to 25 parts per billion of added iron or copper, or 100 to 250 parts per billion of added zinc or lead The true threshold concentrations were generally lower, since the added metal tended to disappear from fuel samples during storage and handling The ambiquities in metal content hinder any clear correlation and make it impractical to recommend metal-content limits for fuel quality control GRA

N72-21816*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
OPTIMIZATION OF ENGINES FOR A COMMERCIAL MACH 0.98 TRANSPORT USING ADVANCED TURBINE COOLING METHODS
Gerald A Kraft and John B Whitlow, Jr Mar 1972 71 p refs
(NASA-TM-X-68031; E-6848) Avail NTIS CSCL 21A

A study was made of an advanced technology airplane using supercritical aerodynamics Cruise Mach number was 0 98 at 40,000 feet altitude with a payload of 60,000 pounds and a range of 3000 nautical miles Separate-flow turbofans were examined parametrically to determine the effect of sea-level-static design turbine-inlet-temperature and noise on takeoff gross weight (TOGW) assuming full-film turbine cooling The optimum turbine inlet temperature was 2650 F Two-stage-fan engines, with cruise fan pressure ratio of 2 25, achieved a noise goal of 103 5 EPNdB with todays noise technology while one-stage-fan engines, achieved a noise goal of 98 EPNdB. The take-off gross weight penalty to use the one-stage fan was 6 2 percent
Author

N72-21817*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PERFORMANCE AND CONTROL STUDY OF A LOW-PRESSURE-RATIO TURBOJET ENGINE FOR A DRONE AIRCRAFT
Kurt Seldner, Lucille C Geyser, Harold Gold, Darrel Walker, and Gary Burgner Apr 1972 55 p refs
(NASA-TM-X-2537; E-6688) Avail. NTIS CSCL 21E

The results of analog and digital computer studies of a low-pressure-ratio turbojet engine system for use in a drone vehicle are presented The turbojet engine consists of a four-stage axial compressor, single-stage turbine, and a fixed area exhaust nozzle. Three simplified fuel schedules and a generalized parameter fuel control for the engine system are presented and evaluated The evaluation is based on the performance of each schedule or control during engine acceleration from a windmill start at Mach 0.8 and 6100 meters to 100 percent corrected speed It was found that, because of the higher acceleration margin permitted by the control, the generalized parameter control exhibited the best dynamic performance Author

N72-21819*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
TECHNICAL EVALUATION REPORT ON PROPULSION AND ENERGETICS PANEL 38TH MEETING ON INLETS AND NOZZLES FOR AEROSPACE ENGINES
David N Bowditch and Rodolfo Monti (Naples Univ.) Paris AGARD Feb 1972 6 p refs
(NASA-TM-X-67741, AGARD-AR-41) Avail NTIS CSCL 21A

The application and use of inlets and nozzles in aerospace, V/STOL, and hypersonic propulsion systems are discussed Data cover test techniques and facilities, experimental results from small rig tests to flight tests, and theoretical analysis of propulsion system flows The problems associated with such a system are also discussed E H W

N72-21825# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div
THEORETICAL INVESTIGATION OF OSCILLATORY BLADE ROW AERODYNAMICS UNDER UNSTALLED CONDITIONS
J Stern 28 Oct 1971 34 p Transl into ENGLISH from Strojnicky Cas (Czechoslovakia), v 21, no 3, 1970 p 265-287
(FSTC Proj 6040102)
(AD-735205, FTD-HC-23-862-71) Avail NTIS CSCL 21/5

In order to calculate the critical flutter-speed of compressor and turbine blade systems, it is necessary to carry out the numerical determination of the oscillatory aerodynamic forces and moments acting on a cascade of aerofoils The object of this paper is to give a method for calculating these oscillatory lifts and moments for the case of an infinite, two-dimensional cascade at non-zero incidence Arbitrary stagger and interblade phase-lag angles are permitted The blades are supposed to be flat plates undergoing oscillatory motion consisting of flexural and torsional degrees of freedom This paper presents a natural extension of the Whitehead method to the more general case, in which the aerodynamics of cascade blades under bending-torsion oscillation is treated Author (GRA)

N72-21827# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div
IMPROVEMENT OF THE CALCULATION OF MULTISTAGED TURBINES OF GAS TURBINE ENGINES
V A Strunkin 9 Nov 1971 13 p refs Transl into ENGLISH from Tr Aviats Inst (Kazan), no 115, 1969 p 41-46
(FTD Proj 3066)
(AD-736489, FTD-MT-24-1453-71) Avail NTIS CSCL 21/5

The extension of the author's single stage gas turbine improved designing technique (1969) to the calculation of

parameters in multistage gas turbine designs is shown Expressions and nomograms are given for the translation of the previous results to multistage turbine parameter and component analysis and selection Optimized turbine stage, geometrical characteristics, blade and wheel parameters and multistage gas turbine efficiencies can be determined by using these expressions in computer calculations Author (GRA)

N72-21901# Battelle-Northwest, Richland, Wash Pacific Northwest Labs
ENGINEERING UTILITY AND SIGNIFICANCE OF STRESS CORROSION CRACKING DATA
W E Anderson *In* AGARD Specialist's Meeting on Stress Corrosion Testing Methods Jan 1972 23 p refs

Avail NTIS HC $6 00/MF $0 95

Some historical experiences with cracking and fracture problems are explored to indicate the significance of corrosion acting concomitantly with stress These experiences suggest that cracks develop either in 'open' or 'closed' areas, and, either at regions accessible to the ambient environment and direct view, or, at regions which are structurally hidden Special attention was given to aircraft structures and various other materials Data cover specimen configurations, methods suitable for low cost testing of specimens, and estimates of service life under loading and environmental conditions A definition of stress corrosion is included Author

N72-21939# Watervliet Arsenal, N Y
NONCLASSICAL FORCED MOTION OF STATIONARY AND ROTATING BEAMS WITH TIP MASSES
Struan Robertson Sep 1971 37 p refs
(AD-735683, WVT-7145) Avail NTIS CSCL 20/11

A formal solution, using Williams' superposition principle, is given for the non-classical forced motion problems of stationary and rotating beams with tip masses, where the coupling of flexure and torsion is included in the governing equations Author (GRA)

N72-21941# Lockheed Missiles and Space Co , Palo Alto, Calif Research Lab
AN ASSESSMENT OF CURRENT CAPABILITY FOR COMPUTER ANALYSIS OF SHELL STRUCTURES Final Report, Apr. 1969 - Apr. 1971
Richard F Hartung Wright-Patterson AFB, Ohio AFFDL Apr 1971 246 p refs
(Contract F33615-69-C-1523, AF Proj 1467)
(AD-735726, AFFDL-TR-71-54) Avail NTIS CSCL 20/11

The report contains an assessment of current shell analysis capability The assessment is based on work conducted at the Lockheed Palo Alto Research Laboratory under contract to the Air Force Flight Dynamics Laboratory In addition to surveying the open literature, information for the study was gathered during a series of visits made to organizations throughout the United States at which there is an active shell analysis research effort More than 40 industrial concerns, government agencies and universities have been visited to date During each visit, technical personnel working in the area of shell analysis were interviewed to determine the scope of their present analysis capability, to learn of current research activities and to discuss computer methods of shell analysis in general Information so obtained is summarized in a series of briefs which appear in the Appendix of this report Author (GRA)

N72-21963# Naval Air Engineering Center, Philadelphia, Pa Engineering Dept
INVESTIGATIONS IN SUPPORT OF MK 7 JET BLAST DEFLECTOR COOLING MODULE DESIGN Final Report
F Slavin, W Goon, and M Siegel 17 Jan 1972 309 p refs
(AD-735877, NAEC-ENG-7707) Avail NTIS HC $6 00/MF $0 95 CSCL 13/1

The MK 7 Jet Blast Deflector was designed by the Naval Air Engineering Center to provide control of shipboard flight deck environment for operations with the Fl 4 and other aircraft The study describes the various design, experimental and analytical efforts undertaken to develop the cooling modules for the Jet Blast Deflector System Analytical and experimental techniques were developed to deal with jet exhaust plume velocity-temperature contour maps in order to project the thermal conditions of the untested Fl 4 case Author (GRA)

N72-21969# Waterloo Univ (Ontario) Transport Group
A DOMESTIC MULTI-MODAL GOODS DISTRIBUTION MODEL WITH EMPHASIS ON AIR CARGO
R S Wallace Feb 1971 293 p refs Sponsored in part by NRC of CAN and the Transport Dept , Ottawa
Avail NTIS, Issuing Activity $2 50

The transport role of air cargo is examined in conjunction with its two major competitors, road and rail over the period 1967 to 1987 for Canada An understanding of these modes is provided by examining the historical development of each and the effect governmental regulations and policy decisions have had on their growth A macro-demand model, forecasting the ton-mile freight demand for road, rail, and air services, is developed A model, employing linear graph analysis, is developed to simulate the three mode transport industry First the methodology and computer programs for the system are developed and demonstrated on a three node, two mode hypothetical system A thirty city, three mode model of the nations goods distribution system is then calibrated on destination distribution using the collected base year data Based on the macro forecast and projected cost trends air cargo is predicted to increase its share of the ton-mile market some sixteen times, from less than 0 05% in 1967 to 0 80% in 1987 Author

N72-21970# Waterloo Univ (Ontario) Transport Group
SIMULATING THE TURNAROUND OPERATION OF PASSENGER AIRCRAFT USING THE CRITICAL PATH METHOD
John P Braaksma May 1971 175 p refs Sponsored in part by NRC of Can and the Transport Dept , Ottawa
Avail NTIS, Issuing Activity $2 50

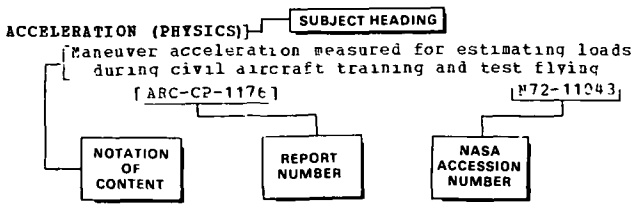
Ways to improve gate utilization at existing airports are studied by developing a simulation model of the turnaround operation The model is based on the critical path method and consists of two components The first is a network which represents the sequence and interrelationships of the turnaround activities The second component is a set of parameters which transforms input data of a particular flight into activity durations Numerical values for the parameters were obtained from an apron time survey conducted at Toronto International Airport The aircraft types surveyed were DC 8L, DC 8, 707, 727L, 727, DC 9, and 737 Similarly the logic of the network was derived from observations on these aircraft made at the same airport The output of the model predicts the turnaround time of a particular flight, identifies the critical path, and gives the spare time or float associated with the noncritical activities The model was tested using two separate sets of data obtained from Toronto and it was demonstrated that it adequately represented the turnaround operations Author

N72-21988# Army Weapons Command, Rock Island, Ill Cost Analysis Office
COST ESTIMATING RELATIONSHIPS FOR AIRCRAFT *ARMAMENT SUBSYSTEM MANUFACTURING LABOR* COST
Patrick J Gannon Sep 1971 38 p refs
(AD-735495, AMSWE-CPE-71-11) Avail NTIS CSCL 19/6

Cost estimating relationships for pintle, side mounted and turret aircraft armament subsystems are described in sufficient detail to allow someone to estimate direct labor plus quality control labor costs given subsystem weight and quantity to be procurred Author (GRA)

SUBJECT INDEX

Typical Subject Index Listing



The subject heading is a key to the subject content of the document The Notation of Content (NOC), rather than the title of the document is used to provide a more exact description of the subject matter The report number helps to indicate the type of document cited (e g NASA report translation NASA contractor report) The accession number is located beneath and to the right of the Notation of Content e g N72-11043 Under any one subject heading the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first

A

A-37 AIRCRAFT
Development of techniques and equipment for determining moment of inertia of aircraft as applied to A-37 and P-1127 aircraft
[PTC-TIM-71-1001] N72-21007

ABLATION
Ablation phase duration during spacecraft decelerated hypersonic reentry flight, using theoretical model based on quasi-steady assumptions
A72-25815

ABLATIVE MATERIALS
Surface patterns from ablating, melting and flowing materials in supersonic flow of wind tunnel, rocket motor and flight test environments, comparing with theory
[AIAA PAPER 72-313] A72-25247

AC GENERATORS
Aircraft cockpit electrical heating system, converting three phase ac energy from alternator with economy and safety
[SAE PAPER 720329] A72-25591

ACCELERATION PROTECTION
Dynamic deceleration anthropomorphic dummy tests of general aviation occupant lap belt/shoulder harness restraint systems
[SAE PAPER 720325] A72-25588

ACOUSTIC MEASUREMENTS
Subsonic jet noise directivity prediction from acoustic pressure measurements
A72-26041
Measurement of spatially coherent and incoherent structure of axial compressor-generated noise modes propagating in duct
[ONERA, TP NO. 1045] A72-28049
Noise measurements of jet augmented lift systems for use on proposed STOL aircraft
[NASA-TN-D-6710] N72-20011

ACRYLIC RESINS
Aircraft fuselage acrylic glazing design, covering passenger cabin window, cockpit windscreen and various surface coatings
A72-27008
Acrylics and polycarbonates properties in aircraft transparencies design, emphasizing cost and optical, mechanical, thermal and chemical properties
A72-27009

ACTUATOR DISKS
Critique of general momentum theory of propeller actuator disk model, showing flow field determination from nonlinear elliptic differential equation solution
A72-25998
Nonlinear integral equations solution for heavily loaded actuator disk induced flow field, taking into account blade tip vortices and thrust coefficient effects
A72-26577

AERIAL RECONNAISSANCE
Experimental aerial gravimetry program to determine feasibility of large scale aerial gravity surveys
[AD-735266] N72-21394

AERIAL RUDDERS
Flight test of direct side force control by rudder deflection and asymmetrical drag on T-33 airplane, noting use in dive bombing
A72-27520
Development of direct side force control on aircraft during flight and application to improved bombing accuracy
[AD-735294] N72-21030

AERODYNAMIC BRAKES
Development and characteristics of parachute fabric for aerodynamic decelerator using lightweight, variable solidity, knitted material
[NASA-CASE-LAR-10776-1] N72-21004

AERODYNAMIC CHARACTERISTICS
Russian book on An-12 turboprop transport aircraft structural and aerodynamic characteristics covering engine operation, piloting, stability, controllability, etc
A72-28343
Aerodynamic characteristics and flow phenomena of supercritical wings near Mach one conditions
[NASA-TT-F-14242] N72-19994
Aerodynamic characteristics of Dornier DO-31 VTOL transport under visual and simulated instrument flight conditions
[NASA-TN-D-6754] N72-20012
Aerodynamic characteristics of experimental aircraft FA-200XS
[RAE-LIB-TRANS-1606] N72-20013
Aerodynamic characteristics and problems encountered in design of TU-144 supersonic aircraft
[NASA-TT-F-14206] N72-20014
Aerodynamic and mechanical design of two-stage, highly-loaded fan for advanced aircraft, and tests with uniform and distorted inlet flow
[NASA-CR-120859] N72-20763
Vortex ring method used for calculations of aerodynamic characteristics of helicopter lifting rotors at any angle of attack in flow with comparatively high velocity
[AD-735439] N72-20973
Flight test procedures for determining stall and spin characteristics of high performance aircraft
N72-20979
Development of flight test procedures for use with advanced aircraft to determine cruise performance characteristics
N72-20985
Techniques and procedures for conducting flight tests of lifting body type aircraft during transonic and supersonic flight conditions
[NASA-TM-X-68306] N72-20986
Determination of performance data and stability and control characteristics from aircraft performance under nonsteady flight conditions
N72-20992
Wind tunnel tests of M2-F2 lifting body entry configuration at transonic and supersonic speeds and selected Reynolds numbers
[NASA-TM-X-2511] N72-21005
Blade stress analysis, wind tunnel models, and test procedures for investigating conversion process of

B

C

D

E

F

G

H

I

J

L

M

N

O

P

Q

R

S

T

U

V

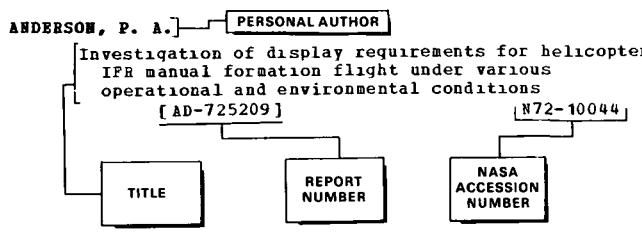
W

X

Y

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author The title of the document provides the user with a brief description of the subject matter The report number helps to indicate the type of document cited (e g NASA report, translation, NASA contractor report) The accession number is located beneath and to the right of the title e g , N72-10044 Under any one author's name the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first

A

ABDELHAMID, A. N.
Unsteady forces and noise from fan-in wing model in cross flow.
[ASME PAPER 72-GT-92] A72-25666

ABERNATHY, F. A.
An estimate of the power required to eliminate trailing vortices by suction
[IDA-LOG-HQ-69-10164] N72-21290

ADAMS, G. D.
Evaluation of STOL instrument landing system (TALAR 4)
[FAA-RD-72-15] N72-20587

AKSENOV, A. F.
Certain features of the metal friction process in an aviation-fuel environment
A72-28183

ALLEN, R.
Aspects of structural safety in general aviation airplanes.
[SAE PAPER 720308] A72-25572

ALLIEGRO, R. A.
Reaction bonded silicon carbide and silicon nitride for gas turbine applications.
[ASME PAPER 72-GT-20] A72-25619

ANDERS, S.
Calculation of body interference loads for wing-body combinations at Mach numbers 1.59 to 7.15 with supersonic linear theory, part 1
[FFA-AU-635-PT-1] N72-19995

ANDERSEN, L. Q.
The use of a powered model for subsonic nacelle optimization.
[ASME PAPER 72-GT-14] A72-25613

ANDERSON, W. E.
Engineering utility and significance of stress corrosion cracking data
N72-21901

ANTHONY, D.
AFCRL's experimental aerial gravimetry program
[AD-735266] N72-21394

ANTHONY, F. M.
Design of a convective cooling system for a Mach 6 hypersonic transport airframe.
[AIAA PAPER 72-334] A72-25369

APPLEGARTH, A. B., JR.
Weather radar for single engine aircraft.
[SAE PAPER 720315] A72-25579

ARCHER, D. D.
Stability and control 747 flight testing
N72-20977

ARGYRIS, J. H.
Application of interactive computer graphics to the calculation of aircraft structures
N72-20196

ARMITAGE, H. B.
Pilot evaluation of the C-5 Category III weather operation.
A72-27521

ASHTON, J. E.
Design, analysis, and testing of an advanced composite F-111 fuselage.
A72-25453

ASTRIDGE, D. G.
Heat generation in high-speed cylindrical roller bearings.
A72-28111

AYFORD, D. N.
A case study of a high level Canberra flight on 11 September 1968.
A72-27709

AYERS, T. G.
The NASA Advanced Transport Technology Program.
[SAE PAPER 720319] A72-25582

B

BABURIN, V. I.
The center of gravity of the spectrum of the received signal and the effective antenna centers of a Doppler-type velocity meter.
A72-26730

BADGER, D. V.
Shot peen forming of wing skins for the Boeing 747.
[ASM PAPER W 72-31,4] A72-28160

BADING, C. E.
North Atlantic satellite ATC-center study
[PB-204862] N72-21642

BAKER, R. C.
Assessment of aircraft emission control technology
[PB-204878] N72-21017

BALE, Y. S.
Feasibility study of a radial inflow compressor.
[ASME PAPER 72-GT-52] A72-25644

BALMER, R. J.
The Harrier - Some aspects of V/STOL stability and control flight testing
N72-20980

BALTZER, R. T.
Impingement cooling performance in gas turbine airfoils including effects of leading edge sharpness.
[ASME PAPER 72-GT-7] A72-25610

BAMMERT, K.
Boundary layers on rough compressor blades.
[ASME PAPER 72-GT-48] A72-25640

BARBER, M. R.
Flight evaluations of the effect of advanced control systems and displays on the handling qualities of a general aviation airplane.
[SAE PAPER 720316] A72-25580

BARBER, V. C.
Design of unsurfaced soil facilities for operations of C-5A aircraft
[AD-735344] N72-21398

BARCHE, J.
Unsolved problems of airplane aerodynamics
[NASA-TT-F-14208] N72-19993

BARNES, R. L.
Pulse operated, multichannel annunciator.
[SAE PAPER 720333] A72-25593

BASTRESS, E. K.
Assessment of aircraft emission control technology
[PB-204878] N72-21017

BATES, H. E.
Design study of general aviation collision avoidance

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

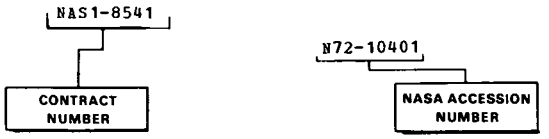
W

Y

Z

CONTRACT NUMBER INDEX

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

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037 (20)		

4. Title and Subtitle	5. Report Date
AERONAUTICAL ENGINEERING A Special Bibliography (Supplement 20)	July 1972
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address	11. Contract or Grant No.
National Aeronautics and Space Administration Washington, D. C. 20546	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This special bibliography lists 437 reports, articles, and other documents introduced into the NASA scientific and technical information system in June 1972.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aerodynamics Aeronautical Engineering Aeronautics Bibliographies	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	136	$3.00 HC

*For sale by the National Technical Information Service, Springfield, Virginia 22151

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA deposits its technical documents and bibliographic tools in eleven special regional libraries located in the organizations listed below. Each library is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

CALIFORNIA
University of California, Berkeley
COLORADO
University of Colorado, Boulder
DISTRICT OF COLUMBIA
Library of Congress
GEORGIA
Georgia Institute of Technology, Atlanta
ILLINOIS
The John Crerar Library, Chicago
MASSACHUSETTS
Massachusetts Institute of Technology, Cambridge
MISSOURI
Linda Hall Library, Kansas City
NEW YORK
Columbia University, New York
PENNSYLVANIA
Carnegie Library of Pittsburgh
TEXAS
Southern Methodist University, Dallas
WASHINGTON
University of Washington, Seattle

NASA publications (those indicated by an "*" following the accession number) are also received by the following public and free libraries

CALIFORNIA
Los Angeles Public Library
San Diego Public Library
COLORADO
Denver Public Library
CONNECTICUT
Hartford Public Library
DELAWARE
Wilmington Institute Free Library, Wilmington
MARYLAND
Enoch Pratt Free Library, Baltimore
MASSACHUSETTS
Boston Public Library
MICHIGAN
Detroit Public Library
MINNESOTA
Minneapolis Public Library
MISSOURI
Kansas City Public Library
St. Louis Public Library
NEW JERSEY
Trenton Public Library
NEW YORK
Brooklyn Public Library
Buffalo and Erie County Public Library
Rochester Public Library
New York Public Library
OHIO
Akron Public Library
Cincinnati Public Library
Cleveland Public Library
Dayton Public Library
Toledo Public Library
OKLAHOMA
Oklahoma County Libraries, Oklahoma City
TENNESSEE
Cossitt-Goodwin Libraries, Memphis
TEXAS
Dallas Public Library
Fort Worth Public Library
WASHINGTON
Seattle Public Library
WISCONSIN
Milwaukee Public Library

An extensive collection of NASA and NASA-sponsored documents and aerospace publications available to the public for reference purposes is maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York, 10017.

EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the National Lending Library for Science and Technology, Boston Spa, Yorkshire, England. By virtue of arrangements other than with NASA, the National Lending Library also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from. ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av. Charles de Gaulle, 92-Neuilly-sur-Seine, France.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA TECHNOLOGY UTILIZATION PUBLICATIONS

These describe science or technology derived from NASA's activities that may be of particular interest in commercial and other non-aerospace applications. Publications include:

TECH BRIEFS: Single-page descriptions of individual innovations, devices, methods, or concepts

TECHNOLOGY SURVEYS Selected surveys of NASA contributions to entire areas of technology.

OTHER TU PUBLICATIONS: These include handbooks, reports, notes, conference proceedings, special studies, and selected bibliographies.

Details on the availability of these publications may be obtained from:

National Aeronautics and
Space Administration
Code KT
Washington, D.C. 20546

Technology Utilization publications are part of NASA's formal series of scientific and technical publications. Others include Technical Reports, Technical Notes, Technical Memorandums, Contractor Reports, Technical Translations, and Special Publications.

Details on their availability may be obtained from:

National Aeronautics and
Space Administration
Code KS
Washington, D.C. 20546

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C. 20546