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A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 70

MAY 1976

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NASA SP-7037 (70)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 70

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in April 1976 in

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INTRODUCTION

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

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 222 reports, journal articles, and other documents originally announced in April 1976 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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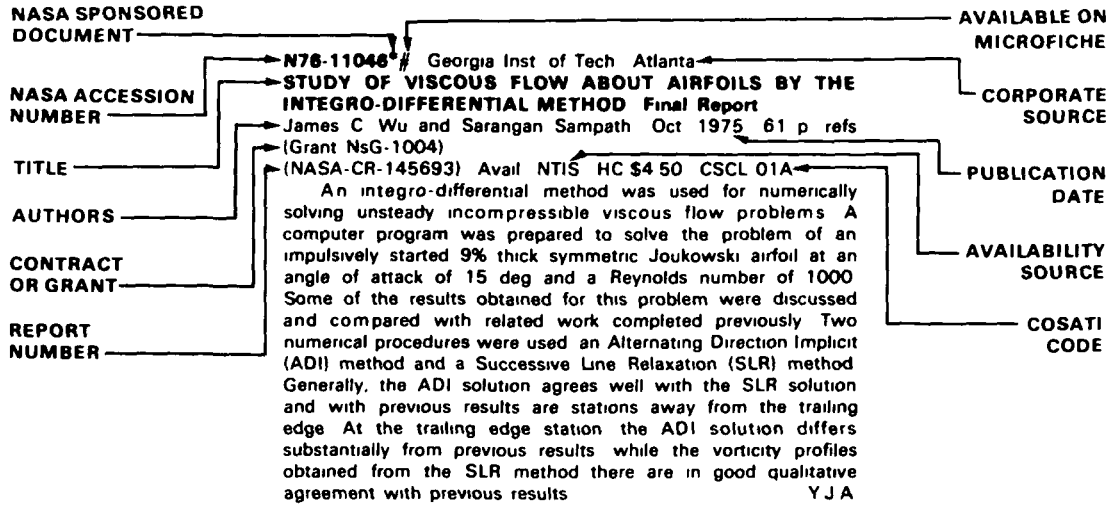

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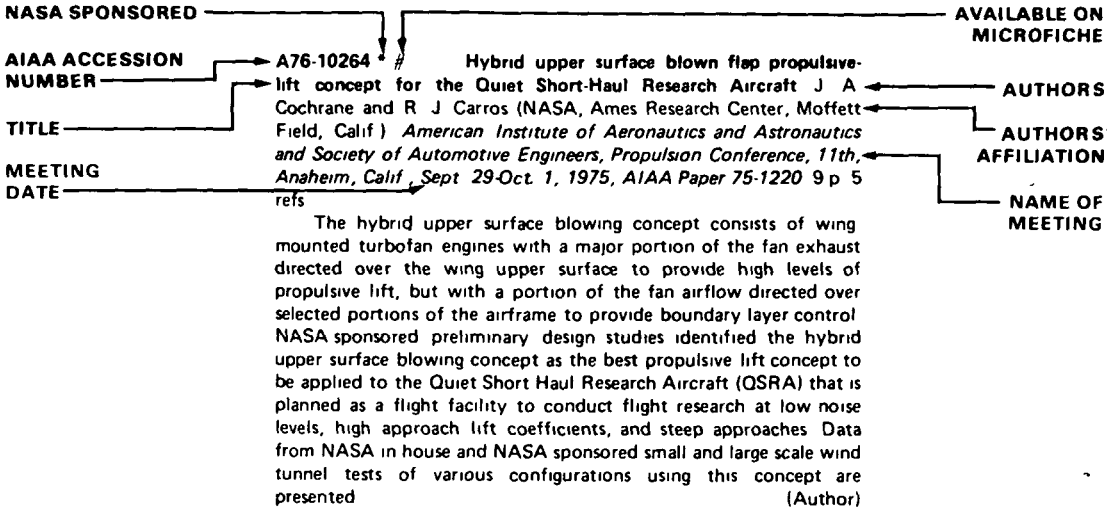

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 70)

MAY 1976

IAA ENTRIES

A76-18960 **Study of the stability of an estimator of intensity in aircraft noise metrology (Etude de la stabilité d'un estimateur de puissance en metrologie des bruits d'avion)** M Ernoult, J Hay (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France), and O Macchi (Paris XI, Universite, Orsay, Essonne, CNRS, Paris, France) *(Comité National Français de Radioélectricité Scientifique, Colloque sur l'Analyse des Signaux Non Stationnaires, Paris, France, Feb. 7-9, 1975) Annales des Télécommunications,* vol 30, July-Aug 1975, p 298-303 5 refs In French

The general problem of estimating noise intensity at the output of an analyzing filter is examined on the basis of a simplified model of unstable noise The definition of an ideal estimator of output noise intensity when the input is a stable Gaussian white noise is presented An experimental study employing an analog bandpass filter and then a digital filter is designed to estimate the intensity for a stable input which deviates slightly from white noise B J

A76-19100 # **Aerodynamic excitation of torsional vibrations in turbomachinery blading (Aerodinamicke uzbude torzijskih vibracija lopatica turbostrojeva)** M Butkovic (JUGOTURBINA, Zdruzeno Poduzece, Karlovac, Yugoslavia) *Strojarstvo,* vol 17, no 5, 1975, p 229 233 33 refs In Serbo Croatian

The article surveys aerodynamic forces exciting vibrations, particularly torsional vibrations in turbine blading Four major modes of turbomachinery blade flutter are distinguished (classical flutter, cascade flutter, rotational stall, shock flutter) The effect of the number of blades in a packet (two to twenty, with the shroud forged, welded, or wired) on the resultant excitation moment is examined Quantitative calculations are considered for the major modes of excitation due to viscous aerodynamic wakes downstream of the stator blades A flow disturbance traveling in phase through the blading at certain combinations of blade width, spacing, and convex and concave contour configurations, is examined R D V

A76-19121 # **Flow over rectangular cylinders immersed in a turbulent boundary layer I - Correlation between pressure drag and boundary-layer characteristics** M Arie, M Kiya, H Tamura (Hokkaido University, Sapporo, Japan), and Y Kanayama (Yoshida Kogyo Co , Ltd , Japan) *JSME, Bulletin,* vol 18, Nov 1975, p 1260-1268 20 refs

Measurements of the pressure distribution on two-dimensional rectangular cylinders are correlated with the characteristics of a smooth wall turbulent boundary layer in which the cylinders are immersed The contribution of shear stress on the horizontal upper surface of the cylinders to total drag is estimated to be a few per cent at most over the entire range of the width-to-height ratios tested For flows with zero pressure gradient, correlations for the variation of pressure drag with the height of the cylinder are obtained which are analogous in form to the law of the wall for the boundary layer velocity profile The coefficients of the law of the wall for the drag are functions of the width-to-height ratio of the cylinder The contribution of base pressure to the pressure drag coefficient is found to be sensitive to the width-to-height ratio of the cylinders, while that of the pressure on the upstream face is almost constant over the entire range of the width-to-height ratios treated in this investigation (Author)

A76-19122 # **Flow over rectangular cylinders immersed in a turbulent boundary layer II - Flow patterns and pressure distributions** M Arie, M Kiya, H Tamura (Hokkaido University, Sapporo, Japan), M Kosugi (Canon Co , Ltd , Japan), and K Takaoka (Hakodate Dock Co , Ltd , Japan) *JSME, Bulletin,* vol 18, Nov 1975, p 1269-1276 10 refs

The present paper describes the flow patterns around rectangular cylinders immersed in a turbulent boundary layer and the pressure distribution on the surface of the cylinders The effect of three parameters - the ratio of cylinder height to boundary-layer thickness, the ratio of shear velocity to free-stream velocity, and the cylinder width-to height ratio - on the pressure distribution is examined in some detail Three sets of measurements of the mean flow and turbulence are presented for the width to-height ratios of 2 0 and 4 0 with cylinder height to boundary-layer thickness ratios of 1 13 and 0 551 It is shown that the mean velocity profiles in the rear separation eddy are closely approximated by the velocity profile in a constant-pressure half-jet theoretically obtained by Goertler (1942), that the base pressure of the cylinders can be correlated with their height in the form of a wall law, and that the pressure distribution on the upstream face of the cylinders can be represented by a single curve, irrespective of the width to-height ratio and boundary-layer characteristics (Author)

A76-19130 # **A design synthesis program for business jet aircraft** D E Salguero (Texas, University, Austin, Tex) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 12th, Washington, D C , Jan 28-30, 1976, Paper 76-216* 7 p 5 refs

A computer program, which combines the various technical disciplines for a sizing or performance analysis, is discussed Emphasis is placed on its development and use as an educational tool for teaching aircraft design The organization of the program is discussed, along with features which were incorporated to make it more useful in the classroom Then, brief descriptions of the methods and the limitations of the program are given Use of the program is demonstrated by the simulation of an existing business jet aircraft and an example where geometrical design parameters have been varied The program is currently being used in the design course at the University of Texas at Austin and its usefulness as an educational tool appears promising (Author)

A76-19131 # **Studies of a new family of general aviation airfoils.** D H Van Tassel (Beech Aircraft Corp , Wichita, Kan) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 12th, Washington, D C , Jan 28-30, 1976, Paper 76-217* 6 p 9 refs

Studies of a family of general aviation airfoil sections based upon the NASA GA(W)-1 airfoil have been initiated This family of sections is formed by a matrix of sixteen airfoils The matrix is created by applying four thicknesses and four design lift coefficients The thicknesses which were applied in these studies vary from 9 to 21 percent chord The design lift coefficients which were applied in

these studies vary from 0 00 to 1 00 The studies are based on the analysis of output from a computer program which predicts the important aerodynamic characteristics of airfoils in two-dimensional viscous flow Analysis of these predictions is discussed and presented as plots The effect of camber and the effect of thickness on the aerodynamic characteristics agree well with the accepted standards presented by Abbott and von Doenhoff (Author)

A76-19149 Mean and turbulent characteristics of the wake of a flat plate heated on one of its sides (Caractéristiques moyennes et turbulentes du sillage d'une plaque plane chauffée sur une de ses faces) R Morel, J -P Schon, and J Mathieu (Ecole Centrale Lyonnaise, Ecully, Rhône, France) *Académie des Sciences (Paris), Comptes Rendus, Serie B - Sciences Physiques*, vol 281, no 23, Dec 15, 1975, p 567-570 In French

An experiment was conducted to measure the kinematic and thermal characteristics of the two-dimensional near wake of a symmetrical airfoil heated on one of its sides The wake is formed by the conjunction of two boundary layers on the airfoil A pitot tube and hot-wire anemometer were used to measure the mean characteristics which consisted of mean velocity and mean temperature, and the turbulent characteristics which consisted of fluctuations of longitudinal velocity, and temperature fluctuations B J

A76-19254 # Flow-induced vibrations of structures M M Sevik (U S Naval Material Command, Ship Research and Development Center, Bethesda, Md) In Seminar on the Vibration of Damped Structures, University Park, Pa , September 22-26, 1975, Proceedings University Park, Pa , Pennsylvania State University, 1975 81 p 63 refs

The problem of time-dependent forces due to separated flows is considered, taking into account structural excitation produced by wake instabilities A description of theoretical and experimental studies is presented Experimental studies have been conducted with respect to the dominant vortex shedding frequency and the unsteady lift and drag forces on circular cylinders Questions concerning mutual interference effects in the case of interacting cylinders and tube bundles are also discussed and attention is given to the aeroelastic oscillations of cylinders G R

A76-19256 # Reduction of the flow-induced vibration of complex structures R H Scanlan (Princeton University, Princeton, N J) In Seminar on the Vibration of Damped Structures, University Park, Pa , September 22 26, 1975, Proceedings University Park, Pa , Pennsylvania State University, 1975 20 p

The nature of flow-induced vibration in a man-made object which is located within a fluid medium is considered, taking into account difficulties regarding an analysis on the basis of the Stokes-Navier equations and approaches utilizing analytical models Typical fluid-structure interaction phenomena are examined, giving attention to classical flutter, stall flutter, panel flutter, galloping, subspan cable oscillation vortex shedding, and turbulence induced effects Approaches are discussed which make it possible to reduce flow-induced vibration by means of an alteration or elimination of the considered interaction phenomena G R

A76-19310 # Engine technology - New maintenance concepts J F Coplin *Royal Aeronautical Society, Symposium on the Changing Balance of Design Requirements and How Designers are Reacting to It, London, England, Feb 26, 1975, Paper* 16 p

Some design concepts related to good maintainability are reviewed for the Rolls Royce RB 211 aircraft engine Emphasis is on the modular concept of design which splits the engine up into seven major subassemblies or modules, all of which is intended to achieve cost reduction and a reduction in overlay needed to keep a fleet of engines serviceable Master chip detectors for monitoring the lubrication system, and boroscopes for in flight monitoring are discussed The flight deck engine instrumentation for engine performance trend plotting is described The vibration indicator is briefly discussed, as are accessibility and transportability features of the modular maintenance concept B J

A76-19575 # Investigation of the aerodynamic characteristics of a ram wing T -H Lin, Y -K Dai, Y -L Li, F -H Nich, and W -C Lo *Tsing Hua University and Peking University, Journal, Section on Science and Technology*, vol 1, Oct 1974, p 54-72 6 refs In Chinese

The design of ram-wing surface effect machines is essentially based on the aerodynamic characteristics of the wing, and so far no satisfactory calculation for such characteristics has been achieved An attempt is made to develop on the basis of incompressible flow theory an effective method for predicting the aerodynamic characteristics of a ram wing The effect of nonlinearity in boundary conditions on the lift of the wing is identified, and the aerodynamic stability of the wing is analyzed for a range of angles of attack C K T

A76-19585 Concorde noise levels - Are they acceptable *Noise Control, Vibration and Insulation*, vol 6, Dec 1975, p 374 383

The article includes the Oct 13, 1975 press notice from the UK Dept of Trade on Concorde noise monitoring and the Oct 13, 1975 British Aircraft Corp news release on Concorde noise measurements in flights in and out of Heathrow airport, the Greater London Council Oct 17, 1975 report (noise level survey, monitoring of Concorde noise at 33 locations near Heathrow, noise abatement procedures and opportunities, conclusions and recommendations), and the Oct 20, 1975 statement by British Aircraft Corp An editorial comment is appended to the reports R D V

A76-19593 * # Improving aircraft energy efficiency F P Povinelli, J M Klineberg, and J J Kramer (NASA, Office of Aeronautics and Space Technology, Aircraft Energy Efficiency Office, Washington, D C) *Astronautics and Aeronautics*, vol 14, Feb 1976, p 18-31

Investigations conducted by a NASA task force concerning the development of aeronautical fuel-conservation technology are considered The task force estimated the fuel savings potential, prospects for implementation in the civil air-transport fleet, and the impact of the technology on air-transport fuel use Propulsion advances are related to existing engines in the fleet, to new production of current engine types, and to new engine designs Studies aimed at the evolutionary improvement of aerodynamic design and a laminar flow control program are discussed and possibilities concerning the use of composite structural materials are examined G R

A76-19597 # Landing on a cushion of air J H Brahney (USAF, Wright-Patterson AFB, Ohio) *Astronautics and Aeronautics*, vol 14, Feb 1976, p 58-61

The possibilities for a utilization of the Air Cushion Landing System (ACLS) are examined The military potential for the U S lies in tactical transport and search and rescue Commercial applications are related to water-based, short haul, intercity service ACLS can operate on the ice of the far North of Canada A description of ACLS design characteristics is given and details of an exploratory test program are discussed G R

A76-19598 # Short-range transports to save fuel G Corning and P Sampath (Maryland, University, College Park, Md) *Astronautics and Aeronautics*, vol 14, Feb 1976, p 62-64 Research supported by the University of Maryland

An investigation was conducted concerning the possibilities to save fuel by using an aircraft designed specifically for the 500-mi range It was found that 7 5% or more fuel could be saved by using such an aircraft in place of a 737-200 It is pointed out that the smaller operating weight of the 500-mi aircraft would also result in lower direct operating costs G R

A76-19708 **Aircraft noise-sound reduction techniques** J B Barriage (FAA, Office of Environmental Quality, Washington, D C) *Aviation, Space, and Environmental Medicine*, vol 47, Jan 1976, p 55-59

Following a review of short and long-term environmental goals for reducing the detrimental impact of aircraft noise on individuals and communities, various noise source reduction techniques are discussed The alternatives which were analyzed are retrofit of all JT3D and/or JT8D-powered aircraft with new nacelles containing sound-absorption material, retrofit of all JT8D powered aircraft with refanned engines and new nacelles, modified approach procedures (two-segment), modified takeoff procedures (thrust cutback), and acquisition of land within the NEF 40 contour (NEF = Noise Exposure Forecast) The costs and effectiveness of the options obtained through comparison of the cost and effectiveness of the aeronautical alternatives are summarized in graphic form Benefit cost analysis which provides a conceptual framework within which alternatives can be compared on the basis of expressing both cost and benefit in a common monetary unit is discussed S D

A76-19779 # **Experimental investigation of the effect of ambient conditions on the acceleration of gas-turbine engines (Eksperimental'noe issledovanie vliianiia uslovii okruzhaiushchei sredy na razgon G T D)** L F Zubarev (Universitet Druzhby Narodov, Moscow, USSR) and I K Shatalov *Mashinostroenie*, no 9, 1975, p 115 118 In Russian

Experiments are performed on a two-spool free turbine gas-turbine engine (turbocompressor 23,500 rpm, power turbine 12,000 rpm, output 220 6 kW, gas temperature upstream of turbine 1023 K) Test results are referred to standard conditions on the basis of similitude formulas When the characteristic of the automatic acceleration control is linear, programmed fuel feed is made dependent on the pressure difference at the compressor exit and ambient pressure A formula is derived for nonlinear automatic acceleration control characteristics All rapidly varying parameters are recorded by oscillograph and studied The gas temperature upstream of the compressor turbine is found from the measured gas temperature between the turbines and from the pressure drop across the compressor turbine R D V

A76-19824 **Graphite/epoxy landing gear environmental tests** P F Dexter (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) *SAMPE Quarterly*, vol 7, Jan 1976, p 39-45 6 refs

The ability of graphite/epoxy composite landing gear hardware to hold up under prolonged operational conditions was studied Specifically, the tests determined whether or not strength degradation occurred as a result of exposure to moisture, heat, or any other environment The tests were designed to simulate accelerated aging and worst real-life conditions in order to establish confidence in hardware fabricated from graphite/epoxy composite (Author)

A76-19931 # **Problem of the landing of a flight vehicle with a controlled shock absorber (O zadache posadki letatel'nogo apparata s upravliaemoi amortizatsiei)** N V Gerasimov *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela*, Sept-Oct 1975, p 58-62 In Russian

Analytic control theory is applied to the optimal change of viscous resistance in the shock absorber during the landing of a flight vehicle with arbitrary vertical landing speed, lift force, and landing weight Optimal control in this case means that the absorption of the kinetic energy of the first landing impact is accomplished with minimal overload, and the recovery of the vehicle to static stability is accomplished in minimal time without the presence of vertical oscillations A shock absorber with programmed control of the dissipative force has been tested on an aircraft landing simulator B J

A76-20109 # **The supercritical wing experimental programme** B Moeken *Dornier-Post* (English Edition), no 3 4, 1975, p 8-10

A program for the development of a supercritical airfoil and investigation of its aerodynamic and mechanical properties is outlined In addition to its design with supercritical sections, the wing is equipped with maneuvering flaps to extend the absolute maneuvering limits in a typical flight speed regime between Mach numbers 0 5 and 0 8 The wing is designed for flight testing on the Alpha Jet without requiring modification of the fuselage and tail unit The leading edge of the supercritical wing is extended forward at the wing-fuselage junction to improve the area distribution over that of the production aircraft wing The thickness/chord ratio is increased to 12% Preliminary wind tunnel tests on a complete model of 1 5 scale are in progress Wind tunnel tests on a full scale half wing incorporating the frozen design will be followed by initial flight tests to open the flight envelope and define the major performance characteristics C K D

A76-20110 # **Modern fibre technology** M Flemming *Dornier Post* (English Edition), no 3 4, 1975, p 11 13

Various applications of fiber reinforced plastics are discussed, with particular attention given to the design and construction of structures using carbon fiber reinforced plastics (CRP) The good specific strength and stiffness properties of CRP are exploited in the design of a horizontal tail unit for the Alpha Jet An antenna reflector for space applications is under construction to take advantage of the extremely low coefficient of expansion of carbon fiber A boat utilizing a fiber-reinforced plastic skin stretched over an aluminum frame has been constructed with substantial weight and cost savings over the corresponding metal and wood model An extensive structural analysis system using a finite element technique has been extended for use in fiber technology, allowing the prediction of cracks in fiber layers that will ultimately result in rupture of the part A program is under way to confirm the method and to determine the general test parameters required for it C K D

A76-20125 # **The French connection** *Aircraft Engineering*, vol 48, Jan 1976, p 13, 16-18, 20

The utilization of British numerical control (NC) machine tools in the production of Concorde components of advanced design is discussed Continuous path control was used in machining complex curves in wing ribs, spars, fuselage bulk-heads, and templates The Cramic milling machines were equipped with a Ferranti electronic control system with magnetic punched tape data input Dimensions from numerical component drawings, in which all change points are given as Cartesian coordinates, and coded data regarding machining sequence and feed rates served as input to a general-purpose computer which calculated the tool center paths A digital differential analyzer subsequently translated these calculations into electrical signals, which were recorded on magnetic tape to control cutter movements The NC machines displayed high accuracy (a deviation of 0 002 in from the theoretical profile) in comparison with copy millers and manually controlled routers Substantial time savings, due to the use of optimum feed rates at all points and the shortening of 'lost' motions, were attained C K D

A76-20139 # **Mutual relationship of factors determining the development of aircraft engine service life (Vzaimosviaz' faktorov, opredeliaiushchikh razvitie resursa aviadvigatelei)** P A Viter In Aspects of economics and production management in mechanical engineering Kazan, Kazanskii Aviatsionnyi Institut, 1973, p 3-7 In Russian

A four-part diagram is presented specifying methods of improving the service life of engines for transport aircraft The first part is devoted to preliminary engine testing, including ground-based and flight fatigue tests, and engine maintainability and controllability The second part is devoted to ensuring the long service life of structural members, including means for optimizing structural strength and for predicting fatigue life The third part is devoted to reliability engineering, including quality control, production stability, preliminary decision making, reliability testing, and data manage-

ment The fourth part is devoted to operational safety, including failure analysis and servicing B J

A76-20140 # **Permissible cost limits for improving a structure for various criteria of effectiveness (Dopustimye predely zatrat na uluchshenie konstruktsii pri razlichnykh kriteriiakh effektivnosti)** M K Nasyrov In Aspects of economics and production management in mechanical engineering Kazan, Kazanskii Aviatsionnyi Institut, 1973, p 8 11 In Russian

Criteria of relative and absolute cost effectiveness are used to set cost limits for improving aircraft structures The analysis is applied to the evaluation of a mechanism for engines of the Il-62, which provides augmented thrust B J

A76-20142 # **Optimal relations between the final design stage and the initial mass production of aircraft engines (Optimal'nye sootnosheniia stadii konstruktorskoi otrabotki i nachala seriinogo proizvodstva aviadvigatelei)** R M Gazizov In Aspects of economics and production management in mechanical engineering Kazan, Kazanskii Aviatsionnyi Institut, 1973, p 17 20 In Russian

An economico mathematical model based on relative criteria of cost effectiveness is used to provide an optimal scheme for the production of aircraft engines The model, which incorporates the finishing stage and the beginning of mass production, would greatly decrease production time, lead to somewhat increased production costs, decrease prices in the long run after short term increases due to increased production costs, and increase service life B J

A76-20143 # **Constructional-technological characteristics of gas turbine engines and technical optimization of production (Konstruktivno-tekhnologicheskie osobennosti GTD i tekhnicheskoe sovershenstvovanie proizvodstva)** Iu N Bloshchitsyn, P A Viter, and R M Gazizov In Aspects of economics and production management in mechanical engineering Kazan, Kazanskii Aviatsionnyi Institut, 1973, p 21 24 In Russian

Data on optimization of production is presented for gas turbine engines of the Tu 104, Tu 154, and Il-62 aircraft It is shown that the creation of a base engine leads to the reorganization of processing and control processes along the entire technological cycle The technology of metallurgical and mechanical production destined for the optimization of engine structural strength is examined B J

A76-20184 # **A nonlinear design theory of supercavitating cascades** B Yim and L Higgins (U S Naval Material Command, Ship Research and Development Center, Bethesda, Md) *(American Society of Mechanical Engineers, Cavity Flow Symposium, Minneapolis, Minn , May 5-7, 1975) ASME, Transactions, Series I - Journal of Fluids Engineering,* vol 97, Dec 1975, p 430-437, Discussion, p 437, 438, Authors' Closure, p 438 19 refs

A nonlinear method of finding two-dimensional supercavitating sections in a cascade is developed The load distribution is taken from linear theory for low drag supercavitating foils in a cascade The double spiral vortex model is used for the cavity termination Linear and nonlinear theories are compared with special emphasis put on analyzing the blunt leading edge The foil-cavity shape, the cavity drag and the cavitation number can be obtained by a computer program from the given cavity length and geometrical parameters of the cascade (Author)

A76-20224 * **Wake-related sound generation from isolated airfoils** L T Clark (Boeing Co , Renton, Wash), J D Chalupnik (Washington, University, Seattle, Wash), and B Hodder (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) *Acoustical Society of America, Journal,* vol 59, Jan 1976, p 24-30 10 refs Grant No NGR 48-002-144

A model for the prediction of wake related sound generation by a single airfoil is presented which assumes that the net force fluctuation on an airfoil can be expressed in terms of the net momentum fluctuation in the near wake of the airfoil The model predicts a forcing function for sound generation which is related to the spectra of the two-point velocity correlations in the turbulent region near the airfoil trailing edge Cross spectra were obtained from correlations of the longitudinal and transverse components of turbulence in the wake of a 36 in chord airfoil in a wind tunnel using x probe hot wire sensors Additional data were obtained from a 10 in chord airfoil in a free jet facility Based on results from these tests, a scaling model was developed using the turbulent boundary layer thickness as the primary length measure The model was used to predict the sound radiated from a 2 in chord airfoil for which acoustical data was available, good agreement was obtained both in level and spectral shape The single airfoil result is extended to a rotor geometry, and comparisons are studied for various aerodynamic parameters (Author)

A76-20319 **Grumman still flies for Navy, but it is selling the world** L Kraar *Fortune,* vol 93, Feb 1976, p 78-83, 142

The paper gives an account of some of the problems encountered by Grumman in recent years, culminating in the decision in 1974 by Congress to cut off Federal financing, and describes how since then the company has recovered by expanding its foreign sales program The politics involved in this activity both with regard to the U S government and the foreign governments is discussed The efforts of the company to use military exports as an entry into foreign markets for its widening line of commercial products are examined P T H

A76-20476 # **Similarity in the turbulent near wake of bluff bodies** R K Sullerey, A K Gupta (Indian Institute of Technology, Kanpur, India), and C S Moorthy *AIAA Journal,* vol 13, Nov 1975, p 1425 1429 20 refs

An experimental investigation has been carried out in the turbulent near wakes of several two-dimensional and axisymmetric bluff body models in the Reynolds number range of 11300-50000 For a 2 D wedge, the effect of varying the blockage ratio up to 25% has also been studied Based on the locations of minimum pressure and maximum reverse velocity on the wake axis, characteristic length and velocity scales are suggested for both 2 D and axisymmetric near wakes Using these scales, similarities in the distributions of static pressure and velocity defect are shown to exist for various models, including those with high blockage ratios The dependence of these scales on model bluffness and blockage ratio is discussed The difference between the near wakes of 2-D and axisymmetric bluff models appears as the opposite variations of the characteristic length scale and the length of the recirculation region with the minimum pressure coefficient In the 2 D case these lengths decrease with the minimum pressure coefficient, while in the axisymmetric case they increase with it (Author)

A76-20480 # **Turbulent boundary-layer growth over a longitudinally curved surface** R N Meroney (Colorado State University, Fort Collins, Colo) and P Bradshaw (Imperial College of Science and Technology, London, England) *AIAA Journal,* vol 13, Nov 1975, p 1448-1453 26 refs Ministry of Defence Contract No AT/2037/0102, Contract No N00014-68-A-0493-0001 NR Project 062-414

Measurements are reported for turbulent boundary-layer growth in a prolonged bend where the additional rates of strain produced by streamline curvature influence the turbulent development The growth rate of the boundary-layer thickness over the convex side is almost halved and the skin friction coefficient falls to about 0 9 of the value expected on a plane surface The mixing rate on the concave side is increased to about 1 1 times the plane surface value, and the customary evidence of longitudinal rolls appears These measurements are the first since those of Schmidbauer's (1936) to provide a test of existing curvature correction formulas for curvatures typical of airfoils and turbomachinery without the complications of compressibility Results have been compared against calculation techniques proposed by Bradshaw (1973), with good agreement (Author)

A76-20493 # **Radiation from panels as a source of airframe noise** E H Dowell (Princeton University, Princeton, N J) *AIAA Journal,* vol 13, Nov 1975, p 1529, 1530 14 refs

The paper analyzes far-field noise generated by vibrating airframe panels which are excited by a near field sound source such as a turbulent boundary layer or separated flows due to flap or spoiler deployment The single structural mode approximation with a uniform spatial pressure distribution given by Miles (1956) is used to investigate the excitation of panels by near field (random) pressures The results of Morse and Ingard (1968) for radiation from a planar piston are used to study the far-field radiation due to the vibrating panels B J

A76-20521 **Semi analytic methods for rotating Timoshenko beams** R O Stafford and V Giurgiutiu (Imperial College of Science and Technology, London, England) *International Journal of Mechanical Sciences,* vol 17, no 11 12, 1975, p 719-727 10 refs

The equations of motion including shear and rotatory inertia are developed for uncoupled lead lag and flapping vibrations of beams rotating at constant angular velocity in a fixed plane Separability assumptions lead to an ordinary differential equation in the space variable, and a solution is obtained in terms of four independent functions, each a convergent power series These beam functions are similar to classic normal beam functions, and application of the boundary conditions yields determinants whose roots are the natural frequencies The simplicity and speed of this method is demonstrated by application to helicopter main rotor blades, and spoke diagrams and mass balancing are illustrated (Author)

A76-20614 # **Comparison of some aerodynamic properties of a canard and a conventional airplane (Porownanie wlasnosci aerodynamicznych samolotu o ukladzie kaczki i ukladzie konwencjonalnym)** J Staszek *Instytut Lotnictwa, Prace,* no 63, 1975, p 63-78 In Polish

An attempt is made to represent in a quantitative manner the advantages and the drawbacks of a canard airplane to be taken into consideration during the early design work The range of the lift and drag coefficient of the wing alone and of the wing with control surfaces are determined for the canard airplane and compared with those for the conventional system The action of the air stream leaving the elevator and flowing towards the main wing is discussed as well as methods for reducing the influence of downwash by (1) application of a twisted wing to achieve the required angle of incidence, (2) correct selection of control surface setting, (3) correct selection of aspect ratio for the control surfaces, and (4) correct location of the wing with respect to the control surfaces (Author)

A76-20620 # ***Developmental status and trends in refractory* alloys employed in aviation turbine engines (Stan i kierunki rozwojowe stopow zarowytrzymalych stosowanych w lotniczych silnikach turbinowych)** J Chodorowski and W Zalewski (Warszawa, Politechnika, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 31, Jan 1976, p 32 37 19 refs In Polish

The article surveys the acceptance, level of technology, and properties of nickel and cobalt alloys, superalloys, and high-melting alloys, inconel and nimonic type alloys, with aviation engine applications in various nations Fatigue strength, creep resistance, and processability are also considered The effect of desirable or harmful small additions (Sn, Sb, Zn, Pb, Bi, Mo, W, S, P, Cr, C, Hf, Zr, Ta, V, Nb) is discussed Contributions from the technologies of powder metallurgy, cermet materials, and reinforced composite materials (particularly tungsten fibers) are also discussed Nickel base alloys and cobalt base alloys are discussed separately R D V

A76-20733 * # **Efficient optimal design of suspension systems for rotating shafts.** W D Pilkey, B P Wang, and D Vannoy (Virginia, University, Charlottesville, Va) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D C , Sept 17-19, 1975, Paper 75-DET-91* 4 p 10 refs Members, $1 00, nonmembers, $3 00 Army-supported research, Grant No NGR-47-005-145

A new technique is proposed for the optimum design of suspension systems for rotating shafts In this approach the conventional method of trial and error search for optimum parameter values for a prescribed design configuration has been replaced by an efficient two-stage procedure In the first stage a generic force is substituted for the suspension system to be designed and the absolute optimum (or limiting) performance characteristics of the shaft are computed In the second stage, using a chosen suspension system configuration, parameter identification techniques are applied to find the design parameters so that the suspension system will respond as close as possible to the absolute optimal performance In this approach the repetitive shaft analyses required in the conventional search techniques are avoided Hence, the new technique is relatively efficient computationally and is suitable for large systems Both linear and nonlinear suspension systems can be designed A simple Jeffcott rotor is used to demonstrate the new technique (Author)

A76-20736 # **A designer-augmented optimization strategy - Concept and implementation** G H Michaud (Texas Instruments, Inc , Dallas, Tex) and J Modrey (Purdue University, West Lafayette, Ind) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D C., Sept 17-19, 1975, Paper 75-DET-99* 14 p 9 refs Members, $1 00, nonmembers, $3 00

The optimization strategy considered is based on an approach involving a communication between man and computer The computer provides information storage, retrieval, and computational operations The man provides control and management of the optimization process Attention is given to the operating system, the optimization algorithm, the display of optimization results, and the structure of the designer-augmented optimization system G R

A76-20740 # **Substructures analysis of impeller vibration modes** S W Mak and M Botman (United Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D C , Sept. 17-19, 1975, Paper 75-DET-112* 9 p 7 refs Members, $1 00, nonmembers, $3 00 Research supported by the Defence Research Board of Canada

The method of substructures employed in the analysis makes use of the fact that the impeller vanes are identical Only one of any number of identical substructures must be analyzed at the substructure level The flat triangular element employed by Clough and Tocher (1965) is selected as finite element for the analysis The impeller investigated consists of sixteen identical full vanes alternating with an equal number of identical splitter vanes G R

A76-20741 # **On predicting the natural frequencies of shrouded bladed disks** D J Cottney (Rolls Royce /1971/, Ltd , Bristol, England) and D J Ewins (Imperial College of Science and Technology, London, England, Lyon, Institut National des Sciences Appliquees, Lyons, France) *American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D C , Sept 17 19, 1975, Paper 75-DET-113* 11 p 6 refs Members, $1 00, nonmembers, $3 00

The vibration characteristics of turbine blades are significantly affected by their interaction through both the disk and the shroud which connect them Vibration analysis of an isolated cantilevered blade often provides a totally inadequate description of how the blade will vibrate in service This paper seeks to find a means of extending the various detailed and sophisticated mathematical models of complex shaped components in such a way as to make accurate predictions for a complete blade-disk-shroud assembly The results given show up some serious problems in achieving this aim but provide a useful insight into what component data must be obtained and how its accuracy will affect the final predictions (Author)

A76-20747 # **Teflon-fabric bearings in the helicopter rotor system.** L D Barrett (Boeing Vertol Co , Philadelphia, Pa)

American Society of Mechanical Engineers, Design Engineering Technical Conference, Washington, D C , Sept 17-19, 1975, Paper 75-DET-125 18 p 18 refs Members, $1 00, nonmembers, $3 00

Prediction of the life of a self-lubricated bearing has always been a problem due to the many factors involved in bearing design and use This paper describes a variety of factors entering into satisfactory performance of the self-lubricated bearing in a helicopter rotor, with special emphasis on Teflon-fabric-lined bearings Present design methods for sizing and for evaluating bearing lives are reviewed, test experience is summarized It is found that Teflon-fabric-lined bearings give satisfactory results in difficult rotor-system applications Maintenance requirements are greatly simplified as compared to their predecessors, the grease-lubricated rolling-element bearing Stringent control of production processes, especially conformity and the bonding operations, are found essential to assure consistent performance High concentrations of sand, salt water, and other environmental contaminants are shown to severely degrade bearing life Future R&D programs should include determination of probable load levels, ratios of steady and alternating loads, and other pertinent factors S D

A76-20805 Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings. Symposium sponsored by the Royal Aeronautical Society London, Royal Aeronautical Society, 1975 232 p $8 60

Papers are presented investigating possible means of reducing aircraft noise, with emphasis on their cost effectiveness Some of the topics covered include engine noise and economics, designing for noise reduction, an airport viewpoint on reducing the impact of aircraft noise, a U S airline operational and regulatory viewpoint on noise reduction, and some helicopter noise aspects P T H

A76-20806 # **Engine noise and economics** L G Dawson and T D Sills (Rolls Royce /1971/, Ltd , Derby, England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 26 p

With the basic truth in mind that a reduction in aircraft noise would mean extension of the hours of the day during which transport aircraft can take off and land and consequent reduction in overall operating costs, the paper reviews some of the areas where research has shown noise improvements are possible It is pointed out that turbine discrete tones can be effectively controlled by axial spacing and de passing frequency cut-off Reduction of jet velocity is the most powerful method of reducing jet noise Research has shown that the bulk absorber, a lining stuffed with fibrous material, is more effective than absorbing equipment of cellular construction Noise due to combustion is still an unsolved problem, and this noise will have to be attenuated with downstream sound absorbers for some time to come P T H

A76-20807 # **The economics and noise of subsonic aircraft** D G Brown (British Airways Corp , Ltd , Weybridge, Surrey, England) and K S Lawson (Hawker Siddeley Aviation, Ltd , Hatfield, Herts , England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 22 p

The paper discusses some of the options open to the designer for reducing noise in aircraft, and comments on the current state of regulations regarding noise requirements Design options include changes in the basic engine cycle to produce lower machinery and jet noise, additional acoustic treatment both within the basic engine and external to the engine in its inlet and exhaust ducting, the use of noise-shielded airframe configurations and vortex refraction effects, and changes in operation techniques for take-off and approach It is argued that the EPNdB unit currently used for noise certification is unrealistic, furthermore, the practice of measuring aircraft noise levels at a fixed distance from the start of roll, with no relation to airport boundary, does not adequately protect the community around a smaller airport Although noise reduction in most respects will entail financial penalties with respect to direct operating cost, some financial advantage will be obtained if lower-noise aircraft can then obtain extended curfew hours at airports where operating restrictions exist P T H

A76-20808 # **Insights into the second generation supersonic transport noise - Performances dilemma** G Cormery (Societe Nationale Industrielle Aerospatiale, Paris, France) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 20 p

The author advocates development of the Concorde B, which would either increase the range of the present Concorde without deterioration of present noise levels or, for a constant mission, reduce the noise level by more than 14 EPNdB, and then defines new goals for an aircraft beyond the Concorde B and derived from the Concorde An initial study investigating the possibility of deriving an aircraft from the Concorde is described, in which the fundamental envelope in terms of wing scale parameter and engine scale parameter was established for obtaining a margin as various parameters were varied Installation of canard surfaces is proposed, and its effect on performance and noise abatement is estimated P T H

A76-20809 # **Designing for noise reduction** R P Gerend (Boeing Commercial Airplane Co , Renton, Wash) and G S Schairer (Boeing Co , Seattle, Wash) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 25 p 49 refs

The paper outlines some of the main problems facing the aircraft designer concerned with reducing noise, and outlines some approaches to their solution Basic aircraft noise components and their generating mechanisms are described, and a historical survey is presented, describing how community noise reductions have been achieved in several generations of production jet-powered transports Tradeoffs associated with designing for steeper design climb-outs are examined, the discussion being limited to medium and long-range supersonic aircraft P T H

A76-20810 Some research towards quieter aircraft F W Armstrong (National Gas Turbine Establishment, Farnborough, Hants , England) and J Williams (Royal Aircraft Establishment, Farnborough, Hants , England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 49 p 25 refs

The paper describes in a general manner some current research in engine exhaust noise, powerplant sound absorption, airframe shielding of engine noise, and airframe self noise Some special-purpose anechoic chambers are briefly described along with some open-jet tunnels for aero acoustic studies The general characteristics of a multivariate design synthesis optimization computer program developed for preliminary studies of new subsonic swept-wing transport aircraft are discussed Some studies on noise annoyance reduction with minimum cost penalties are briefly characterized P T H

A76-20812 # **A United Kingdom airline operational and regulatory viewpoint** R H Whitby (British Airways Corp , Ltd , Weybridge, Surrey, England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 8 p

The paper examines some estimates regarding noisiness of aircraft in the coming few years, and then discusses briefly some

operational methods of reducing noise which are currently in use or which are proposed Figures are presented comparing the costs of retrofit and early retirement with replacement by new quieter aircraft The cumulative operating cost/seat figure is calculated through 1995, on the assumption that aircraft would be replaced on a seat-by-seat basis and that a 10% per annum escalation of prices will be effective This shows that the difference between the two approaches in terms of present value is not very great P T H

A76-20813 # **Noise abatement - A U S airline operational and regulatory viewpoint** F W Kolk (American Airlines, Inc , New York, N Y) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 17 p

The paper reviews some of the history of aircraft noise regulations and examines some noise reduction technology and operating procedures A method is outlined by which community noise exposure can be measured on the basis of sufficiently simple technical computations The model involves a three-dimensional plot, with land area as two dimensions and an annoyance index as the third This 3-D visualization produces a volume which is directly proportional to the total annoyance from aircraft operation Using annoyance index vs EPNdB data, one can compute the Specific Annoyance Factor Some figures are also presented on noise reduction program costs P T H

A76-20814 # **Analysis of the costs, effectiveness and benefits of aircraft noise reduction programs.** C R Foster (FAA, Washington, D C) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 13 p

The paper summarizes the results of a series of studies devoted to the analysis of costs and benefits of various alternative means of reducing the impact of aircraft noise The alternatives analyzed were retrofit of all JY3D and/or JT8D powered aircraft with new nacelles containing sound absorption material (SAM), retrofit of all JT8D powered aircraft with refanned engines and new nacelles (REFAN), modified approach procedures (2-segment), modified takeoff procedures (thrust cutback), and acquisition of land within the NEF 40 contour Cost effectiveness analysis, benefit cost analysis, and total cost analyses were carried out Some of the basic conclusions drawn are examined to obtain a general evaluation of the meaningfulness of noise reductions and to indicate paths of positive action P T H

A76-20815 # **A practical philosophy for noise reduction** K Smith (Department of Trade and Industry, London, England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 16 p

Some views are expressed on possible practical steps toward alleviating the problem of aircraft noise, three general areas of noise reduction being discussed reduction of noise generated at the source, reduction of noise received on the ground by aircraft design, and reduction of noise received on the ground by operating technique The outline of a certification scheme is given, entailing definition of noise-critical flight phases, definition of noise units, definition of certification noise limits in relation to known technical capability, and laying down an instruction book on how certification trials are to be carried out and results analyzed P T H

A76-20816 # ***Some comments on helicopter noise aspects*** M V Lowson (Westland Helicopters, Ltd , Yeovil, Somerset, England) In Symposium on the Impact of Economics on the Design and Operation of Quieter Aircraft, London, England, April 23, 24, 1975, Proceedings London, Royal Aeronautical Society, 1975 3 p

The main sources of helicopter noise are identified as blade slap (when it occurs), tail rotor noise, main rotor noise, and engine/transmission Rotor noise can be attacked by tip modification, or by reduction of main rotor speed The latter solution has a considerable performance penalty, however Tail rotor noise is the chief source of noise Reduction of the order of 5 dB in rotor noise could probably be achieved in a future helicopter design Blade slap causes the most complaints, although its low frequency banging is not accounted for in conventional noise criteria Reduction of blade tip thickness and modification of flying technique may result in up to 10 dB noise reduction due to blade flap P T H

A76-20870 # **Noise in aviation (El ruido en aviación)** M Cuesta Alvarez *IAA/Ingeniería Aeronáutica y Astronáutica,* vol 27, Dec 1975, p 7 16 *In Spanish*

The paper examines some of the basic aspects of noise generated by aircraft The unit used to measure noise (the decibel) and some scales indicating human sensitivity to noise are reviewed The seven noise grades and their calculation formulas, defined in Annex 16 of the ICAO, are described The ICAO permissible noise levels and tolerances at specified measuring points during take off and approach and on the ground are defined The basic idea of noise reduction by nacelle jet suppression (NJS) and new front fan (NFF) is described Some data are presented on noise levels at various distances from an afterfan-type engine, and some basic protective measures for personnel working in the vicinity of noisy aircraft are discussed P T H

A76-20871 # **CASA C-101 - A Spanish trainer for 1980 (CASA C-101 - Un entrenador español para 1980)** J D Calvo Ruiz (Dirección de Proyectos e Investigación de Construcciones Aeronáuticas, S A , Spain) *IAA/Ingeniería Aeronáutica y Astronáutica,* vol 27, Dec 1975, p 17-27 In Spanish

The paper describes the design philosophy and general characteristics of the most important systems of the C-101 jet trainer The aircraft is intended to train pilots in all flight modes, navigation (including IFR capability), weapons firing, combat maneuvers, and counter-insurgent and close support operations The aircraft is of simple modular construction, with the capability of using distinct propulsion groups without fundamental changes in structure Characterizations of the wing, fuselage, take-off and landing, flight controls, hydraulic system, electrical system, fuel system, pressurization and climate control, oxygen system, communications, navigation equipment, and armament are given P T H

A76-20916 * # **Lip noise generated by flow separation from nozzle surfaces** W Olsen and A Karchmer (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D C , Jan. 26-28, 1976, Paper 76-3* 28 p 11 refs

Flow separation from nozzle surfaces can be a source of significant noise in addition to the jet noise When no flow separation region exists only jet noise is observed at every angle, for velocities down to 120 m/sec, with both low and high levels of initial turbulence Intense nearly periodic turbulence and noise is caused by flow separation from the thin core nozzle lip of a coaxial nozzle This can be described by a combination of aeolian tone and trailing edge noise theory Noise caused by flow separation from the surfaces of other nozzle geometries has somewhat different characteristics (Author)

A76-20917 # **A model for predicting aero-acoustic characteristics of coaxial jets** C Y Chen (United Technologies Research Center, East Hartford, Conn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D C , Jan. 26-28, 1976, Paper 76-4* 8 p 17 refs Research supported by the United Technologies Corp

An analytical model is presented for predicting the velocity field and noise characteristics of coaxial jets of ambient temperature, including the dependence of sound-power spectral density on

velocity and area ratio The far-sound field is related to the turbulence field by assuming that a given axial slice of jet emits sound at a single characteristic frequency The predictions are in reasonable agreement with experimental data For both single and coaxial jets, the power spectrum is shown to follow the frequency squared and inverse-square power laws in the low- and high-frequency limits, respectively The source strength distribution is shown to be constant in the initial mixing region and to decay as the -7th power of the axial distance from the jet exit in the fully turbulent region downstream For a given core jet velocity, the total noise output from a coaxial jet is found to reach a minimum when the secondary stream velocity is approximately half the core jet velocity For a given thrust, the coaxial jet is found to produce minimum noise when the two stream velocities are equal (Author)

A76-20919 * # **Viscous/potential flow about multi-element two-dimensional and infinite-span swept wings - Theory and experiment** L E Olson (NASA, Ames Research Center, U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) and F A Dvorak (Analytic Methods, Inc , Bellevue, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D C , Jan 26-28, 1976, Paper 76-18* 10 p 22 refs

The viscous subsonic flow past two-dimensional and infinite-span swept multi-component airfoils is studied theoretically and experimentally The computerized analysis is based on iteratively coupled boundary-layer and potential flow analysis The method, which is restricted to flows with only slight separation, gives surface pressure distribution, chordwise and spanwise boundary-layer characteristics, lift, drag, and pitching moment for airfoil configurations with up to four elements Merging confluent boundary layers are treated Theoretical predictions are compared with an exact theoretical potential flow solution and with experimental measures made in the Ames 40- by 80-Foot Wind Tunnel for both two-dimensional and infinite-span swept wing configurations Section lift characteristics are accurately predicted for zero and moderate sweep angles where flow separation effects are negligible (Author)

A76-20928 * # **Effects of Mach number and afterbody length on aerodynamic side forces at zero sideslip on symmetric bodies at high angles of attack** E R Keener, G T Chapman, and R L Kruse (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D C , Jan 26-28, 1976, Paper 76-66* 10 p 24 refs

Wind-tunnel measurements of side force over the Mach number range of 0 25 to 2 for pointed forebody-alone and for ogive-cylinder models of various fineness ratios up to 16, are presented The angle of attack where side force first occurs (onset), where it returns to zero (upper limit), and its magnitude are examined The onset angle depends only on body geometry, longer bodies having lower onset angles The upper limit, which is about 80 deg at M = 0 25, decreases with Mach number The maximum side forces decrease with increasing Mach number, approaching zero within the Mach number range of 0 8 to 1 2, within this range, the Mach number at which the forces approach zero varies directly with forebody slenderness. (Author)

A76-20929 * # **Vortex noise from nonrotating cylinders and airfoils** R H Schlinker, R K Amiet (United Technologies Research Center, East Hartford, Conn), and M R Fink *American Institute of Aeronautics and Astronautics, Aerospace Science Meeting, 14th, Washington, D C , Jan 26-28, 1976, Paper 76-81* 17 p 27 refs Contract No NAS1-13372

An experimental study of vortex-shedding noise was conducted in an acoustic research tunnel over a Reynolds-number range applicable to full-scale helicopter tail-rotor blades Two-dimensional tapered-chord nonrotating models were tested to simulate the effect of spanwise frequency variation on the vortex-shedding mechanism Both a tapered circular cylinder and tapered airfoils were investigated The results were compared with data for constant-diameter cylinder and constant-chord airfoil models also tested during this study Far-field noise, surface pressure fluctuations, and spanwise correlation lengths were measured for each configuration Vortex-shedding noise for tapered cylinders and airfoils was found to contain many narrowband-random peaks which occurred within a range of frequencies corresponding to a predictable Strouhal number referenced to the maximum and minimum chord The noise was observed to depend on surface roughness and Reynolds number (Author)

A76-20931 * # **Jet noise characteristics of unsuppressed duct burning turbofan exhaust system** A B Packman, H Kozlowski (United Technologies Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn), and O Gutierrez (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D C , Jan 26-28, 1976, Paper 76-149* 8 p 6 refs Contract No NAS3-17866

Recent aero-acoustic tests of model coannular nozzles have shown that less noise is generated if the higher velocity jet is exhausted from the outer annular passage rather than from the primary nozzle These findings are of particular significance to a duct-burning turbofan (DBTF) engine being studied for application to an advanced supersonic transport Unlike conventional turbofan engines that have peak velocities from the primary nozzle, it is possible to design a DBTF engine to have a fan velocity higher than that of the primary flow Results are presented for a NASA sponsored model test program that covers a range of fan to primary-area ratios from 0 75 to 1 2, and a range of fan to primary-velocity ratios from 0 4 to 2 8 Correlations are given that relate radiated sound power to fan velocity, fan to primary velocity ratio, and fan to primary-area ratio Corresponding exhaust-plume velocity traverse data are presented which suggest that the observed noise benefits may be due to the more rapid decay of the annular flow because of shear stresses on the inner surface that result from the lower-velocity primary flow (Author)

A76-20968 **Designing supersonic transports for low sonic boom (Die Auslegung von Uberschallverkehrsflugzeugen im Hinblick auf geringen Uberschallknall)** R Stuff (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Stromungsmechanik, Gottingen, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Jan.-Feb 1976, p 34-38 26 refs In German

The acoustoelastic effects in the response of large windows to sonic booms discussed by Pretlove (1969) are taken as a basis to show that the dynamic loads produced by sonic booms can well exceed the standard loads for structures The state of the art of studies aimed at determining the feasibility of low-sonic-boom supersonic transports is reviewed, and the methods which have been proposed to meet this purpose are critically analyzed Several problems that have to be resolved in order to determine the cost effectiveness of a low-sonic-boom supersonic transport are noted V P

A76-21075 * # **Aero-acoustic performance characteristics of duct burning turbofan exhaust nozzles** H Kozlowski, A B Packman (United Technologies Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn), and O Gutierrez (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 14th, Washington, D C , Jan 26-28, 1976, Paper 76-148* 8 p Contract No NAS3 17866

A recent experimental investigation has identified the aero/acoustic characteristics of exhaust nozzles for duct heating turbofan engines over a range of simulated flow conditions Jet noise and performance levels are summarized for a series of coannular nozzles representing both acoustically suppressed and unsuppressed designs operating in a static environment The basic coannular nozzles were found to provide inherent noise suppression Multi-element suppressor nozzles provided additional noise suppression, but with appreciable thrust loss The impact of these results on the advanced supersonic transport studies is also presented, indicating potentially

large reductions in take-off gross weight or community noise footprints (Author)

A76-21137 # **Experimental study of axial flow in wing tip vortices** D H Thompson (Weapons Research Establishment, Aeronautical Research Laboratories, Melbourne, Australia) *Journal of Aircraft*, vol 12, Nov 1975, p 910, 911 12 refs

A description is given of a qualitative towing tank study of some of the factors which control the axial flowfield in a trailing vortex Two rectangular wing models were used in the study For each wing three alternative tip configurations were tested The hydrogen bubble technique was used for flow visualization The velocity distribution at any position behind the wing was found to depend on a number of factors related to the wing section, the tip shape, the Reynolds number, the wing incidence, and the distance from the wing G R

A76-21138 # **Analytical solution for inviscid vortex rollup from elliptically loaded wings** D K Lezius (Lockheed Research Laboratories, Palo Alto, Calif) *Journal of Aircraft*, vol 12, Nov 1975, p 911-914 8 refs Research sponsored by the National Research Council

An explicit analytical perturbation solution based upon the rollup theory developed by Betz (1932) is presented The derived series solution converges rapidly Expressions for the vortex circulation and the associated tangential velocity and vorticity are obtained It is pointed out that the degree of approximation to inviscid vortex rollup offered by the presented equations far exceeds that required for most engineering applications or for a comparison with experimental data G R

A76-21139 # **Effect of aeroacoustic interactions on ejector performance** B Quinn (USAF, Aero-Propulsion Laboratory, Wright Patterson AFB, Ohio) *Journal of Aircraft*, vol 12, Nov 1975, p 914-916 14 refs

The mass entrainment performance of a family of ejectors over a range of primary air pressures and temperatures was studied The test results indicate that the performance of short or compact ejectors could be raised to the performance level of longer configurations if attention is given to aeroacoustic interaction effects Such a performance enhancement for compact ejectors would be a vital factor for the success of V/STOL aircraft applications in which the location of the thrust augmenting ejectors on the wings makes compact geometries necessary G R

A76-21157 # **The medium-haul jet transport aircraft Tu-154A (Das Mittelstrecken-Strahlverkehrsflugzeug Tu-154A).** R Jeger *Technisch-okonomische Information der zivilen Luftfahrt*, vol 11, no 6, 1975, p 313-316, 351 In German (Translation)

The key to the design improvement of the Tu-154A over the Tu-154 is the improved takeoff thrust characteristics of the jet engine The thrust augmentation permits one to increase the takeoff weight of the aircraft, its average flight speed and its load-carrying capacity Aircraft noise has been diminished by throttling back the engine The fuel supply system is so designed that each of the three engines is fueled independently of the other engines The feasibility of applying automatic landing control to the aircraft has been explored A diagram of the passenger compartments is included B J

A76-21163 # **Aerodynamic analysis of different flight attitudes of conventional aircraft. XVI (Flugmechanische Analyse verschiedener Flugzustande konventioneller Flugzeuge XVI)** F Seidler (Dresden, Hochschule fur Verkehrswesen, Dresden, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt*, vol 11, no 6, 1975, p 352-368 In German

The effect of wing shape on the induced angle of attack and the induced drag coefficient is investigated, as is the effect of the warping of the wing on the induced drag coefficient The effects of swept back wing design on the drag coefficient is studied Induced drag is calculated for rectangular, triangular, elliptical and trapezoidal wings, and lift-drag relations are investigated for the various wing shapes and for warped wings B J

A76-21175 **Data processing as an aid to every stage of landing gear design (L'informatique - Une aide à la conception des atterrisseurs à tous les niveaux)** A Turiot and M Genouille-Dalfort (Societe Messier-Hispano, Paris, France) *L'Aéronautique et l'Astronautique*, no 56, 1976, p 63-73 In French

The paper reviews the development of the computerized design of landing gear at the Messier-Hispano Society, with particular emphasis on analysis of landing gear kinematics, and the application of the finite element method The first part of the paper is devoted to the study of kinematics, using two test examples of landing gear (balancing gear and sliding gear), on the basis of the analysis of engineering drawings The second part is devoted to the sizing of landing gear structures using the finite element method, which is applied to the computerized design of the principal landing gear of the Airbus and of the Super-Mirage B J

A76-21187 **Ice formation on aircraft (Le givrage des aéronefs)** M Friedlander (Centre d'Essais en Vol, Bretigny sur Orge, Essonne, France) *La Météorologie*, Nov 1975, p 129 136 In French

The physical conditions of ice formation are discussed These include temperature, liquid water content, and the average diameter of the water drops The role played by associated meteorological conditions - fog, turbulence, lightning, snow, etc - on ice formation on aircraft is also considered The effect of ice on aerodynamic drag and lift is examined Deicing equipment for engines, aircraft, and helicopters is described Ice formation simulation flight experiments involving the Concorde which is sprayed with artificial ice from another aircraft are discussed B J

A76-21188 **Atmospheric turbulence and the analysis of aircraft structures (La turbulence atmospherique et le calcul des structures d'avions)** J P Perrais (Ecole Nationale Superieure de l'Aeronautique, Paris, France) *La Météorologie*, Nov 1975, p 137-145 10 refs In French

The effect of clear air turbulence in the free atmosphere on aircraft is studied on the basis of discrete and continuous gust models Central to the analysis is the determination of the transfer function of the aerodynamically loaded aircraft which is related to the vertical acceleration of the center of gravity of the aircraft, and to the variation of load factors Critical load factors are determined and ways to optimize the flight on the basis of the calculation of the transfer function are examined In-flight measurements of gust-load induced acceleration are considered B J

A76-21190 **Effects of lightning on aircraft (Le foudroiement des aéronefs)** Y Mouffoc (Service Technique de l'Aeronautique, Paris, France) *La Météorologie*, Nov 1975, p 163-168 In French

The accumulation of electrostatic charge on aircraft in flight due to contact with precipitation is discussed as a mechanism for attracting lightning, and methods for reducing the electrostatic potential of aircraft surfaces are considered Electrical phenomena associated with lightning striking an aircraft are described, and the possibility of designing lightning resistant aircraft structures is examined The results of a survey of lightning effects on 1045 aircraft over 18 months are summarized B J

A76-21192 **Propagation of noise generated by helicopter rotors (Propagation du bruit généré par les rotors d'helicoptères)** G Petit, M D'Ambra, and M Marze (Societe Nationale Industrielle Aerospatiale, Marignane, Bouches du-Rhône, France) *La Meteorologie*, Nov 1975, p 191-205 6 refs In French

There are two large categories of mechanisms of helicopter rotor

noise those that are due to potential flow and cause rotational noise, and those that are due to atmospheric viscosity and cause broadband noise Both mechanisms of rotor noise can be intrinsic, i e , due to lift and drag, or motion of the airfoils in unperturbed flow, or parasitic, i e , due to asymmetry of the rotor and to perturbations of the flow The effect of meteorological conditions on these various types of rotor noise is investigated The effect of the steady-state and the turbulent atmosphere on noise propagation is studied, as are molecular attenuation of sound waves, and attenuation due to precipitation The effects of wind, temperature, and proximity to the ground on noise propagation are also examined B J

A76-21586 # **A solution for conically cambered delta wings in supersonic flow** D Mateescu *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée,* vol 20, no 2, 1975, p 189 216 7 refs

The paper studies the supersonic flow past conically cambered thin delta wings A method of generating cambered wings with attached flow at their subsonic leading edges is presented General expressions of the pressure coefficient (axial disturbance velocity) and lift coefficient are derived both for the design and off-design conditions The comparison with the experiments made by Rogers shows a good agreement of the theoretical results obtained in the present paper with the experimental data (Author)

A76-21626 Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Symposium sponsored by the International Union of Theoretical and Applied Mechanics Edited by F I Niordson (Danmarks Tekniske Hojskole, Lyngby, Denmark) Berlin, Springer-Verlag, 1975 576 p $36 10

Papers are presented on the multi-plane, multi-speed balancing of flexible rotors, on the stability of high-speed centrifugal pump rotors, and on the vibrational behavior of flexible shafts driven by Hooke's joints Also discussed are the self-excited vibrations of rotors, helicopter ground resonance, modal balancing of flexible rotors, and the effect of support flexibility on the stability of rotors mounted on journal bearings A rotor blade analysis is performed by means of the finite element method Precessional vibrations of symmetrical rotors are studied, as is the dynamics of synchronous whirl in turbine rotors and the damping of self-excited rotor vibrations by an active bearing

B J

A76-21627 * **Recent developments in multiplane-multispeed balancing of flexible rotors in the United States** R H Badgley (Mechanical Technology, Inc , Latham, N Y) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 1-26 8 refs Contracts No NAS3-14420, No F33615-72 C-1801

This paper describes current developments in the evolution of a computer-implemented balancing procedure which permits flexible rotors to be precisely balanced in a cost-effective manner Correc tions in virtually any reasonable number of planes, computed by the procedure using signals from vibration sensors at critical locations, permit rotor operation over any design speed range Steady-state operation at undamped critical speeds has been demonstrated Results of recent test efforts indicate that the procedure can be applied with equal effectiveness to rotors of any size Manufacturing and overhaul cost reductions are expected to flow from its adoption, together with performance advantages from operation in hitherto restricted dynamic regimes (Author)

A76-21634 Vibration and its control in rotating systems R Holmes (Sussex, University, Brighton, England) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 156-181 9 refs

The effect of the lubricating oil film of the bearing on the vibrational behavior of three kinds of rotors is discussed These rotor systems are a rigid steam-turbine rotor supported on journal bearings, a rigid gas-turbine rotor supported on squeeze-film bearings, and a flexible supercritical shaft supported on journal bearings It is shown that the amplitudes and shapes of the vibrations of rigid rotors are governed by the oil film limits within the journal or squeeze-film bearings These oil limits depend on the inability of the film to rupture under conditions of high frequency and amplitude of vibration Also, the amplitudes of small vibrations of both rigid and flexible rotors and the onset of oil-whirl instability for such rotors is well predicted by using the appropriate oil-film coefficients B J

A76-21636 Limits to modal balancing of flexible rotors W Kellenberger (Brown, Boveri et Cie AG, Baden, Switzerland) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 206-243 23 refs

Modal balancing of flexible rotors is based on the fact that the deflection of the rotor due to unbalance forces can be represented by the sum of the various modes With a precisely defined set of balancing weights, it is possible to eliminate the first, second and each successive mode up to the n-th mode When those modes which are disturbing in the operating range have been reduced to a tolerable limit, the undesired rotating bearing forces are reduced correspondingly, and the rotor is considered balanced The balancing procedure is applied to an isotropic (round) shaft and to an anisotropic (oval) shaft B J

A76-21637 The effect of support flexibility on the stability of rotors mounted in plain cylindrical journal bearings R G Kirk (United Technologies Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn), P De Choudhury (Elliott Corp , Jeannette, Pa), and E J Gunter (Virginia, University, Charlottesville, Va) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 244-298 24 refs

The effect of the flexibility and damping characteristics of the supports on the vibrational behavior of a symmetrical turbine rotor mounted on nonlinear fluid-film bearings is examined The stability analysis is based on the Routh criteria and the calculation of damped eigenvalues The effect of rotor imbalance on rotor stability is discussed, and the time transient orbits of shaft and support motions are considered The special case of a vertical or zero-g rotor system is investigated An experimental investigation on a turbine rotor reveals both support and shaft resonant whip in addition to the classical half-frequency whirl B J

A76-21638 Rotating blade analysis by the finite element method M Lalanne, R Henry, and P Trompette (Lyon, Institut National des Sciences Appliquees, Villeurbanne, Rhône, France) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 299-318 19 refs Direction des Recherches et Moyens d'Essais Contract No 70/688

A mathematical model of a rotating blade is developed using Lagrange equations and the finite element method In the case of thin blades, the structure is modeled by triangular plane elements with three nodes and 6 degrees of freedom per node, and in the case of thick blades, the structure is modeled by isoparametric elements with 24 nodes and 3 degrees of freedom per node The method is applied to the stress analysis of the blades of a gas turbine, and to the study of the turbofan and turbine blades of an aircraft engine B J

A76-21641 Nonlinear excited and self-excited precessional vibrations of symmetrical rotors A Muszynska (Polska Akademia Nauk, Instytut Podstawowych Problemow Techniki, Warsaw, Poland) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 380 412 82 refs

In the paper the symmetrical rotor systems having nonlinear properties are considered Various origins of the nonlinearities are discussed (internal and structural damping, nonlinear elastic and

damping characteristics of elastic supports and dampers, nonlinear aero and hydrodynamical forces in plain bearings or in seals of hydraulic machines, electrodynamical forces, geometrical nonlinearities of systems) On the grounds of a general symmetrical nonlinear mathematical model it is shown the occurrence of excited, self-excited and combined vibrations It is found also that the equilibrium position (the center of vibrations) is displaced Some numerical examples demonstrate shapes of the amplitude-frequency-phase-rotational speed curves (Author)

A76-21642 **The balancing of flexible rotors** A G Parkinson (University College, London, England) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer-Verlag, 1975, p 413-435 10 refs

The state of the art of balancing flexible rotors is reviewed Three methods of balancing are discussed modal balancing, rigid body balancing, and the influence coefficient method The first two methods depend directly on modal analysis and upon the predictions of a certain equation describing the motions of the rotor system, while the third method does not depend explicitly on modal analysis, although it can be expedited by a modal interpretation of the rotor vibration A comparison of the three methods is presented B J

A76-21643 **Some recent computer studies on the stability of rotors in fluid-film bearings** N F Rieger and C B Thomas, Jr (Rochester Institute of Technology, Rochester, N Y) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer Verlag, 1975, p 436-471 27 refs

Several computer studies of rotor system stability are presented The rotor systems include rigid and flexible rotors, fluid-film bearings, gas seals, and structural hysteresis Equations for the stability of a general two bearing rotor system model were obtained, and several rotor systems used by previous investigators were calculated Close correlation between test and calculated rotor threshold speeds was observed A comparison of digital and analog techniques for linear rotor systems with various destabilizing factors was made, using a specific rotor system test case Close correlation between all analog and digital results was observed A short bearing theory for non-linear forces was developed and programmed for the EAI Pacer 600 hybrid computer Published results for rigid rotor stability tests were used for program verification Results from all cases are given and discussed in the paper (Author)

A76-21644 **Stabilization of self-excited rotor vibrations by an active damper** G Schweitzer (Munchen, Technische Universitat, Munich, West Germany) In Dynamics of rotors, Proceedings of the Symposium, Lyngby, Denmark, August 12-16, 1974 Berlin, Springer Verlag, 1975, p 472-493 10 refs

An active bearing for stabilizing the self-excited vibrations of a multi-body rotor and for reducing resonance amplitudes when the rotor runs through critical speeds is described The equations of motion are presented for a symmetric rotor model consisting of a string of viscoelastically interconnected rigid bodies that are elastically supported by bearings at the end of the rotor A stability analysis is performed on the basis of matrix theorems and generalized Rayleigh quotients to assess the effect of internal and external damping and of the rotor speed on the natural rotor motion Control forces are exerted by an active electromagnetic damper in such a way that the self-excited vibrations are optimally damped Suggestions are made for the optimal position of the damper along the rotor axis, as well as for the optimal choice of measuring signals that are used to create the control signals B J

A76-21653 **Form of minimum-drag body in hypersonic gas flow** V L Berdichevskii (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *(Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol 30, May-June 1975, p 90-96) *Moscow University Mechanics Bulletin,* vol 30, no 3-4, 1975, p 13-18 Translation

The correct formulation of hypersonic gas flow problems involving a Newtonian functional describing the force exerted by the flow on a body located in the flow in a Cartesian coordinate system is discussed The problem concerning the search for the minimum of the relevant Newtonian functional is solved for the class of bounded-area surfaces S D

A76-21697 **Powerplants - Past, present and future /The Fifth William Littlewood Memorial Lecture/** G Neumann (General Electric Co , Fairfield, Conn) Warrendale, Pa , Society of Automotive Engineers, Inc , 1975 14 p (SAE Paper 751120, SAE SP-398)

The paper recalls the major phases of the development of jet aircraft powerplants, the origins of the gas turbine, the experiments of Sanford Moss in the early 1900s, the LaPere biplane equipped with turbosuperchargers, early German jet engine work, the first U S jet engine aircraft, the XP-59, and the subsequent development of military and commercial powerplants in service today Some recent trends and current problems in the aviation industry are briefly indicated Extensive research is now being carried out in new materials, especially composites Significant impact on the cost of engine development will be felt from application of the 'design to cost' philosophy Although much progress has been achieved in reduction of engine emissions, engine noise, and fuel consumption, research is still going on for further improvements It is predicted that in the future, there will not be as many new systems developed and procured in any time interval, and the level of research and development support will be less The limitations and cost of fuel may well redesign the transport of the future lowest drag, optimum speed, less wind sweep, more composites, variable cycle engines, and higher bypass P T H

A76-21700 # **Faith restored - The F-15 program** G B Guarino (USAF, Systems Command, Andrews AFB, Md), R L Lilly (USAF, Washington, D C), and J J Lindenfelser (USAF, Inspection and Safety Center, Norton AFB, Calif) *Air University Review,* vol 27, Jan -Feb 1976, p 63-77

Full-scale work related to the development of the air superiority fighter aircraft F-15 was started on January 1, 1970 The key elements of the management approach taken on the F-15 program are presented, giving attention to the F-15 weapon system acquisition concepts implemented in response to the demand for effective and efficient program management Personnel questions are considered along with organizational aspects, planning objectives, details of test philosophy, contracting methodology, and problems of production and quality assurance G R

A76-21749 **The principles and practice of airworthiness control /The Lawrence Hargrave Memorial Lecture/** P S Langford (Department of Transport, Melbourne, Australia) *Aeronautical Journal,* vol 80, Jan 1976, p 20-28

Australian airworthiness training and testing practice is discussed at large and compared to that of other nations, specifically the U S Problems in the definition and quantification of airworthiness and related topics are discussed, and existing certification standards such as the FAR (U S Federal Air Regulations), BCAR (British Civil Airworthiness Requirements), and the West European JAR (Joint Airworthiness Requirements) are mentioned The most common serious flaws to be coped with in aircraft structural design are listed Disparities in the U S and Australian approaches to airworthiness are discussed at length, and details are presented on aircraft maintenance requirements and procedures, airworthiness training and certification, and inspection and testing of materials and parts in Australia R D V

A76-21801 # **Review of aeronautical fatigue investigations in Japan during the last years.** R Kamiyama, E Nakai, K Takeuchi, and S Iida *International Committee on Aeronautical Fatigue, Meeting, 14th, Lausanne, Switzerland, May 28-June 6, 1975, Paper* 15 p 30 refs (NAL-TM-284T)

The role of fatigue tests in the development of new types of aircraft is described The results of fatigue tests on aluminum alloy specimens are discussed with emphasis on scatter of fatigue life and the use of new rules on cumulative damage A stress analysis is performed on fatigue crack propagation in aircraft structures and acoustic fatigue and full scale fatigue tests are considered The scatter factor for fatigue life used in the development of the YS-11 aircraft is specified S-N diagrams and scatter factor diagrams illustrating the fatigue test results discussed in the paper are included B J

A76-21874 # **Incipient failure detection in CH-47 helicopter transmissions** D B Board (Boeing Vertol Co , Philadelphia, Pa) *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex , Nov 30-Dec 4, 1975, Paper 75-WA/DE-16* 10 p Members, $1 50, nonmembers, $3 00

During research of state-of-the-art diagnostic and prognostic techniques for potential application to the CH-47C Chinook medium lift helicopter, a new technique for high frequency vibro-acoustic emission analysis was evaluated on three CH-47 drive system transmissions in a regenerative test stand Test results indicate that this new technique for high frequency vibro-acoustic analysis shows excellent potential for early stage in-situ detection and identification of faults in complex high-speed rotating machinery Of the five faults indicated and verified by teardown inspection during this test, only one was known at the outset of the test and all five were detectable through analysis of test data without any need for baseline information This capability for in-situ fault detection and isolation without the need for baseline data and with decisions based on engineering rationale rather than rationalized pattern recognition indicates an important superiority over the more classical forms of low frequency vibration analysis that have been employed to date for helicopter transmission diagnosis and prognosis (Author)

A76-21991 # **Unsteady aerodynamics of helicopter blades (Aerodynamique instationnaire des pales d'hélicoptere)** R Dat (ONERA, Châtillon sous Bagneux, Hauts-de-Seine, France) *(NATO, AGARD, Table Ronde sur l'Aérodynamique Instationnaire, Gottingen, West Germany, May 30, 1975) ONERA, TP* no 1975 121, 1975 7 p 10 refs In French

The method developed at ONERA to predict the unsteady periodic aerodynamic forces on helicopter blades in forward flight is described The blade sections are modeled by airfoils The lift at high angle of attack is given by an empirical model and the three dimensional interferences between blades and between separate sections of the blades are given by the linearized lifting surface theory The comparison between theoretical and experimental results is satisfactory (Author)

A76-21993 # **A new analysis of spin based on French experience with combat aircraft (Une nouvelle analyse de la vrille basée sur l'experience française sur les avions de combat)** C La Burthe (Centre d'Essais en Vol, Bretigny-sur-Orge, Essonne, France) *(NATO, AGARD, Réunion sur le Décrochage et la Vrille des Avions Militaires, Brussels, Belgium, Nov 18-21, 1975) ONERA, TP* no 1975-143, 1975 10 p In French

In light of the hazards imposed by the effects of wing loading, the prevention and control of spin at high angles of attack in combat aircraft are discussed A comparison of the spins of four aircraft (Jaguar, Viggen, Fouga CM 170, F5) reveals significant similarities, indicating that their motion is dominated by a common element On the basis of these observations and an analysis of Euler Poinsot motion in spin, a model in which spin in high-mass aircraft is considered to be organized by inertial effects and perturbed by aerodynamics is suggested Angle of attack measurements are used to obtain limits of credibility for stall warning systems It is suggested that aircraft operating at high angles of attack be equipped with a gyro torque detector in addition to present warning devices C K D

A76-22048 **Criteria concerning the use of titanium in aircraft construction (Kriterien fur den Einsatz von Titan im Flugzeugbau)** K O Sippel and H Kellerer (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *Metall,* vol 30, Feb 1976, p 138-143 11 refs In German

A decision concerning an employment of titanium in specific cases of aircraft development requires a comparison of the advantages of such an employment with the additional costs involved in a use of this metal The reported investigation has the objective to present data and information which can be used as a basis for such a decision Pure titanium metal and the available titanium alloys are considered Attention is given to the material characteristics, questions of manufacturing technology, and economic considerations It is pointed out that decrease in the current price of titanium would require entirely new methods for its production G R

A76-22178 # **Erosion damage to high-speed aircraft and guided missiles** M Schulz (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) In International Conference on Rain Erosion and Associated Phenomena, 4th, Meersburg, West Germany, May 8-10, 1974, Proceedings Volume 1 Farnborough, Hants , England, Royal Aircraft Establishment, 1975, p 29-62

Numerous photographs are used to illustrate the results of an erosion study carried out for the Starfighter F 104 and the Phantom military aircraft The erosion damage discussed and illustrated was established on the pitot tube, the radome, the infrared windows, the center windshield, the angle-of attack transducer, the leading edge of the air-intake duct, the antennas, the leading edge of the wing, the infrared seeker of the Sidewinder, the missile supports, external tank tips, the navigation lights at the wing tips, the fin leading edge, and engine compressor blades Remedial measures are proposed for each of these cases It is seen that no attention is given to the erosion problem in the design and construction of a new aircraft Subsequent measures against corrosion are very costly The need to treat the corrosion problem seriously is indicated V P

A76-22192 # **Study of parameters of flight materials at speeds up to 1000 metres per second** A Behrendt (Dornier System GmbH, Friedrichshafen, West Germany) In International Conference on Rain Erosion and Associated Phenomena, 4th, Meersburg, West Germany, May 8-10, 1974, Proceedings Volume 2 Farnborough, Hants , England, Royal Aircraft Establishment, 1975, p 425-448 8 refs

Results are presented for rain erosion investigations of flight materials using a rotating arm in the velocity range 400-1000 m/sec In contrast to the investigations with the M = 1 4 test apparatus, the investigations are carried out at pressures between 6 and 18 torr The dimensions of the apparatus such as the arm radius and the sample holding device correspond to the dimensions of the M = 1 4 test apparatus The rain is produced by oscillating tubes with a corresponding diameter, and the materials tested are pure aluminum, polyurethane, and glass fiber-reinforced plastics The dependence of rain erosion on impact velocity, drop size, and impact frequency is discussed It is shown that the results obtained earlier for the lower velocity range can be qualitatively transferred to the velocity range up to 1000 m/sec However, the limitations for the use of various materials are reached within the investigated velocity range For window materials, it is not permissible to extrapolate the measurement results to the higher velocity range The optical transparency is compromised before the incubation time is reached S D

A76-22198 # **Analysis of rain erosion of coated materials.** G S Springer (Michigan, University, Ann Arbor, Mich), C -I Yang, and P S Larsen In International Conference on Rain Erosion and Associated Phenomena, 4th, Meersburg, West Germany, May 8-10, 1974, Proceedings Volume 2 Farnborough, Hants , England, Royal Aircraft Establishment, 1975, p 601-636 26 refs Contract No F33615-72-C-1563

A model based on fatigue concepts is developed for the quantitative prediction of rain erosion of coated materials under previously untested conditions In particular, the proposed model describes the incubation period defined as the time elapsed before the mass loss of the coating becomes appreciable, and the degradation of the coating past the incubation period as manifested by its mass loss The results presented are valid for any material and for any impact velocity, provided that there is a finite incubation period and that the mass loss varies linearly either with time or with the number of impacts S D

A76-22199 # **Erosion behaviour of surface coatings** H Rieger (Dornier System GmbH, Friedrichshafen, West Germany) and H Boche (Dornier GmbH, Friedrichshafen, West Germany) In International Conference on Rain Erosion and Associated Phenomena, 4th, Meersburg, West Germany, May 8-10, 1974, Proceedings Volume 2 Farnborough, Hants , England, Royal Aircraft Establishment, 1975, p 637-675

The complex effects which determine the rain erosion behavior of laminar bonded materials used in aircraft or guided missile construction are studied These effects are divided into two groups (1) effects governed by structure, predetermined by the construction of the laminar bonded system, and (2) effects governed by erosion, predetermined by erosion parameters such as velocity, diameter, density, and angle of impact of the raindrops The stressing of a laminar bonded material due to rain erosion is analyzed taking an example of a two-layer bonded system, such as polyurethane-coated glass-fiber reinforced plastics and steel galvanically coated with nickel among others Factors governing the erosion resistance of systems for protection against erosion are identified and examined Of significant importance are the erosion resistance of the coating material and particularly the shear stresses occurring in the joint S D

A76-22207 # **Sand erosion of dome and window materials** A Behrendt (Dornier System GmbH, Friedrichshafen, West Germany) In International Conference on Rain Erosion and Associated Phenomena, 4th, Meersburg, West Germany, May 8-10, 1974, Proceedings Volume 2 Farnborough, Hants , England, Royal Aircraft Establishment, 1975, p 845-861 9 refs

The sand erosion behavior of some dome and window materials including sapphire and fiber reinforced plastic with a protective layer of coating is studied for cylindrical samples subjected to impingement of sand of various grain sizes in a rotating arm facility Most materials show no incubation period The effects of impact velocity, angle of attack, and grain size on sand erosion are evaluated Results indicate that the resistance of fiber-reinforced plastics to sand erosion can be appreciably improved by suitable coatings such as polyurethane or fluorocarbon The weight losses of protective layers lie within the same order of magnitude as those of metals Unprotected GFRP shows an erosion effect some 8 to 15 times greater than that of polyurethane Materials with a hardness higher than that of SiO2 have a relatively low degree of erosion, hence sapphire and Degussit Al 22 are most suitable for use as dome and window materials S D

A76-22222 # ***Research and development applications of the* new NAE air-borne simulator** W S Hindson and S R M Sinclair (National Aeronautical Establishment, Flight Research Laboratory, Ottawa, Canada) *(Canadian Aeronautics and Space Institute, Flight Test Symposium, Edmonton, Alberta, Canada, Mar 12, 1975) Canadian Aeronautics and Space Journal,* vol 21, Oct 1975, p 305-316 16 refs

The National Aeronautical Establishment of Canada has developed an airborne flight simulator, based on a single rotor helicopter, which can simulate a fairly wide range of V/STOL aircraft The concept of the simulator can best be described as a flight simulation task typical of a ground-based simulation facility but where the cockpit motion results from controlling the helicopter simulation platform as a servomechanism The design characteristics of the simulation helicopters are described with particular attention paid to the electrohydraulic control system, the autopilot design, the instrumentation and the onboard computers with emphasis on the computational capacity The general control logic and fault monitoring of the integrated simulator system is described Independent control of longitudinal and lateral linear motion is considered, and the flight control and guidance aspects of the helicopter are discussed B J

A76-22283 **Design freedom offered by fly-by-wire** C F Newberry (Boeing Co , Wichita, Kan) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif , Nov. 17-20, 1975, Paper 751044* 7 p 7 refs

The paper examines the basic principles of the fly-by-wire (FBW) approach and the control configured vehicle design philosophy, studies their benefits and technological requirements, and suggests the possibility of a synergism of FBW and CCV Although the advantages of FBW and CCV have been demonstrated, they have not received widespread consideration for new aircraft designs, because insufficient information and preliminary design tools are available It is necessary that preliminary design efforts include personnel with electronic/electrical experience These designers must have available fast iterative techniques to configure the FBW/CCV system The design procedure must allow for specification of reliability requirements, load criteria, handling qualities, and system stability, and must lead to system weight and cost predictions P T H

A76-22284 **Fly-by-wire flight control system design considerations for fighter aircraft** E C Livingston (General Dynamics Corp , Fort Worth, Tex) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif , Nov 17-20, 1975, Paper 751046* 9 p

The application of fly-by-wire flight control systems in fighter aircraft influences the basic design of the aircraft and requires special attention to certain design characteristics of the control system The use of control-configured vehicle concepts for performance benefits makes fly-by-wire a logical choice Redundancy management, protection against power loss, lightning protection and controller selection are prime design factors to be considered Flight testing of the YF-16 aircraft has demonstrated excellent performance and operating characteristics of its fly-by-wire flight control system (Author)

A76-22288 * **Trends in high temperature materials technology for advanced aircraft turbine engines** C P Blankenship (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif , Nov. 17-20, 1975, Paper 751050* 14 p 32 refs

The utilization of high temperature materials for turbine blades, disks, vanes, and combustors is reviewed The use of directionally solidified eutectic alloys and of metal fiber reinforced superalloys as turbine blade materials is discussed The application of powder metallurgy to the production of turbine disks is considered It is shown that oxide-dispersion strengthened alloys (including NiCr and NiCr-Al) and ceramics are the best refractory turbine vane materials The use of heat resistant sheet alloys as combustor materials is examined The cost benefits to be derived from the application of high temperature technology to advanced CTOL and STOL engines are described B J

A76-22289 **Impact of active controls on future transport design, performance, and operation** R L Schoenman and H A Shomber (Boeing Commercial Airplane Co , Renton, Wash) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif , Nov 17-20, 1975, Paper 751051* 18 p

The paper reviews Active Control Technology (ACT) and discusses the impact of ACT on transport aircraft design and

performance ACT means that improvements in aircraft efficiency are possible through increased dependence on augmentation control systems Six different ACT systems are described (1) augmented stability, (2) gust load alleviation, (3) maneuver load control, (4) fatigue reduction, (5) ride control, and (6) flutter mode control The feasibility of two other ACT systems active landing gear for reducing taxi loads and advanced electronic propulsion systems - is examined The cost benefits of ACT are discussed in terms of sensitivity to design speed, range, configuration and size, and the risks associated with ACT implementation are considered B J

A76-22291 Future SST engines with particular reference to Olympus 593 evolution and Concorde experience P H Calder and P C Gupta (Rolls-Royce /1971/, Ltd, Bristol, England) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751056* 23 p 7 refs

The current achievements of Concorde and its powerplant are summarized, and the route by which technology may be evolved for making further SST performance and environmental advances appropriate to a second generation aircraft is indicated Experimental data on take-off noise is discussed Future improvements in turbine cooling technology applied to a turbofan of around 1 7 bypass ratio, together with possible future improvements in aircraft L/D and structure weight, should permit the development of an SST with substantial increases in payload percentage and range relative to Concorde while meeting current noise limits without a suppression system The engine could be derived from the current Olympus 593 Mk 610 (Author)

A76-22303 Fairchild Republic advanced fighter technology integrator /AFTI/ - Phase 1 program review G Rosenthal (Fairchild Republic Co, Farmingdale, N Y) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751077* 33 p USAF-sponsored research

A study was made of desirable advanced fighter technologies for integration into a demonstrator aircraft which would be used to evaluate combat effectiveness The demonstrator aircraft configuration development is traced, and its physical and performance characteristics are summarized The technologies incorporated are described and their performance characteristics and benefits are discussed and substantiated by applicable wind tunnel or manned simulation results Key technologies include advanced aerodynamic configuration, advanced structural concepts, integrated maneuvering nozzle, variable incidence outer wing panel, variable camber, chin fin, multi-mode digital fly-by-wire control system, integrated fire flight control system, and high acceleration crew station (Author)

A76-22304 Vectored lift advanced fighter technology integrator T A Gibbons and H H Ostroff (McDonnell Aircraft Co, St Louis, Mo) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751079* 19 p USAF-supported research

The paper presents the results of an advanced fighter technology integration study, which involved identification of high-payoff, mature technologies, the integration of these technologies into effective operational configurations, the design of manned demonstrator aircraft, and the validation of a selected concept through windtunnel tests and manned simulation. The Vectored Lift Fighter (VLF), employing new flight and control modes, was studied In the air-to-ground role, this advanced technology fighter/attack aircraft, when compared in sophisticated manned simulation with a baseline representative of the best current technology, killed one-and-a-half times as many targets while sustaining only one-fourth as many losses In air-to-air engagements, it killed twice as many targets while sustaining only one-sixth as many losses Perhaps the most significant finding was that the effectiveness of fighter/attack aircraft employing these new flight and control modes cannot be properly assessed by traditional performance parameters (Author)

A76-22305 * Variable cycle engines for advanced supersonic transports R A Howlett and H Kozlowski (United Technologies Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751086* 10 p NASA-sponsored research

Variable Cycle Engines being studied for advanced commercial supersonic transports show potential for significant environmental and economic improvements relative to 1st generation SST engines The two most promising concepts are a Variable Stream Control Engine and a Variable Cycle Engine with a rear flow-control valve Each concept utilizes variable components and separate burners to provide independent temperature and velocity control for two coannular flow streams Unique fuel control techniques are combined with cycle characteristics that provide low fuel consumption, similar to a turbojet engine, for supersonic operation This is accomplished while retaining the good subsonic performance features of a turbofan engine A two-stream coannular nozzle shows potential to reduce jet noise to below FAR Part 36 without suppressors Advanced burner concepts have the potential for significant reductions in exhaust emissions In total, these unique engine concepts have the potential for significant overall improvements to the environmental and economic characteristics of advanced supersonic transports (Author)

A76-22306 Modern aviation turbine fuel handling systems J R McCoy (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751087* 7 p 12 refs

Air Force design criteria have been published for the pressurized hydrant fueling system, and the philosophy and operation of a typical system is described The use of noncorrosive pipeline materials and the internal coating of storage tanks have contributed significantly to maintaining a high level of quality for aviation fuels Experience with the use of fiberglass reinforced plastic pipe is discussed (Author)

A76-22307 Predicting propulsion related drag of jet aftbodies P W Herrick (United Technologies Corp, Pratt and Whitney Aircraft Div, East Hartford, Conn) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751088* 15 p 12 refs

Two propulsion related drag correlation parameters have been developed Existing or planned parametric jet aftbody drag data can therefore be reduced into a simple prediction technique for aircraft preliminary design studies The drag due to the external nozzle geometry correlates with the average slope of the aftbody's area distribution (Integral Mean Slope), and the drag influence of the internal nozzle geometry/exhaust plume correlates with an effective plume inclination angle (Plume Correlation Parameter) The propulsion related drags of single, twin, and two-dimensional jet installations, and convergent, convergent-divergent, and plug nozzles are shown to correlate with the two parameters An example of the prediction system utilization is also presented (Author)

A76-22308 The transonic jet flap - A review of recent results H Yoshihara (General Dynamics Corp, Convair Div, San Diego, Calif) and D Zonars (USAF, Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif, Nov 17-20, 1975, Paper 751089* 11 p

Experimental results are used to explore the physical mechanism of lift augmentation and the drag due to lift, and to show the inadequacies of the Taylor-Spence thin jet model of the jet flap In the jet-flapped wing-fuselage configuration, 3D effects, particularly due to the wing-fuselage interference, are shown to have major effects on the performance of the jet flap At large sweeps the 3D vortical nature of the shock-induced separation is shown to also play a dominant role (Author)

A76-22309 **Aircraft pay-offs and requirements for a jet flap propulsion system** S M Silverman (Rockwell International Corp., El Segundo, Calif.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751091* 11 p

The technology of an afterburning jet flap is reviewed, and its potential for improving fighter aircraft performance is considered The nature of the aerodynamic-propulsion system interaction is described with particular attention paid to flap span effects on induced lift The integration of the propulsive-lift jet flap into a fighter aircraft is dependent on several major design considerations related primarily to afterburner flow and geometrical parameters It is shown that the jet flap, because of its interaction with the wing flow field, provides a means of increasing the design wing loading while maintaining the required maneuverability B J

A76-22310 * **Propulsion concepts for high speed aircraft** F D Stull (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio), R A Jones (NASA, Langley Research Center, Hampton, Va.), and W P Zima (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751092* 17 p 14 refs

A wide variety of potentially useful and effective airbreathing aircraft have been postulated to operate at speeds in excess of Mach 3.0 by NASA and the USAF These systems include hydrogen fueled transports of interest for very long ranges and airbreathing launch vehicles which are aircraft type first stage candidates for future space shuttle systems Other high speed airbreathing systems for possible future military applications include advanced reconnaissance and fighter/interceptor type aircraft and strategic systems This paper presents (1) a chronology of Air Force technical activity on future propulsion concepts, (2) a status report on NASA research on scramjet technology for future systems which may require speeds above Mach 5, and (3) a description of a research vehicle by which advanced propulsion technology and other technologies related to high speed can be demonstrated (Author)

A76-22311 **Tank and fuel systems considerations for hydrogen fueled aircraft** G D Brewer and R E Morris (Lockheed-California Co., Burbank, Calif.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751093* 18 p 9 refs

The feasibility of using liquid hydrogen as a fuel for subsonic and supersonic transport aircraft is examined and the advantages which would result from its use are discussed The use of liquid hydrogen results in aircraft designs which are lighter, quieter, use smaller engines, are able to operate from shorter runways, minimize pollution, and expend less energy Liquid-hydrogen fueled aircraft can be operated by the airlines at a significant savings in direct operating cost The requirements of hydrogen tank and fuel system design indicate that it is feasible to construct a prototype system using today's state of the art Certain areas, though, require significant technological improvement to meet airline standards These include tank insulation and repairability, instrumentation systems, and engine pump and fuel control systems B J

A76-22315 * **Mechanically coupled lift fan propulsion and control for multimission V/STOL aircraft** J M Zabinsky, P Gotlieb, and G W Jakubowski (Boeing Commercial Airplane Co., Renton, Wash.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751100* 7 p 8 refs Contract No. NAS2-6563

A two-engine, three-fan V/STOL airplane was designed to fulfill naval operational missions Use of interconnected variable pitch fans led to a good balance between the requirements for high thrust and responsive control at low speed, and efficient thrust at cruise speeds Engine-out requirements, integration of propulsion and aerodynamic controls, and the propulsion installation were the major factors influencing the configuration An airplane with a multimission capability from both vertical and short takeoff was conceived (Author)

A76-22316 **How requirements influence the lift/cruise fan aircraft.** L E Ames (McDonnell Aircraft Co., St Louis, Mo.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751101* 11 p

The development of a multimission V/STOL aircraft with powered lift for various naval operations is discussed The advantages of the lift fan in reducing Specific Fuel Consumption and giving good thrust augmentation are described A propulsion design philosophy is developed, examining the elements and ramifications of two different gas generator/lift fan sizing philosophies Methods for obtaining gas generator emergency ratings are considered along with the philosophy of fuselage sizing B J

A76-22317 **Vertical attitude takeoff and landing remotely piloted demonstration vehicle** W H Eilertson (U S Naval Material Command, David W Taylor Naval Ship Research and Development Center, Carderock, Md.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751103* 19 p

The VATOL remotely piloted vehicle for demonstration purposes incorporates a delta wing, has its power plant located at the rear of the aircraft, and uses a close coupled canard to extend maximum lift A single vertical tail is used for horizontal flight directional stability, and elevons on the wing and a rudder on the vertical tail are used for horizontal flight control The Harpoon midcourse guidance unit serves as both an autopilot and an inertial navigator by means of an Attitude Reference Assembly in a strapdown inertial sensor configuration, a digital computer autopilot and a self-contained power supply Experimental data on aerodynamic performance (trim lift vs trim drag, longitudinal stability, lateral stability), jet vane performance, velocity distribution, and exhaust flow conditions at lift-off are discussed The results of engine installation tests are presented, together with the planning of future flight tests tethered hover tests, horizontal flight tests, and ship interface tests B J

A76-22318 **Three-engine two-fan Navy multimission V/STOL aircraft considerations.** J C Ford (Rockwell International Corp., Los Angeles Aircraft Div., Los Angeles, Calif.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751104* 15 p 5 refs

A three-engine, two-fan arrangement for an advanced vertical and short takeoff and landing (V/STOL) lift/cruise multimission aircraft has many advantages With three engines, sufficient engine-out thrust is available for safe operation, over the range of multimission emergency landing requirements The flexibility offered by being able to shut down one engine for loiter and cruise results in a fuel-conserving aircraft The capability to add the power of the third engine provides a high-speed vehicle when the mission requires A two-fan system with fans under each wing provides for smooth transition from vertical flight to forward flight and return Minimum-distance STOL performance is achievable because all of the thrust is available to accelerate the aircraft during the takeoff ground roll and to interact with the wing during climbout In shaft-driven systems, clutching horsepower can be drastically reduced or eliminated Fans can be made interchangeable Maximum fuselage volume is available for payload and operational systems components Wing-mounted pod arrangements provide good compatibility with such passenger-carrying configurations as vertical onboard delivery (VOD) and commercial aircraft (Author)

A76-22319 **Improvements in VTOL engineering resulting from the U S Army HLH and YUH-61 programs** W E Hooper (Boeing Vertol Co., Philadelphia, Pa.) *Society of Automotive*

Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751105 20 p 9 refs

Various improvements relating to performance, flying qualities, reliability, and utility based on specifications for the Heavy Lift Helicopter and the YUH-61 are discussed These include improvements in rotor hover performance, reduction of airframe vibration, improved pitch and roll control with hingeless rotors and improved single rotor yaw control Also considered are improved control in hover for cargo handling, drive system development, improved survivability, reliability, and maintainability (emphasizing defect tolerant design for survivability) B J

A76-22320 Rotor technology for new generation helicopters D S Jenney (United Technologies Corp., Sikorsky Aircraft Div., Stratford, Conn.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751106* 12 p 5 refs

A systems approach, with emphasis on life cycle costs, is brought to bear on the design of utility transport helicopters The development of the heavy lift rotor for the CH-54A and CH-54B is considered The rotor blades of the CH-53E and the YUH-60A (UTTAS) are described in detail The use of a titanium spar which can take more than twice the vibratory strain of an aluminum spar, thereby permitting a high blade twist to optimize hover performance while achieving good cruise speed is the main advantage The development of a graphite composite blade for the H-3 helicopter is discussed as well as the development of a graphite composite bearingless rotor used on UTTAS The Sikorsky Advancing Blade Concept which uses two coaxial counterrotating rigid rotors to eliminate retreating blade stall is described B J

A76-22321 Metal/composite hybrid rotor blade spar construction P A Reyes and M Glass (Bell Helicopter Co., Fort Worth, Tex.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751107* 9 p

Unidirectional fiberglass straps are investigated as a means of providing metal rotor blades with a redundant load path and reduced fatigue crack growth rate A comparison of crack growth rates for a metal/composite hybrid spar and a conventional metal blade structure are shown Comparisons of ballistic impact damage for the hybrid spar and the metal spar are presented Additionally, the results of small specimen fatigue tests to investigate void propagation at the glass/metal interface are discussed (Author)

A76-22322 Composite structures - Technical breakthrough for helicopter rotor blades L L Douglas and W K Stratton (Boeing Vertol Co., Philadelphia, Pa.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751108* 19 p

In this decade we are witnessing the transition from all metal to all composite helicopter rotor blades One such helicopter is already in full scale production A driving factor is structural reliability and guarantee against catastrophic failure Low crack propagation rate and the nature of failures in composite structures are the characteristics which make this quality product superior to metal structures for rotor blades The ability to economically tailor blades aerodynamically and dynamically offer important advances in performance, flying qualities, low stress levels, and low vibratory forces (Author)

A76-22323 Component performance and system payoff for advanced internal power generation unit F J Suriano (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper 751114* 11 p

It is shown how small gas turbine engines for aircraft internal power systems have evolved into high performance engines in terms of horsepower per engine cubic foot and pound These performance levels must be met while facing various problems which include operation at higher loading percentages for a longer time than a propulsion engine, installations that generally are not as 'clean' relative to envelope, volume, and weight as propulsion system installations, extremely high engine rotating speeds, generally smaller sized aerodynamic components that are more susceptible to scaling, clearance, and matching problems, and the dichotomy of high performance and low cost objectives Some of these problems are demonstrated by examining the engine performance influence coefficients of a USAF advanced internal power generation engine and comparing them with those of a larger propulsion engine B J

A76-22326 * # A review of the QCSEE program C C Ciepluch (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov 17-20, 1975, Paper* 23 p

A description of the overall QCSEE (Quiet Clean Short-haul Experimental Engine) Program is presented The design of the two experimental engines in the program is essentially completed The engine designs are described and projections of their performance presented And finally, the advanced technology elements being incorporated into the engines are discussed (Author)

A76-22374 # An unsteady vortex panel method and its application to aeroelastic calculations of a fixed, thin wing and an unconstrained flying vehicle H U Mai Helsinki University of Technology, Doctor of Technology Thesis, 1975 114 p 35 refs Research supported by the Emil Aaltonen Foundation

The paper describes a generalization to unsteady subsonic and supersonic flow of the vortex panel method of Woodward In this method the aerodynamic interaction coefficients are computed by numerically integrating the kernel of the pertinent integral equation over the appropriate elements The strong singularity encountered in the spanwise integration is eliminated by using the method of Mangler The unsteady vortex panel method is applied to derivation of aeroelastic equations of motion for rigidly fixed, thin wing and a free flying vehicle The equations of motion are given in an element method form For the thin wing equations are derived which interrelate the element method forms of material damping and flutter equations with the classical formulations Equations obtained for the free flying vehicle are applied to the aeroelastic analysis of a swept wing bomber (Author)

A76-22401 # Design principles of plants and workshops for aircraft production /2nd revised and enlarged edition/ (Osnovy proektirovaniia samoletostroitel'nykh zavodov i tsekhov /2nd revised and enlarged edition/) V A Tikhomirov Moscow, Izdatel'stvo Mashinostroenie, 1975 472 p 31 refs In Russian

The first part of the textbook is devoted to the general theoretical principles for designing aircraft production plants and workshops, and to a development of a general plan of design The second part deals with methods for designing specific types of plants, including plants for pressing and machining, mechanical processing plants, and plants for the electrochemical processing of aircraft parts and for thermal processing The design of plants for the assembly of aircraft parts, for the final stages of production, and for ground and flight tests is also described The third part is devoted to special auxiliary systems, including data processing and computer control systems for the aircraft plants, and power supply systems for the plants B J

STAR ENTRIES

N76-16033*# Chrysler Corp New Orleans La Space Div
AERODYNAMIC RESULTS OF A SEPARATION TEST (CA20) CONDUCTED AT THE BOEING TRANSONIC WIND TUNNEL USING 0 030-SCALE MODELS OF THE CONFIGURATION 140A/B (MODIFIED) SSV ORBITER (MODEL NO 45-0) AND THE BOEING 747 CARRIER (MODEL NO AX 1319 I-1), VOLUME 1
T Dziubala (Rockwell Intern Downey Calif) V Esparza (Rockwell Intern Downey Calif) R L Gillins (Rockwell Intern Downey Calif) and M Petrozzi (Rockwell Intern Downey Calif) Dec 1975 921 p refs
(Contract NAS9-13247)
(NASA-CR-141844 DMS-DR-2217-Vol-1) Avail NTIS HC $23 75 CSCL 01A

A Rockwell built 0 030-scale 45-0 modified Space Shuttle Orbiter Configuration 14A/B model and a Boeing built 0 030-scale 747 carrier model were tested to provide six component force and moment data for each vehicle in proximity to the other at a matrix of relative positions attitudes and test conditions (angles of attack and sideslip were varied) Orbiter model support system tare effects were determined for corrections to obtain support-free aerodynamics In addition to the balance force data pressures were measured Pressure orifices were located at the base of the Orbiter on either side of the vertical blade strut and at the mid-root chord on either side of the vertical tail Strain gages were installed on the Boeing 747 vertical tail to indicate buffet onset Photographs of aerodynamic configurations tested are shown Author

N76-16034*# Chrysler Corp New Orleans La Space Div
AERODYNAMIC RESULTS OF A SEPARATION TEST (CA20) CONDUCTED AT THE BOEING TRANSONIC WIND TUNNEL USING 0 030-SCALE MODELS OF THE CONFIGURATION 140A/B (MODIFIED) SSV ORBITER (MODEL NO 45-0) AND THE BOEING 747 CARRIER (MODEL NO AX 1319 I-1), VOLUME 2
T Dziubala (Rockwell Intern Downey Calif) V Esparza (Rockwell Intern Downey Calif) R L Gillins (Rockwell Intern Downey Calif) and M Petrozzi (Rockwell Intern Downey Calif) Dec 1975 1021 p refs
(Contract NAS9-13247)
(NASA-CR-141845 DMS-DR-2217-Vol-2) Avail NTIS HC $28 25 CSCL 01A

For abstract see N76-16033

N76-16035*# Chrysler Corp New Orleans La Space Div
AERODYNAMIC RESULTS OF A SEPARATION TEST (CA20) CONDUCTED AT THE BOEING TRANSONIC WIND TUNNEL USING 0 030-SCALE MODELS OF THE CONFIGURATION 140A/B (MODIFIED) SSV ORBITER (MODEL NO 45-0) AND THE BOEING 747 CARRIER (MODEL NO AX 1319 I-1), VOLUME 3
T Dziubala (Rockwell Intern Downey Calif) V Esparza (Rockwell Intern Downey Calif) R L Gillins (Rockwell Intern Downey Calif) and M Petrozzi (Rockwell Intern Downey Calif) Dec 1975 1106 p refs
(Contract NAS9-13247)
(NASA-CR-141846 DMS-DR-2217-Vol-3) Avail NTIS HC $32 75 CSCL 01A

For abstract see N76-16033

N76-16036*# Virginia Polytechnic Inst and State Univ Blacksburg Aerospace and Ocean Engineering Dept
AN INVESTIGATION OF SUPERSONIC AEROELASTIC CHARACTERISTICS OF OBLIQUE WINGED AIRCRAFT
Semiannual Progress Report, 1 Apr - 30 Sep 1975
Terry A Weisshaar 30 Sep 1975 38 p refs
(Grant NsG-2016)
(NASA-CR-146141) Avail NTIS HC $4 00 CSCL 01A

Two formulations of the oblique wing flutter problem are presented one formulation allows wing bending deformations and the rigid body roll degree of freedom while the second formulation includes bending-torsional deformation and roll degrees of freedom Flutter is found to occur in two basic modes The first mode is associated with bending-roll coupling and occurs at low reduced frequency values The other instability mode is primarily one of classical bending-torsion with negligible roll coupling this mode occurs at much higher reduced frequencies The occurrence of bending-roll coupling mode leads to lower flutter speeds while the bending-torsion mode is associated with higher flutter speeds The ratio of the wing mass moment of inertial in roll to the fuselage moment of inertia evidently plays a major role in the determination of which of the two instabilities is critical Author

N76-16039# Aeronautical Research Inst of Sweden Stockholm Aerodynamics Dept
HEAT TRANSFER MEASUREMENTS ON A DELTA WING WITH BLUNTED LEADING EDGES IN HYPERSONIC FLOW
Bo Lemcke Mar 1975 39 p refs
(Contract FMV-INK-11-12-73292)
(FFA-TN-AU-648-Pt-3) Avail NTIS HC $4 00

To study the influence of leading edge blunters on heat transfer rates pressure distribution and heat transfer measurements were made on a model of a delta wing with blunted leading edges in a hypersonic wind tunnel The model was later tested in a free flight experiment at a range in Woomera Australia In the wind tunnel tests the effects of small angles of incidence and yaw were investigated Only small but still noticeable variations in pressure and heat transfer rates were observed The performed measurements of pression and heat transfer distributions on the delta wing together with schlieren and oil dot pictures gave no conclusive results in terms of the flow around the model and the presence of transition to turbulent boundary layer Some modifications in the data processing system and the measurement stations are suggested Author (ESA)

N76-16040# Aeronautical Research Inst of Sweden Stockholm Aerodynamics Dept
CALCULATIONS OF TWO-DIMENSIONAL POTENTIAL FLOW WALL INTERFERENCE FOR MULTI-COMPONENT AIRFOILS IN CLOSED LOW SPEED WIND TUNNELS
Lars-Erik Eriksson Apr 1975 50 p refs
(Contract F-INK-82223-73-009-07001)
(FFA-TN-AU-1116-Pt-1) Avail NTIS HC $4 00

The two-dimensional optimization of high lift devices requires the use of large models to obtain reliable results The accommodation of these models in given wind tunnels necessitates advanced interference calculations since classical wall correction methods are unsatisfactory For attached flow it is thought that the total interference can be separated into a viscid wake blockage part and an inviscid potential flow part A numerical method calculating the potential flow part was developed and tested The airfoil and tunnel boundaries were simulated by a continuous surface vortex distribution determined by the boundary conditions The results for a simple airfoil between tunnel walls agree well with analytic methods where these apply Analogous results for a wing-flap configuration show that the lift interference is nonlinear in lift coefficient This effect is caused by the large vertical displacement of the flap Author (ESA)

N76-16041# National Aerospace Lab Amsterdam (Netherlands)
AN INTRODUCTORY DESCRIPTION OF A HODOGRAPH METHOD FOR TRANSONIC SHOCK-FREE AEROFOIL DESIGN
J W Boerstoel and G H Huizing 15 Nov 1973 43 p refs
(NLR-TR-73152-U) Avail NTIS HC $4 00

The aerodynamic design process for transonic shock-free airfoils using the analytical hodograph theory is sketched A user-oriented outline of the developed program system is presented A number of examples of computed airfoils show that the computer program package provides final results of sufficient accuracy at acceptable costs and seems flexible enough to cover a wide range of engineering applications ESA

N76-16044# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
ON THE DETERMINATION OF BODY-WING INTERFERENCE IN THE NONLINEAR ANGLE OF ATTACK RANGE [ZUR BESTIMMUNG DER FLUEGEL-RUMPFINTERFERENZ IM NICHTLINEAREN ANSTELLWINKELBEREICH]
Gregor Gregoriou Bonn DOKZENTBw 1975 28 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin der Verteidigung
(BMVg-FBWT-75-2) Avail NTIS HC $4 00 DOKZENTBw DM 20

Based on a potential theory an iterative singularity method was developed for determining the pressure distribution of symmetric body-wing configurations in the non-linear angle of attack range The body is axisymmetric of finite length and of arbitrary thickness The wing is infinitely thin and located at mid-wing position A comparison with wind-tunnel tests confirms that the proposed mathematical model is adequate but the numerical procedure has to be improved Author (ESA)

N76-16045# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering
CALCULATION METHODS FOR THE SUPERSONIC FLOW FIELD OF AN ARROWED WING WITH SUBSONIC LEADING EDGE WITH PART OF THE FLOW PLANE AS FUSELAGE [BEREKENINGSMETHODEN VOOR HET SUPERSONE STROMINGSVELD VAN EEN PIJLVLEUGEL MET SUBSONE VOORRAND MET EEN DEELSTROOMVLAK ALS ROMP]
J M deKooter Mar 1975 82 p refs In DUTCH Sponsored by Neth Organ for Pure Sci Res (ZWO)

Assuming the fuselage is part of the flow plane of an oblique wing under supersonic conditions the flow fields were calculated At subsonic leading edge conditions this flow is shock free The supersonic flow around an infinite oblique wing is discussed and the geometry of the partial flow planes of the fuselage are dealt with The two-dimensional flow field was calculated followed by a discussion of the three-dimensional flow Finally the shock strength in the far field was calculated An asymptotic treatment of the flow around an oblique wing is annexed ESA

N76-16047# European Space Agency Paris (France)
CALCULATION OF THE INVISCID FLOW FIELD AROUND THREE-DIMENSIONAL LIFTING WINGS, FUSELAGES AND WING-FUSELAGE COMBINATIONS USING THE PANEL METHOD
Syed Rafeeq Ahmed Dec 1975 67 p refs Transl into ENGLISH of Berechnung des reibungslosen Stroemungsfeldes von dreidimensionalen auftriebsbehafteten Tragfluegeln Ruempfen u Fluegel-Rumpf-Kombinationen nach dem Panel-Verfahren DFVLR Brunswick Report DLR-FB-73-102 21 Aug 1973 Original German report available from DFVLR Porz West Ger 16 DM
(ESA-TT-210 DLR-FB-73-102) Avail NTIS HC $4 50

The practical use of the panel method for calculating the inviscid flow field around arbitrarily shaped wings fuselages and wing-fuselage combinations was verified on the basis of four examples swept wing and three wing-body configurations A modified version of a computer program developed at Messerschmitt-Boelkow-Blohm in Munich was used for this investigation Th3 investigations included the prediction of the pressure field over the complete wing and body surfaces of the configurations The results of the calculation were compared with corresponding measurements Author (ESA)

N76-16049# Army Missile Command Redstone Arsenal Ala
A METHODOLOGY FOR DETERMINING THE FLIGHT PATH OF A SIX DEGREE OF FREEDOM AIRCRAFT AND ITS ORIENTATION WITH RESPECT TO A GROUND SITE
Harold R Bright and John M Whitaker Jul 1975 37 p refs (AD-A015011 USAMICON-C-TR-75-11) Avail NTIS CSCL 01/2

This report presents a unique methodology for determining maneuvers of a six degree of freedom target whose flight path has been prescribed by a set of straight line segments The attitude of this target at any point in time with respect to a ground site is also determined The methodology can be applied to the modeling of any system whose performance is related to the orientation of the target with respect to a ground site GRA

N76-16052*# Duke Univ Durham N C Dept of Civil Engineering
THE ROLE OF THE HELICOPTER IN TRANSPORTATION
Jarir S Dajani Dennis Warner David Epstein and Jeremy OBrien 13 Feb 1976 75 p refs
(Grant NsG-1121)
(NASA-CR-146351) Avail NTIS HC $4 50 CSCL 01C

A general overview is presented of the role that the helicopter plays in the current aviation scene with special emphasis on its use in the airport access function Technological problems of present-day aircraft are discussed along with some plausible solutions The economic and regulatory aspects of commercial helicopter operations are presented Finally six commercial operations utilizing helicopters are reviewed and conditions that enhance the success of the helicopter in the airport access function are proposed Author

N76-16053# Committee on Government Operations (U S House)
IMPROVED PROCEDURES NEEDED BY FAA FOR IMPLEMENTING NTSB SAFETY RECOMMENDATIONS
Washington GPO 1975 73 p refs Hearing before a subcomm of Comm on Govt Operations 94th Congr 1st Sess 25 Mar 1975
(GPO-50-870) Avail Comm on Govt Operations

The Federal Aviation Administration (FAA) system for responding to and implementing the National Transportation Safety Board s recommendations following an aircraft accident investigation is examined along with the Board s system for monitoring and following up on FAA s responses J M S

N76-16055# Naval Surface Weapons Center White Oak Md
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS BASIC RELATIONSHIPS IN MILITARY FIRES, PHASE 4, HIGH SPEED DISSEMINATION OF DRY CHEMICAL FIRE SUPPRESSION AGENTS Final Technical Report, Mar - Nov 1974
R S Alger F I Laughridge L L Wiltshire R G McKee and W H Johnson Wright-Patterson AFB Ohio DOD Aircraft Ground Fire Suppression and Rescue Office May 1975 63 p refs Prepared jointly by Stanford Res Inst Menlo Park Calif
(AD-A014227 DOD-AGFSRS-75-3) Avail NTIS CSCL 13/2

The feasibility and effects of applying dry chemical fire suppression agents at very high rates were explored with a series of cascade and pool type jet-fuel fires Powders were dispensed at conventional rates with hand held extinguishers and at high rates with a rocket motor type disseminator Typical discharge conditions with the high speed disseminator are described along with fire sizes and effectiveness GRA

N76-16056# Naval Surface Weapons Center White Oak Md
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS BASIC RELATIONSHIPS IN MILITARY FIRES PHASES 3, 5, 6, AND 7 Final Technical Report, Oct 1971 - Nov 1974
R S Alger and Ervin L Capner Wright-Patterson AFB Ohio DOD Aircraft Ground Fire Suppression and Rescue Office May 1975 158 p refs Prepared jointly by Stanford Res Inst Menlo Park Calif
(AD-A014228 DOD-AGFSRS-75-4) Avail NTIS CSCL 13/12

The suppression of class B fuel fires with aqueous film forming foam was studied as a function of fuel, environment and mode of agent application Cooling insulating and isolating the fuel were examined as functions of conventional foam quality parameters such as expansion ratio drainage rate and agent concentration In field tests on fires ranging in area from 1500 to 48 000 sq ft suppression efficiency and burnback protection were measured as a function of foam quality and mode of application from various crash trucks Yardsticks were defined to evaluate the efficiency of equipment and techniques and two simple extinguishment models were developed GRA

N76-16058*# Massachusetts Inst of Tech Cambridge Decision and Control Sciences Group
DESIGN AND SIMULATION OF A DESCENT CONTROLLER FOR STRATEGIC FOUR-DIMENSIONAL AIRCRAFT NAVIGATION M S Thesis
Frederick M Lax Nov 1975 206 p refs
(Grant NGL-22-009-124 Contract DOT-TSC-982)
(NASA-CR-146127, ESL-R-632) Avail NTIS HC $7 75 CSCL 17G

A time-controlled navigation system applicable to the descent phase of flight for airline transport aircraft was developed and simulated The design incorporates the linear discrete-time sampled-data version of the linearized continuous-time system describing the aircraft s aerodynamics Using optimal linear quadratic control techniques an optimal deterministic control regulator which is implementable on an airborne computer is designed The navigation controller assists the pilot in complying with assigned times of arrival along a four-dimensional flight path in the presence of wind disturbances The strategic air traffic control concept is also described followed by the design of a strategi control descent path A strategy for determining possible times of arrival at specified waypoints along the descent path and for generating the corresponding route-time profiles that are within the performance capabilities of the aircraft is presented Using a mathematical model of the Boeing 707-320B aircraft along with a Boeing 707 cockpit simulator interfaced with an Adage AGT-30 digital computer a real-time simulation of the complete aircraft aerodynamics was achieved The strategic four-dimensional navigation controller for longitudinal dynamics was tested on the nonlinear aircraft model in the presence of 15 30 and 45 knot head-winds The results indicate that the controller preserved the desired accuracy and precision of a time-controlled aircraft navigation system Author

N76-16064*# Lehigh Univ Bethlehem Pa Dept of Mechanical Engineering
AIRCRAFT MODEL PROTOTYPES WHICH HAVE SPECIFIED HANDLING-QUALITY TIME HISTORIES Final Technical Report
S H Johnson Jan 1976 150 p refs
(Grant NsG-4005)
(NASA-CR-146138) Avail NTIS HC $6 00 CSCL 01C

Several techniques for obtaining linear constant-coefficient airplane models from specified handling-quality time histories are discussed One technique the pseudodata method solves the basic problem yields specified eigenvalues and accommodates state-variable transfer-function zero suppression The method is fully illustrated for a fourth-order stability-axis small-motion model with three lateral handling-quality time histories specified The FORTRAN program which obtains and verifies the model is included and fully documented Author

N76-16065*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OH-58 HELICOPTER TRANSMISSION FAILURE ANALYSIS
D P Townsend J J Coy (Army Air Mobility Res and Develop Lab Cleveland), and B R Hatvani Jan 1976 35 p refs
(NASA-TM-X-71867 E-8633) Avail NTIS HC $4 00 CSCL 01C

The OH-58 main transmission gearbox was run at varying output torques speeds and oil cooling rates The gearbox was subsequently run to destruction by draining the oil from the gearbox while operating at a speed of 6200 revs per minute and 36 000 inch-pounds output torque Primary cause of gearbox failure was overheating and melting of the planet bearing aluminum cages Complete failure of the gearbox occurred in 28 1/2 minutes after the oil pressure dropped to zero The alternating and maximum stresses in the gearbox top case were approximately 10 percent of the endurance limit for the material Deflection of the bevel gear at 67000 inch-pounds output torque indicate a marginal stiffness for the bevel gear supporting system Author

N76-16066*# Lockheed-Georgia Co Marietta
CORRELATION OF C-5A ACTIVE LIFT DISTRIBUTION CONTROL SYSTEM (ALDCS) AEROELASTIC MODEL AND AIRPLANE FLIGHT TEST RESULTS
H D McWhirter W W Hollenbeck and W F Grosser [1976] 199 p refs
(Contract NAS1-13731)
(NASA-CR-144903) Avail NTIS HC $7 50 CSCL 01C

The C-5A aeroelastic wind tunnel model and airplane flight test results each with an active lift distribution control system (ALDCS), are correlated on a one-to-one-basis The ALDCS redistributes the outer wing lift to reduce wing-bending moments and maintains trim flight when the aircraft encounters vertical gusts and/or performs symmetrical maneuvers The system responds electrically to vertical acceleration and pitch rate to command aileron and inboard elevator deflections The primary data presented are aeroelastic responses to oscillating aerodynamic controls The correlation shows that an aeroelastic model is a useful tool in the development of active control technology and systems Author

N76-16067*# Joint Publications Research Service Arlington Va
HELICOPTERS ON THE BAYKAL-AMUR LINE
V A Nazarov Washington NASA Feb 1976 52 p Transl into ENGLISH from Izd Transp (Moscow) 1975 p 1-72
(NASA Order W-13183)
(NASA-TT-F-16869) Avail NTIS HC $4 50 CSCL 01C

Flight performance and technical specifications of the Mi-8 Mi-6 Mi-10K, Mi-2, Ka-26 Mi-4 and Mi-1 helicopters are reported in relation to their use in the construction of the Baykal-Amur Line The book is designed for pilots technical personnel and construction leaders and workers on the Line Author

N76-16068# Loughborough Univ of Technology (England) Dept of Transport Technology
LIGHT AIRCRAFT DESIGN PROJECTS 1972 LUTRAC AND TWILIGHT
L R Jenkinson May 1975 27 p Presented at the Can Aeron and Space Inst Symp on Recreational Aircraft Ottawa 23-25 Jun 1975
(TT-7505) Avail NTIS HC $4 00

Two light aircraft design studies undertaken by finalist students studying aeronautical engineering and design are described The first study the formula 1 racer Lutrac (Loughborough University Tourer/Racer Aircraft) concerns the postulating of a new formula for air racing and therefore the design of an aircraft to compete in this class The second study Twilight (Twin Light aircraft) results from the desirability to reduce the minimum size of twin-engined light aircraft in order to affect lower initial and operating costs The major parameters affecting the aircraft size are the airworthiness criterion for flight performance following engine failure and the availability of engines at a power to match the above requirements Some modifications to the aircraft specifications are shown to be necessary and these changes would be incorporated in further design work ESA

N76-16069# Boeing Vertol Co Philadelphia Pa
CH-47C FIXED-SYSTEM STALL-FLUTTER DAMPING Final Report, Feb 1974 - Mar 1975
Joseph M Baskin Aug 1975 37 p refs
(Contract DAAJ02-74-C-0029 DA Proj 1F2-62208-AH-90)
(AD-A014890 USAAMRDL-TR-75-29) Avail NTIS CSCL 01/3

This program was conducted to evaluate the effect of fixed-system damping on stall-induced control loads Damping

was introduced into the CH-47C aft-rotor control system by connecting the housing portion of the linear damper to the longitudinal-trim system and grounding the piston portion of the damper to the aft transmission Five damper-rate configurations were evaluated on a helicopter with a gross weight of 40 000 pounds Data obtained in speed sweeps at five density altitudes to 10 000 feet indicate that the rotating-system loads were reduced by 16 percent and the fixed-system loads were reduced by 22 percent The program proved that fixed-system damping is effective in reducing stall-induced control loads Recommendations are presented for reducing these loads by softening the swashplate support as well as by increasing the effectiveness of the fixed-system damper Author (GRA)

N76-16071# United Technologies Corp Stratford Conn Sikorsky Aircraft Div

FAN-IN-TAILCONE VEHICLE DEFINITION RESULTING FROM ENGINE/TRANSMISSION/AIRFRAME Final Report, 28 May 1974 - 28 May 1975

M L Potash Jul 1975 148 p refs

(Contract DAAJ02-74-C-0042 DA Proj 1G2-62207-AH-89) (AD-A015000 SER-50911 USAAMRDL-TR-75-28) Avail NTIS CSCL 01/1

The study objective was identification of innovative engine/transmission/airframe concepts that provide total airflow and power management to meet the projected requirements of future Army helicopters with minimum effect on vehicle performance A study system specification for a reconnaissance helicopter was developed and a current-technology baseline air vehicle was synthesized Advanced subsystem concepts were developed including integration of the IR suppression/directional control subsystem dynamic components airframe components and airflow subsystems GRA

N76-16072# Dayton Univ Research Inst Ohio

HELICOPTER FATIGUE LOAD AND LIFE DETERMINATION METHODS Final Report, Mar 1974 - Mar 1975

John Patrick Ryan Alan P Berens Richard G Coy and George J Roth Aug 1975 74 p refs

(Contract DAAJ02-74-C-0031 DA Proj 1F2-62208-AH-90) (AD-A014998 USAAMRDL-TR-75-27) Avail NTIS CSCL 01/3

Fatigue life estimation of helicopter dynamic components is a complex process that is currently achieved through many different methods The objective of this study was to review existing methods and to develop a standardized method that could be used by the Army for reliably predicting operational life This report presents results of a detailed review of fatigue life methods used by five helicopter manufacturers as determined by site visits and literature reviews Recommendations for a standardized method are presented in areas of mission spectra definition flight strain survey techniques laboratory fatigue strength characterization and safe-life calculation procedures GRA

N76-16073# Naval Ship Research and Development Center Bethesda Md Aviation and Surface Effects Dept

REMOTELY PILOTED VEHICLE/VERTICAL ATTITUDE TAKE-OFF AND LANDING DEMONSTRATION VEHICLE Final Report

Warren H Ellertson Aug 1975 19 p refs

(AD-A014873 AERO-1209 NSRDC-4697) Avail NTIS CSCL 01/3

Launch and recovery of RPV s aboard ship has been identified by the Navy as a major design impact area Vertical attitude take-off and landing offers attractive advantages to the Navy in that ship/RPV interface problems are alleviated To assess these advantages the Aviation and Surface Effects Department at the Naval Ship Research and Development Center (NSRDC) has designed and constructed a 560 lb demonstration vehicle This vehicle during 1975 will be flight tested to assess vertical hover capability of the RPV in the turbulent aerodynamic wake generated by a ships superstructure while underway GRA

N76-16074# Rochester Applied Science Associates Inc N Y

THE DEVELOPMENT AND APPLICATION OF AN ANALYSIS FOR THE DETERMINATION OF COUPLED TAIL ROTOR/HELICOPTER AIR RESONANCE Final Report

Lawrence R Sutton and Santu T Gangwani Aug 1975 162 p refs

(Contract DAAJ02-74-C-0026 DA Proj 1F2-62209-AH-76) (AD-A014989 RASA/SRL-75-01 USAAMRDL-TR-75-35) Avail NTIS CSCL 01/3

An analysis and associated computer program have been developed to provide a highly sophisticated mathematical representation of coupled tail rotor/support structure systems The coded analysis allows the consideration of an anisotropically supported flexible swashplate control system rotor drive shaft torsional flexibility anisotropic mounting of the gearbox about two mutually orthogonal axes and an elastic support structure such as a fuselage-tailboom-fin structure in addition to the rotor system As such the analysis can also be applied to main rotor systems The resulting analysis has the capability of predicting the air resonance (frequency, stability and mode shape) behavior of a coupled tail rotor/support structure system in hover and forward flight where the rotor may be of a rigid teetering gimballed flexstrap or partial to fully articulated type The blade aerodynamics representation including both quasi-steady and unsteady (Theodorsen s) terms can utilize either a uniform or a variably defined induced velocity field and up to five types of airfoil sections All blade and fuselage-tailboom-fin structure characteristics required to adequately represent these structures in a lumped parameter form are considered including inertia and gyroscopic damping effects The analysis includes aerodynamic interharmonic blade coupling and interharmonic coupling due to support structure behavior GRA

N76-16075# Army Engineer Waterways Experiment Station Vicksburg Miss

A STUDY OF THE EFFECTS OF BRAKING ON DRAG FORCE AND SINKAGE Final Report, Jun - Dec 1966

J L Smith and G W Turnage Aug 1975 51 p refs Sponsored by AF

(AFWL Proj 73-191)

(AD-A014912 AFWL-TR-74-315) Avail NTIS CSCL 01/3

In modern warfare it may be necessary to airlift men and supplies into areas of operations where airfields do not exist are too few or are too far away for proper support operations It is suggested that cargo aircraft land on unsurfaced runways with only minimum preparation This requires landing gear designed to withstand the drag force and wheel sinkage associated with soft soils To determine the effect of braking on drag force and sinkage and to ascertain the feasibility of scale modeling the equipment involved braked wheel tests were conducted at low forward speed in a desert sand environment using specified tires The results are analyzed GRA

N76-16076# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering

AN ANALYSIS OF DECISION CRITERIA FOR THE SELECTION OF F-16 RELIABILITY IMPROVEMENT INCENTIVE ALTERNATIVES M S Thesis

Thomas B Koegel and Nathan B Mills Jr Sep 1975 195 p refs

(AD-A014786 GSM/SM/75S-4) Avail NTIS CSCL 01/3

The F-16 Air Combat Fighter development and acquisition contract includes special logistic supportability incentive alternatives for certain critical subsystems which have been designated as control First Line Units The alternatives are a contractor commitment to a Target Logistic Support Cost a Reliability Improvement Warranty and a Reliability Improvement Warranty with guaranteed mean time between failure The Reliability Improvement Warranties may be selected at either a First Line Unit or module level This report analyzes those alternatives from a Government benefit point of view to assist in the final selection process A methodology is developed to compute significant costs to the Government over the equipment operational lifetime for each alternative with the exception of module level Reliability Improvement Warranties The procedure and results of the methodology are demonstrated for two selected F-16 First Line Units the Flight Control Computer and the Heads

Up Display Electronics Limitations and assumptions of the methodology are identified and discussed GRA

N76-16077# Army Aviation Systems Command St Louis Mo
MAJOR ITEM SPECIAL STUDY (MISS), OH-58A FREE-WHEELING ASSEMBLY Interim Report, 1 Oct 1969 - 31 May 1974
Aug 1975 21 p
(AD-A014895 USAAVSCOM-TR-75-33) Avail NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA form 2410 reportable components These are time change items and certain condition change items selected because of high cost or need for intensive management Basically the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting From this data removal distributions can be plotted and an MTR (mean time to removal) can be calculated The MISS reports then investigate possible cost savings based on total elimination of selected failure modes These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas Author (GRA)

N76-16081*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECTS OF AIRPLANE CHARACTERISTICS AND TAKE-OFF NOISE AND FIELD LENGTH CONSTRAINTS ON ENGINE CYCLE SELECTION FOR A MACH 2 32 CRUISE APPLICATION
John B Whitlow Jr Jan 1976 49 p refs
(NASA-TM-X-71865 E-8631) Avail NTIS HC $4 00 CSCL 01C

Sideline noise and takeoff field length were varied for two types of Mach 2 32 cruise airplane to determine their effect on engine cycle selection One of these airplanes was the NASA/Langley-LTV arrow wing while the other was a Boeing modified delta-plus-tail derived from the earlier 2707-300 concept Advanced variable cycle engines were considered A more conventional advanced low bypass turbofan engine was used as a baseline for comparison Appropriate exhaust nozzle modifications were assumed where needed to allow all engines to receive either an inherent co-annular or annular jet noise suppression benefit All the VCE s out-performed the baseline engine by substantial margins in a design range comparison regardless of airplane choice or takeoff restrictions The choice among the three VCE s considered however depends on the field length noise level and airplane selected Author

N76-16083# MAN-Acoustics and Noise Inc Seattle Wash
NOISE CERTIFICATION CRITERIA AND IMPLEMENTATION CONSIDERATIONS FOR V/STOL AIRCRAFT Final Report
Nov 1975 82 p refs
(Contract DOT-FA74WAI-490)
(AD-A018036/4 MAN-101M FAA-RD-75-190) Avail NTIS HC $5 00 CSCL 20/1

Although this first phase of a two-phase program emphasized the extent that perceived noise level in PNdB perceived level in dBA and corrections to these engineering calculation procedures reflected annoyance to next generation STOL aircraft noise signatures other aspects of certification implementation were also considered As a means of determining the accuracy and reliability of engineering calculation procedures that could be utilized as a basis for noise certification of V/STOL commercial aircraft 36 persons made annoyance judgements to 34 noise signals presented at 5 different levels The signals included recordings of conventional jet aircraft operations turboprop and reciprocating engine powered commercial aircraft helicopter flybys and simulations of V/STOL operations Both relative annoyance and absolute acceptability judgements were obtained Some of the results are (1) for flyover (not hover) operations EPNdB validly and reliably predicts annoyance (2) for hover type of operations EPNdB under predicts annoyance, (3) when applied to all aircraft types the FAR-36 tone correction degrades reliability for both PNdB and dBA while the duration correction improves reliability to a significant extent and (4) a difference between calculated and judged values should be equal to or greater than 3 EPNdB in order to conclude that the difference is reliable Author

N76-16084# Technische Univ Berlin (West Germany) Inst fuer Luft- und Raumfahrt
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF AEROTHERMODYNAMIC CONTROL OF AIRCRAFT JET PROPULSION SYSTEMS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUR AEROTHERMODYNAMISCHEN UEBERWACHUNG VON LUFTFAHRT-STRAHLTRIEBWERKEN]
Manfred Ziegner 1974 159 p refs In GERMAN
(ILR-2-1974 ISBN-3-7983-0532-3) Avail NTIS HC $6 75

The aerothermodynamic control of aircraft jet engines was investigated in order to study automatic (without taking the engine apart) indication and localization of propulsion system failures The problem of the theoretical values for propulsion control is discussed and an analysis of the influencing factors was made Failure localization is discussed and the measurement method and data collection and data processing techniques are considered Finally experimental investigations are presented ESA

N76-16095# Naval Air Development Center Warminster Pa Air Vehicle Technology Dept
ANALYSIS OF RESPONSE REQUIREMENTS FOR V/STOL LIFT/CRUISE ENGINES USED TO PROVIDE HEIGHT AND MOMENT CONTROL Final Report
J W Clark Jr 30 Jun 1975 78 p refs
(AD-A014868 NADC-75037-30) Avail NTIS CSCL 01/3

Parametric investigations were performed to determine constraints imposed by handling qualities requirements on a V/STOL lift/cruise propulsion system when used to provide at least a portion of the vehicle moment control Primary emphasis was placed on defining the magnitude of engine response time and incremental thrust necessary to satisfy the applicable requirements of the V/STOL Flying Qualities Specification MIL-F-83300 Where possible the results were normalized by baseline aircraft parameters to eliminate configuration dependence GRA

N76-16100*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AN ANALYTICAL STUDY OF AIRCRAFT LATERAL-DIRECTIONAL HANDLING QUALITIES USING PILOT MODELS
James J Adams and Frederick L Moore (Army Air Mobility Research Development Lab Hampton Va) Washington Jan 1976 54 p refs
(NASA-TN-D-8103 L-8452) Avail NTIS HC $4 50 CSCL 01C

A procedure for predicting lateral-directional pilot ratings on the basis of the characteristics of the pilot model and the closed-loop system characteristics is demonstrated A correlation is shown to exist between experimentally obtained pilot ratings and the computed pilot ratings Author

N76-16102# National Aeronautical Establishment Ottawa (Ontario)
[AIRFOIL STUDIES IN NAE 5 ft x 5 ft WIND TUNNEL, SECOND-ORDER WAVE RESEARCH, AND CURRENT PROJECTS] Quarterly Bulletin, 1 Jul - 30 Sep 1975
Sep 1975 92 p refs
(DME/NAE-1975(3) ISSN-0047-9055) Avail NTIS HC $5 00

The NAE wind tunnel is described with emphasis on the facility's usefulness in modern airfoil development Results are presented from investigations of a large variety of airfoils demonstrating the effect of Reynolds number on airfoil characteristics A brief description of wave drift forces is given along with

a listing of current research in various areas including control systems and human engineering engine design fuels and lubricants gas dynamics high speed aerodynamics low speed aerodynamics marine dynamics low temperature research structures and materials and unsteady aerodynamics J M S

N76-16113# Utah State Univ Logan Coll of Engineering
MODEL STUDY OF C-5A LANDINGS ON DOW TRUSS WEB LANDING MAT Final Report, 28 Jun 1973 - 28 Mar 1975
Fred W Kiefer Paul T Blotter and Vance T Christiansen Aug 1975 97 p refs
(Contract F29601-73-C-0131 AF Proj 683M DA Proj 1T1-62112-A-131)
(AD-A015021 AEWES-CR-S-75-3) Avail NTIS CSCL 01/5

A series of model C-5A landing tests on 4 by 4 5 ft and 2 by 9 ft Dow truss web landing mat runways were studied using a 1/7 scale physical model Model landing mat units were constructed of extruded aluminum joint edges bonded to a foam core fiber glass panel Simulated landings were made on 14 5 by 128 ft mat runways The model 4 by 4 5 ft mats were tested in four runway laying patterns Laying patterns without a transverse hinged joint formed the most stable runway When laid in the standard brick pattern with a transverse hinged joint the 4 by 4 5 ft mat runway was more stable than the 2 by 9 ft mat runway The 2 by 9 ft mat runways were tested only in the standard brick pattern Restraint at the runway edge did not prevent buckling of the 2 by 9 ft mat runway in the standard brick pattern Tension anchors at the touchdown end of the runway controlled th3 longitudinal displacement and prevented buckling of both mat types when laid in the standard brick pattern The use of end anchorage appears to be a practical method to reduce mat runway maintenance and prevent buckling failure Author (GRA)

N76-16114# General Dynamics/Convair San Diego, Calif
STUDY OF MULTIPIECE, FLOW-THROUGH WIND TUNNEL MODELS FOR HIRT Final Report, Apr - Dec 1973
W K Alexander S A Griffin and A E Brady Nov 1975 92 p refs
(Contract F40600-72-C-0015)
(AD-A017286 CASD-AFS-73-006, AEDC-TR-75-60) Avail NTIS CSCL 14/2

The usefulness of the proposed High Reynolds Number Transonic Wind Tunnel (HIRT) of AEDC will be largely influenced by the restrictions placed on testing due to model limitations A preliminary study of models determined that basic models (without internal airflow) could be designed and tested in HIRT with few restrictions The present study contains a more detailed analysis of the limitations of a high-performance fighter aircraft model with variables similar to those for present-day transonic wind tunnels A typical test plan is outlined and model balance and support system limitations are presented GRA

N76-16256# Advisory Group for Aerospace Research and Development Paris (France)
ELECTROMAGNETIC NOISE INTERFERENCE AND COMPATIBILITY
Nov 1975 585 p refs In ENGLISH and FRENCH Presented at the Joint Avionics/Electromagnetic Wave Propagation Panels Symp Paris 21-25 Oct 1974
(AGARD-CP-159) Avail NTIS HC $13 75

Electromagnetic interference and compatibility studies on avionics equipment and subsystems are presented

N76-16273 Ministry of Defence London (England)
ELECTROMAGNETIC COMPATIBILITY IN MILITARY AIRCRAFT
D H Hight and W A Kelly *In* AGARD Electromagnetic Noise Interference and Compatibility Nov 1975 5 p ref

Common sources of electromagnetic compatibility problems ar3 outlined and the difficulties confronting engineers who are responsible for producing successful aircraft weapon systems are discussed A definition of EMC is given within the context of an aircraft weapon system EMC problems can be minimized by defining clearly the requirements of the weapon system translating this requirement into an overall system specification defining subsystem and installation specifications writing an EMC control plan and producing a detailed test plan Author

N76-16281 Electronic Communications Inc St Petersburg Fla
ANTENNA-TO-ANTENNA EMC ANALYSIS OF COMPLEX AIRBORNE COMMUNICATION SYSTEMS
William L Dillion *In* AGARD Electromagnetic Noise Interference and Compatibility Nov 1975 16 p ref

Methodology and applied techniques for antenna-to-antenna electromagnetic compatibility analysis of complex airborne communication systems are presented Potential interference modes and system isolation factors are examined in conjunction with a typical equipment complement A method of analysis is discussed which uses computer calibrated antenna space isolations with conventional analysis techniques Some typical analysis results are presented in summary form Antenna isolation is discussed as a limited factor for EMC optimization The results of past analysis clearly show the need for frequency management to effect interference control as an integral part of the antenna-to-antenna EMC profile of complex airborne systems Author

N76-16285 Naval Postgraduate School Monterey Calif Dept of Electrical Engineering
THE CROSSED-DIPOLE STRUCTURE OF AIRCRAFT IN AN ELECTROMAGNETIC PULSE ENVIRONMENT
Robert W Burton *In* AGARD Electromagnetic Noise Interference and Compatibility Nov 1975 15 p refs

The crossed dipole receiving antennas has been used as a representative model to aproximate electromagnetic pulse effects on aircraft Electromagnetic properties of the crossed dipole receiving antenna illuminated by a monochromatic source are considered Results are presented for electrically moderately thin structures In practice when a crossed dipole receiving antenna is excited by a broad spectrum electromagnetic pulse certain important electrical resonances occur that is at specific single frequencies of excitation some portions of the structure can support large amplitude standing waves of current and/or charge Under such conditions a current maximum/charge minimum current minimum/charge minimum or current minimum/charge maximum may occur at the junction region Examples of resonant and antiresonant situations for the parasitic monopole and the crossed dipole which highlight the possible interactions between the arms of the crossed dipole are presented which give insight into methods of analyzing aircraft in an electromagnetic pulse environment Author

N76-16287 Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany)
DIGITAL DATA TRANSMISSION IN AIRCRAFT EMC-PROBLEMS AND POSSIBLE SOLUTIONS
R Rode *In* AGARD Electromagnetic Noise Interference and Compatibility Nov 1975 10 p

In the use of digital systems in aircraft, where a great deal of interference emission and very sensitive equipment are concentrated in a small space new problems can arise due to the special type of emission and susceptibility of the digital systems Great care must therefore be laid on the selection of the cabling (twisting rate shielding) the line drivers and receivers the rise and fall time and the transmission rate To prove in practice the meaning of theoretical evaluations of a choice of line drivers line receivers and cables special tests were performed on EMC test facilites These tests also covered the different shielding and earthing possibilities Special EMC tests were established to prove the compatibility of the digital systems with the complete aircraft system Author

N76-16360 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany)
AN EXPERIMENTAL STUDY OF THE INFLUENCE OF THE JET PARAMETERS ON THE AFTERBODY DRAG OF A JET ENGINE NACELLE SCALE MODEL
H Dissen and A Zacharias *In* AGARD Improved Nozzle Testing Tech in Transonic Flow Oct 1975 14 p ref

Numerous experimental tests with an engine nacelle scale model were made to investigate the influence of engine jet parameters on the pressure distribution of the engine nacelle and therefore on the boattail pressure drag Regarding the planned flight tests on the HFB 320 Hansa Jet at the end of 1975 the experimental work was done with a model of the GE CJ 610 engine nozzle including its nacelle The influence of jet pressure ratio and jet temperature on the boattail pressure distribution at different flight Mach numbers are shown The effect of boundary layer control and the influence of changing the internal nozzle geometry on the pressure drag is also investigated Author

N76-16375*# Michigan State Univ East Lansing Div of Engineering Research
THE OBLIQUE IMPINGEMENT OF AN AXISYMMETRIC JET Annual Report
John F Foss and Stanley J Kleis 9 Feb 1976 185 p refs (Grant NGR-23-004-068)
(NASA-CR-134961 AR-2) Avail NTIS HC $7 50 CSCL 20D

The mechanics of the oblique impingement of an axisymmetric jet on a plane surface are examined in detail The stagnation point is discussed A schematic drawing of the problem and coordinate system used to describe the flow field are given The kinematic features of the flow above the plate are examined in the context of the conservation of mass the vorticity of the jet and the vorticity introduced by the jetplate interaction The dynamic features of the flow are examined in terms of the surface pressure distribution and the cause-effect relationships which exist between the pressure and velocity/vorticity distributions Flow calculations performed are given The investigation is relevant to the flow resulting from the interaction of the propulsion jet with the main airfoil (STOL aircraft) and is appropriate to an over- or under- wing configuration Author

N76-16387# Aerospace Research Labs Wright-Patterson AFB Ohio
VISCOUS FLOW INTERACTION STUDIES Final Report, 1 Jul 1965 - 30 Jun 1974
Robert H Korkegi Jul 1975 55 p refs
(AF Proj 7064)
(AD-A015191 ARL-0164) Avail NTIS CSCL 20/4

The research was designed to gain understanding of the flow of air at high speeds over the components of lifting supersonic and hypersonic vehicles--wings, flaps, fins inlets--and their interactions with respect to heating surface friction pressure, and aerodynamic forces The objective was to help predict (a) flows on complex aerospace vehicle configurations in high-speed flight and (b) the location of areas of high heating The research covers the areas of laminar and turbulent boundary layers boundary layer transition boundary layer separation base flows and wakes, low density flows three-dimensional interactions viscous flow problems and some flow measurement techniques GRA

N76-16491# Royal Aircraft Establishment, Farnborough (England)
THE EFFECT OF SECONDARY BENDING ON THE FATIGUE STRENGTH OF JOINTS
D Schutz and H Lowak Aug 1975 74 p refs Transl into ENGLISH from Lab fuer Betriebsfestigkeit Rept FB-113 (West Ger) 1974
(RAE-Lib-Trans-1858 BR49708 Rept-FB-113) Avail NTIS HC $4 50

Strain measurements on complete structures and structural sections were carried out with the help of bending-strain gauges in order to obtain information concerning the magnitude of secondary bending loads encountered on typical constructional elements of aircraft structures In addition an analytical method for the determination of the secondary bending load is presented and its validity investigated In order to ascertain the effect of the secondary bending stresses on the fatigue strength of joints constant amplitude and flight by flight tests were carried out results of which were supplemented by an evaluation of data given in the literature For future fatigue strength tests signal-shear joints the results of which are to be used in a preliminary design process a realistic value of the ratio of the secondary bending stress to the axial stress is proposed and a way is indicated by which the accuracy of the life prediction of single-shear joints can be increased Author

N76-16500# National Aerospace Lab Amsterdam (Netherlands) Div of Structures and Materials
FAIL-SAFE CHARACTERISTICS OF BUILT-UP SHEET STRUCTURES
H Vlieger Jul 1974 16 p refs Presented at the 9th ICAS Congr Haifa Israel 25-30 Aug 1974 Sponsored in part by Neth Agency for Aerospace Programs
(NLR-MP-75017-U) Avail NTIS HC $3 50

Results of analytical computations of residual strength and fatigue crack propagation characteristics of built-up sheet structures using the strength and fatigue properties of sheet and stiffener separately and accounting for sheet-stiffener interaction are given The computational results are compared with the results of tests performed on riveted specimens consisting of a 2 mm flat-sheet stiffened by symmetric strip stiffeners or eccentric z-stringers The material of sheet and stiffener was Alclad 7075-T6 Author (ESA)

N76-16822* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
APPLICATIONS OF COMPUTER GRAPHICS TO AIRCRAFT SYNTHESIS
Ralph L Carmichael and Richard Putnam *In its* Appl of Computer Graphics in Eng 1975 p 189-201 refs
CSCL 09B

The history of the development of an aircraft configuration synthesis program using interactive computer graphics was described A system based on time-sharing was compared to two different concepts based on distributed computing Author

N76-16823* British Aircraft Corp Preston (England) Military Aircraft Div
USE OF GRAPHICS IN THE DESIGN OFFICE AT THE MILITARY AIRCRAFT DIVISION OF THE BRITISH AIRCRAFT CORPORATION
W A Coles *In* NASA Langley Res Center Appl of Computer Graphics in Eng 1975 p 203-231 refs
CSCL 09B

The CAD/CAM interactive computer graphics system was described, uses to which it has been put were shown and current developments of the system were outlined The system supports batch, time sharing and fully interactive graphic processing Engineers using the system may switch between these methods of data processing and problem solving to make the best use of the available resources It is concluded that the introduction of on-line computing in the form of teletypes storage tubes and fully interactive graphics has resulted in large increases in productivity and reduced timescales in the geometric computing, numerical lofting and part programming areas together with a greater utilization of the system in the technical departments Author

N76-16824* Israel Aircraft Industries Ltd, Lod
INTERACTIVE COMPUTER GRAPHICS SYSTEM FOR STRUCTURAL SIZING AND ANALYSIS OF AIRCRAFT STRUCTURES
Dror Bendavid Aharon Pipano Alex Raibstein and Emil Somekh *In* NASA Langley Res Center Appl of Computer Graphics in Eng 1975 p 233-256 refs

CSCL 09B

A computerized system for preliminary sizing and analysis of aircraft wing and fuselage structures was described The system is based upon repeated application of analytical program modules which are interactively interfaced and sequence-controlled during the iterative design process with the aid of design-oriented graphics software modules The entire process is initiated and controlled via low-cost interactive graphics terminals driven by a remote computer in a time-sharing mode Author

N76-16825* Sigma Corp Los Altos Calif
COMPUTER GRAPHICS APPLICATION IN THE ENGINEERING DESIGN INTEGRATION SYSTEM
C R Glatt R W Abel G N Hirsch, G E Alford W N Colquitt and W A Stewart *In* NASA Langley Res Center Appl of Computer Graphics in Eng 1975 p 257-286 refs

(Contract NAS9-12829 NAS9-13584 NAS9-14520)
CSCL 09B

The computer graphics aspect of the Engineering Design Integration (EDIN) system and its application to design problems were discussed *Three basic types of computer graphics may be* used with the EDIN system for the evaluation of aerospace vehicles preliminary designs offline graphics systems using vellum-inking or photographic processes online graphics systems characterized by direct coupled low cost storage tube terminals with limited interactive capabilities and a minicomputer based refresh terminal offering highly interactive capabilities The offline line systems are characterized by high quality (resolution better than 0 254 mm) and slow turnaround (one to four days) The online systems are characterized by low cost instant visualization of the computer results, slow line speed (300 BAUD) poor hard copy and the early limitations on vector graphic input capabilities The recent acquisition of the Adage 330 Graphic Display system has greatly enhanced the potential for interactive computer aided design YJA

N76-16828* National Aeronautics and Space Administration Langley Research Center Langley Station Va
APPLICATION OF INTERACTIVE COMPUTER GRAPHICS IN WIND-TUNNEL DYNAMIC MODEL TESTING
Robert V Doggett Jr and Charles E Hammond (Army Air Mobility R and D Lab) *In its* Appl of Computer Graphics in Eng 1975 p 325-353 refs
CSCL 09B

The computer-controlled data-acquisition system recently installed for use with a transonic dynamics tunnel was described This includes a discussion of the hardware/software features of the system A subcritical response damping technique called the combined randomdec/moving-block method for use in windtunnel-model flutter testing that has been implemented on the data-acquisition system is described in some detail Some results using the method are presented and the importance of using interactive graphics in applying the technique in near real time during wind-tunnel test operations is discussed Author

N76-16830* Dayton Univ Research Inst Ohio
COCKPIT DESIGN AND EVALUATION USING INTERACTIVE GRAPHICS
Susan M Evans *In* NASA Langley Res Center Appl of Computer Graphics in Eng 1975 p 361-373 refs

(Contract F33615-75-C-5092)
CSCL 09B

A general overview of the characteristics of an interactive graphics system which was developed to assist cockpit engineers design and evaluate work stations was presented The manikin used in this COMputerized Biomechanical MAN-model (COMBIMAN) was described as are provisions for generating work stations and assessing interactions between man and environment The applications of the present system are explained and critiques of COMBIMAN are presented The limitations of the existing programs and the requirements of the designers necessitate future revisions and additions to the biomechanical and erogonomic properties of COMBIMAN Some of these enhancements are discussed Author

N76-16832* National Aeronautics and Space Administration Langley Research Center Langley Station Va
A FLEXIBLE FLIGHT DISPLAY RESEARCH SYSTEM USING A GROUND-BASED INTERACTIVE GRAPHICS TERMINAL
Jack J Hatfield Henry C Elkins Vernon M Batson and William L Poole *In its* Appl of Computer Graphics in Eng 1975 p 387-418 refs
CSCL 09B

Requirements and research areas for the air transportation system of the 1980 to 1990 s were reviewed briefly to establish the need for a flexible flight display generation research tool Specific display capabilities required by aeronautical researchers are listed and a conceptual system for providing these capabilities is described The conceptual system uses a ground-based interactive graphics terminal driven by real-time radar and telemetry data to generate dynamic experimental flight displays These displays are scan converted to television format processed and transmitted to the cockpits of evaluation aircraft The attendant advantages of a Flight Display Research System (FDRS) designed to employ this concept are presented The detailed implementation of an FDRS is described The basic characteristics of the interactive graphics terminal and supporting display electronic subsystems are presented and the resulting system capability is summarized Finally the system status and utilization are reviewed Author

N76-16836* Pratt and Whitney Aircraft East Hartford Conn
ENGINEERING COMPUTER GRAPHICS IN GAS TURBINE ENGINE DESIGN, ANALYSIS AND MANUFACTURE
Richard S Lopatka *In* NASA Langley Res Center Appl of Computer Graphics in Eng 1975 p 475-493 refs

CSCL 09B

A time-sharing and computer graphics facility designed to provide effective interactive tools to a large number of engineering users with varied requirements was described The application of computer graphics displays at several levels of hardware complexity and capability is discussed with examples of graphics systems tracing gas turbine product development beginning with preliminary design through manufacture Highlights of an operating system stylized for interactive engineering graphics is described Author

N76-16841* National Aeronautics and Space Administration Langley Research Center Langley Station Va
A COMPUTER PROGRAM FOR FITTING SMOOTH SURFACES TO THREE-DIMENSIONAL AIRCRAFT CONFIGURATIONS
Charlotte B Craidon and Robert E Smith Jr *In its* Appl of Computer Graphics in Eng 1975 p 569-586 refs

CSCL 09B

A computer program developed to fit smooth surfaces to the component parts of three-dimensional aircraft configurations was described The resulting equation definition of an aircraft numerical model is useful in obtaining continuous two-dimensional cross section plots in arbitrarily defined planes local tangents *enriched surface plots and other pertinent geometric information* the geometry organization used as input to the program has become known as the Harris Wave Drag Geometry Author

N76-16845* United Aircraft Corp Stratford Conn
SIKORSKY INTERACTIVE GRAPHICS SURFACE DESIGN/MANUFACTURING SYSTEM
Richard Robbins *In* NASA Langley Res Center Appl of Computer Graphics in Eng 1975 p 633-640

CSCL 09B

An interactive graphics system conceived to be used in the design analysis and manufacturing of aircraft components with free form surfaces was described In addition to the basic surface definition and viewing capabilities inherent in such a system numerous other features are present surface editing automated smoothing of control curves variable milling patch boundary

definitions surface intersection definition and viewing automatic creation of true offset surfaces digitizer and drafting machine interfaces and cutter path optimization Documented costs and time savings of better than six to one are being realized with this system The system was written in FORTRAN and GSP for use on IBM 2250 CRTs in conjunction with an IBM 370/158 computer Author

N76-17022*# George Washington Univ, Washington D C
AN INVESTIGATION OF AIRFLOW OVER THE AFT PORTIONS OF A VARIABLE SWEEP FIGHTER CONFIGURATION M S Thesis
Ernald B Graves Dec 1975 74 p refs
(NASA-CR-146361) Avail NTIS HC $4 50 CSCL 01A

An investigation of air flow over the aft portions of a variable sweep fighter aircraft configuration was made Tests conducted in the unitary plan wind tunnel at Mach number 2 16 included measurements of forces moments, and local static pressures as well as visual recordings of the air flow An aerodynamic analytical prediction method was evaluated when used in data comparison at angles of attack of 0 5 and 15 degrees The results indicate that in supersonic flow the typical outboard located twin vertical tail arrangement tends to provide a more positive increment in normal-force on the afterbody fuselage and the horizontal tail than a single center-mounted vertical tail of similar planform shape In addition the results indicate that a method for aerodynamic analysis of wing-body-tail configurations currently available can provide reasonable estimates of pressure coefficient distributions on configurations in regions of complex supersonic flow At this time however the available analytical method cannot adequately replace experimental wind tunnel tests for determining the supersonic flow environment of a given configuration Author

N76-17024*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
PERFORMANCE OF A LOW-PRESSURE FAN STAGE WITH REVERSE FLOW
Royce D Moore George W Lewis Jr and Edward R Tysl Washington Feb 1976 63 p refs
(NASA-TM-X-3349 E-8482) Avail NTIS HC $4 50 CSCL 01A

The reverse flow aerodynamic performance of a 51-centimeter-diameter fan stage is presented The stage was tested with the variable pitch rotor blades set through feather at -75 deg -80 deg and -85 deg from design setting angle Of the three tested the stage with the rotor blades set at -75 deg exhibited the highest pressure ratio and highest flow For all three configurations there was little or no flow in the inner third of the exit passage due to the rotor blade being almost perpendicular to the axial direction in the hub region Author

N76-17025*# Massachusetts Inst of Tech Cambridge Aeroelastic and Structures Research Lab
FURTHER STUDIES OF STALL FLUTTER AND NONLINEAR DIVERGENCE OF TWO-DIMENSIONAL WINGS Final Report, Jun 1974 - Aug 1975
John Dugundji and Inderjit Chopra Aug 1975 87 p refs
(Grant NsG-1051)
(NASA-CR-144924 ASRL-TR-180-1) Avail NTIS HC $5 00 CSCL 01A

An experimental investigation is made of the purely torsional stall flutter of a two-dimensional wing pivoted about the midchord and also of the bending-torsion stall flutter of a two-dimensional wing pivoted about the quarterchord For the purely torsional flutter case large amplitude limit cycles ranging from + or - 11 to + or - 160 degrees were observed Nondimensional harmonic coefficients were extracted from the free transient vibration tests for amplitudes up to 80 degrees Reasonable nondimensional correlation was obtained for several wing configurations For the bending-torsion flutter case large amplitude coupled limit cycles were observed with torsional amplitudes as large as + or - 40 degrees The torsion amplitudes first increased then decreased with increasing velocity Additionally a small amplitude predominantly torsional flutter was observed when the static equilibrium angle was near the stall angle Author

N76-17026*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AIRFOIL SECTION DRAG REDUCTION AT TRANSONIC SPEEDS BY NUMERICAL OPTIMIZATION
Raymond M Hicks Garret N Vanderplaats Earll M Murman (Flow Res Inc Kent, Wash) and Rosa R King (Computer Sci Corp, Mountain View Calif) Feb 1976 34 p refs
(NASA-TM-X-73097 A-6407) Avail NTIS HC $4 00 CSCL 01A

A practical procedure for the design of low drag transonic airfoils is demonstrated The procedure uses an optimization program based on a gradient algorithm coupled with an aerodynamic analysis program that solves the full non-linear potential equation for transonic flow The procedure is useful for the design of retrofit modifications for drag reduction of existing aircraft as well as for the design of low drag profiles for new aircraft Results are presented for the modification of four different airfoils to decrease the drag at a given transonic Mach number Author

N76-17032 Office National d Etudes et de Recherches Aerospatiales Paris (France)
LAMINAR SEPARATION AT A TRAILING EDGE
Jean-Pierre Guiraud and Rene Schmitt *In* AGARD Flow Separation Nov 1975 5 p refs

A model of incipient separation is provided for the trailing edge of a thin wing in incompressible very high Reynolds number flow The model of separated flow with a (small) recirculation zone of streamwise length is consistent with a matched asymptotic expansion scheme of solution of the Navier-Stokes equations in the vicinity of the trailing edge The structure of the flow involves a triple deck of Sytchev s type very close to separation embedded in another triple deck of Stewartsons type which is relevant to the overall separated flow Ignoring angle of attack effects the flow depends on two constants the value of vorticity in the recirculation zone and the precise position of separation which is known already as far as order of magnitude is concerned Author

N76-17040 Technische Hogeschool Delft (Netherlands)
ON THE CALCULATION OF LAMINAR SEPARATION BUBBLES IN TWO-DIMENSIONAL INCOMPRESSIBLE FLOW
J L Vanlngen *In* AGARD Flow Separation Nov 1975 16 p refs

A new laminar boundary layer calculation method is presented which combines the simplicity of Thwaites method for the prediction of the momentum loss thickness with the accuracy of Stratford s two layer method for the prediction of the position of laminar separation Calculated boundary layer characteristics for arbitrarily prescribed pressure distributions in general show a singular behavior at separation It is shown that a real separating flow tends to adjust itself in such a way that the resulting pressure distribution prevents singular behavior of the boundary layer An earlier method for the prediction of transition in attached boundary layers based on linear stability theory is extended to the case of separated flows Two methods are discussed which might be used to predict whether reattachment of the turbulent shear layer will occur Finally some results are discussed of wind tunnel experiments on the FX 66-S-196-V1 Wortmann airfoil and on a circular cylinder with a tapered tail Author

N76-17043 Southern Methodist Univ Dallas Tex Dept of Civil and Mechanical Engineering
CHARACTERISTICS OF A SEPARATING INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
Roger L Simpson *In* AGARD Flow Separation Nov 1975 14 p refs
(Grants DA-ARO(D)-31-124-72-G31 DAHC04-74-G-0024 DAHC04-75-G-0051)

Laser and hot film anemometer measurements upstream and downstream of the separation zone are presented for a nominally

two dimensional incompressible turbulent boundary layer for an airfoil type flow The directionally sensitive laser anemometer measurements indicate that the location of intermittent separation as defined by Sandborn is the proper location of where the flow first deflects from the wall to relieve the imposed pressure gradient Upstream of separation the correlations of Perry and Schofield for mean velocity profiles are supported within the uncertainty of the data The separated flow field shows some profile similarity for all measured quantities The normal stress terms in the momentum and turbulence energy equations are shown to be important near separation and cannot be neglected for the close prediction of the separation location Author

N76-17055 Office National d'Etudes et de Recherches Aerospatiales Paris (France)
VISCOUS INTERACTIONS WITH SEPARATION UNDER TRANSONIC FLOW CONDITIONS [INTERACTION VISQUEUSE AVEC DECOLLEMENT EN ECOULEMENT TRANSSONIQUE]
J Delery, J J Chattot, and J C LeBalleur *In* AGARD Flow Separation Nov 1975 13 p refs In FRENCH ENGLISH summary

Strong viscous interactions which are present in transonic flows past airfoils give rise to an important thickening of the boundary layer with the frequent formation of a separated region Under such conditions the calculation of the flow must call upon rapid interaction theories whose application for the case of a turbulent boundary layer is examinated in conjunction with experimental analysis A detailed analysis of the flow field has been made by using interferometry and a method of calculation similar to Klineberg s approach The principle of this theory is to divide the flow into two domains a weak interaction region where the pressure gradient is moderate, and a rapid interaction region if separation is likely to occur Author

N76-17056 Technische Hochschule Aachen (West Germany)
UNSTEADY SHOCK WAVE-BOUNDARY LAYER INTERACTION ON PROFILES IN TRANSONIC FLOW
Klaus Finke *In* AGARD Flow Separation Nov 1975 11 p refs

Many unsteady flows are characterized by the interaction of shock waves with separated boundary layers In particular shock oscillations occur on thick airfoils at high angles of attack and transonic free stream Mach numbers Measurements were carried out in an intermittent indraft tunnel to study shock oscillations on various two dimensional wings Alternating separation and attachment at the leading edge is the observed severest type of the unsteady flow conditions For this case multispark interferograms show periodical oscillations of the circulation of the wing, accompanied by the same oscillation of the circulation in the opposite sense in the wake Large periodical disturbances exist throughout the entire flow field with defined phase shifts The primary source of the observed instability is the shock induced separation of the boundary layer on the profile Author

N76-17059 Royal Aircraft Establishment Farnborough (England)
A REVIEW OF SEPARATION IN STEADY, THREE-DIMENSIONAL FLOW
J H B Smith *In* AGARD Flow Separation Nov 1975 17 p refs

An attempt is made to present a unified view which leads from a consideration of the structure of the problem and the role of modelling through the partial solutions which have been found to some illustrations of the application of three dimensional flow separation in aircraft design Much of the work reported is only partially three dimensional in the sense that boundary layers are calculated for flows over cones or infinite sheared wings and that slender body theory is used to calculate the separated flow These treatments reveal the limitations of some two dimensional concepts like reattachment and present an exciting range of problems and possibilities Author

N76-17062 National Aerospace Lab Amsterdam (Netherlands)
THREE DIMENSIONAL SEPARATION OF AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER ON AN INFINITE SWEPT WING
A Elsenaar B VandenBerg and J P F Lindhout *In* AGARD Flow Separation Nov 1975 15 p refs

A three dimensional boundary layer flow under infinite swept wing conditions is simulated A description is given of the development of the boundary layer in a region of an adverse pressure gradient leading to increased cross flows and finally terminating in a three dimensional separation Measurements are reported of the mean velocity profiles the wall shear stress and the components of the Reynolds stress tensor These measurements reveal a decreasing mixing length with increased cross flow and a substantial difference between the direction of the shear stress and the velocity gradient After the separation line a region with an almost spanwise flow is observed Calculations are presented of the boundary layer development with a finite difference method using semi-empirical shear stress relations based on the turbulent energy equation This method fails to predict separation When empirical modifications, based on the experimental results are introduced the agreement improves Close to separation however the calculations are very sensitive to the pressure distribution and this might be related to a Goldstein-type singularity at separation Author

N76-17071*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FLUCTUATING PRESSURES IN FLOW FIELDS OF JETS
James C Schroeder and John Kenneth Haviland (Virginia Univ) Feb 1976 21 p refs
(NASA-TM-X-71979) Avail NTIS HC $3 50 CSCL 01A

The powered lift configurations under present development for STOL aircraft are the externally blown flap (EBF) involving direct jet impingement on the aircraft flaps and the upper surface blown (USB) where the jet flow is attached on the upper surface of the wing and directed downwards Towards the goal of developing scaling laws to predict unsteady loads imposed on the structural components of these STOL aircraft from small model tests the near field fluctuating pressure behavior for the simplified cases of a round free cold jet and the same jet impinging on a flat plate was investigated Examples are given of coherences phase lags (giving convection velocities) and overall fluctuating pressure levels measured The fluctuating pressure levels measured on the flat plate are compared to surface fluctuating pressure levels measured on full-scale powered-lift configuration models Author

N76-17072*# Boeing Commercial Airplane Co Seattle, Wash
COMPUTATION OF THE TRANSONIC PERTURBATION FLOW FIELDS AROUND TWO- AND THREE-DIMENSIONAL OSCILLATING WINGS Final Report
Warren H Weatherill F Edward Ehlers and James D Sebastian Washington NASA Dec 1975 155 p refs
(Contract NAS1-13002)
(NASA-CR-2599 D6-42536) Avail NTIS HC $6 75 CSCL 01A

Analytical and empirical studies of a finite difference method for the solution of the transonic flow about an harmonically oscillating wing are presented along with a discussion of the development of a pilot program for three-dimensional flow In layer separated at the foot of the shock and reattached 4 5 undisturbed boundary layer thickness downstream of the separation point The velocity profiles at the start of the interaction and downstream of the reattachment point correlate well with the logarithmic velocity distribution in the wall region Author

N76-17073*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
PERFORMANCE OF LOW-PRESSURE-RATIO LOW-TIP-SPEED FAN STAGE WITH BLADE TIP SOLIDITY OF 0 65
George Kovich and Ronald J Steinke Washington Feb 1976 97 p refs
(NASA-TM-X-3341, E-7604) Avail NTIS HC $5 00 CSCL 01A

The overall and blade-element performance of a low pressure ratio low tip speed fan stage is presented over the stable operating range at rotative speeds from 90 to 120 percent of design speed Stage peak efficiency of 0 927 was obtained at a weight flow of 32 4 kg/sec (190 31 kg/sec/sq m of annulus area) and a pressure ratio of 1 134 The stall margin at design speed and peak efficiency was 15 3 percent Author

N76-17074*# Washington Univ Seattle
A NON-GAUSSIAN MODEL OF CONTINUOUS ATMOSPHERIC TURBULENCE FOR USE IN AIRCRAFT DESIGN
Paul M Reeves Robert G Joppa and Victor M Ganzer Jan 1976 254 p refs
(Grant NGR-48-002-085)
(NASA-CR-2639) Avail NTIS HC $9 00 CSCL 01A

A non-Gaussian model of atmospheric turbulence is presented and analyzed The model is restricted to the regions of the atmosphere where the turbulence is steady or continuous and the assumptions of homogeneity and stationarity are justified Also spatial distribution of turbulence is neglected so the model consists of three independent stationary stochastic processes which represent the vertical lateral and longitudinal gust components The non-Gaussian and Gaussian models are compared with experimental data and it is shown that the Gaussian model underestimates the number of high velocity gusts which occur in the atmosphere while the non-Gaussian model can be adjusted to match the observed high velocity gusts more satisfactorily Application of the proposed model to aircraft response is investigated with particular attention to the response power spectral density, the probability distribution and the level crossing frequency A numerical example is presented which illustrates the application of the non-Gaussian model to the study of an aircraft autopilot system Listings and sample results of a number of computer programs used in working with the model are included Author

N76-17077# West Virginia Univ Morgantown Dept of Aerospace Engineering
HELICOPTER LIFTING SURFACE THEORY WITH FORCE FREE WAKES, PART 2
Hsi F Chou and Jerome B Fanucci Feb 1975 91 p refs
(Contract N00014-73-A-0417-0004 NR Proj 215-232)
(AD-A015192 TR-44) Avail NTIS CSCL 01/3

Steady potential flow nonlinear lifting surface theory is applied to an arbitrary helicopter rotor system in constant rotational and constant axial translational motion including hover An unknown velocity doublet distribution is imposed on both the blade and wake surfaces satisfying the normal boundary conditions on the true wetted surface and the Kutta condition at the trailing edge The governing equation then becomes a Fredholm integral equation of the first kind A numerical scheme is developed to solve the doublet strength distribution by approximating the surface with a finite number of uniformly loaded elements and satisfying the boundary conditions at their centroids The integral equation is thereby transformed into a system of linear algebraic equations The solution provides the velocity magnitude and direction and the pressures on the blade surface GRA

N76-17078*# Washington Univ, St Louis, Mo Dept of Civil Engineering
A STATE-OF-THE-ART REVIEW OF TRANSPORTATION SYSTEMS EVALUATION TECHNIQUES RELEVANT TO AIR TRANSPORTATION, VOLUME 1
Lonnie E Haefner Aug 1975 142 p refs 2 Vol
(Contract NAS2-8324)
(NASA-CR-137770) Avail NTIS HC $6 00 CSCL 01C

Mathematical and philosophical approaches are presented for evaluation and implementation of ground and air transportation systems Basic decision processes are examined that are used for cost analyses and planning (i e, statistical decision theory linear and dynamic programming, optimization game theory) The effects on the environment and the community that a transportation system may have are discussed and modelled Algorithmic structures are examined and selected bibliographic annotations are included Transportation dynamic models were developed Citizen participation in transportation projects (i e in Maryland and Massachusetts) is discussed The relevance of the modelling and evaluation approaches to air transportation (i e airport planning) is examined in a case study in St Louis Missouri J R T

N76-17079*# Washington Univ St Louis Mo Dept of Civil Engineering
DEVELOPMENT OF AIR TRANSPORTATION EVALUATION PROCESSES, VOLUME 2
Lonnie E Haefner Aug 1975 297 p refs 2 Vol
(Contract NAS2-8324)
(NASA-CR-137771) Avail NTIS HC $9 25 CSCL 01C
For abstract see N76-17078

N76-17080# National Transportation Safety Board Washington D C Bureau of Aviation Safety
AIRCRAFT ACCIDENT REPORT GOLDEN WEST AIRLINES, INC., DE HAVILLAND DHC-6, N6383 AND CESSNAIR AVIATION, INC., CESSNA 150, N11421, WHITTIER, CALIFORNIA, JANUARY 9, 1975
7 Aug 1975 24 p
(PB-245583/0 NTSB-AAR-75-14 File-3-1941) Avail NTIS HC $3 50 CSCL 01B

Golden West Airlines Inc Flight 261 a De Havilland Twin Otter and a Cessnair Aviation Inc Cessna 150 collided in flight near Whittier California The accident occurred during daylight hours at approximately 4 07 p m P s t January 9 1975 Both aircraft were destroyed by the collision and subsequent ground impact The 10 passengers and 2 crewmembers on the Twin Otter, and the instructor pilot and student pilot of the Cessna 150 were killed The National Transportation Safety Board determines that the probable cause of the accident was the failure of both flightcrews to see the other aircraft in sufficient time to initiate evasive action GRA

N76-17081# National Transportation Safety Board, Washington, D C Bureau of Aviation Safety
AIRCRAFT ACCIDENT REPORT MONTANA POWER COMPANY ROCKWELL TURBO COMMANDER 690A, N40MP AND USAF F-111A, 77-055 NEAR KINGSTON, UTAH, NOVEMBER 12, 1974
1 Aug 1975 30 p
(PB-245582/2, NTSB-AAR-75-12) Avail NTIS HC $4 00 CSCL 01B

About 1804 m s t on November 12 1974 a United States Air Force (USAF)F-11 A 77-055, and a Montana Power Company Rockwell Turbo Commander, Model 690A N40MP, collided in flight near Kingston Utah The F-111A was the lead aircraft in a formation of two F-111A s The formation was attempting a rendezvous with a USAF KC-135 for night air refueling training when the planes collided The pilot of N40MP the sole occupant was killed The two crewmembers of the F-111A ejected successfully from their aircraft Both aircraft were destroyed by the collision, the postcollision fire and impact with the ground The National Transportation Safety Board determines that the probable cause of this accident was the F-111A pilot s misidentification of the Turbo Commander as a refueling tanker with which he intended to rendezvous Contributing to the misidentification was his failure to use prescribed procedures and techniques during rendezvous with a tanker aircraft for refueling GRA

N76-17082# National Transportation Safety Board, Washington, D C Bureau of Aviation Safety
AIRCRAFT ACCIDENT REPORT NORTHWEST AIRLINES, INC., BOEING 727-251, N26 4US, NEAR THIELLS, NEW YORK, DECEMBER 1, 1974
13 Aug 1975 32 p
(PB-245581/4, NTSB-AAR-75-8) Avail NTIS HC $4 00 CSCL 01B

About 1926 e s t on December 1 1974, Northwest Airlines Flight 6231 a Boeing 727-251 crashed about 3 2 nmi west of Thiells New York The accident occurred about 12 minutes after the flight had departed John F Kennedy International Airport Jamaica New York and while on a ferry flight to Buffalo New York Three crewmembers the only persons aboard the aircraft

died in the crash The aircraft was destroyed The aircraft stalled at 24 800 feet m s l and entered an uncontrolled spiralling descent into the ground Throughout the stall and descent the flightcrew did not recognize the actual condition of the aircraft and did not take the correct measures necessary to return the aircraft to level flight Near 3 500 feet m s l a large portion of the left horizontal stabilizer separated from the aircraft which made control of the aircraft impossible The National Transportation Safety Board determines that the probable cause of this accident was the loss of control of the aircraft because the flightcrew failed to recognize and correct the aircraft s high-angle-of-attack low-speed stall and its descending spiral GRA

N76-17092# Advisory Group for Aerospace Research and Development Paris (France)
SPECIALISTS MEETING ON STRUCTURAL DESIGN TECHNOLOGY
Nov 1975 163 p refs partly in ENGLISH and FRENCH Presented at the 40th Meeting of the Struct and Mater Panel Brussels, 13-18 Apr 1975
(AGARD-CP-184) Avail NTIS HC $6 75

The many problems of dynamics, aerodynamics and stress which are involved in aircraft structural design are discussed

N76-17093 Hawker Siddeley Aviation Ltd Woodford (England)
THE SIGNIFICANCE OF VARIOUS MANAGEMENT AND TECHNICAL TECHNIQUES ON AIRCRAFT STRUCTURAL DESIGN
Alan James Troughton *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 16 p refs

Techniques are summarized which are used in aircraft structural design The in-service performance of aircraft as regards structural accidents and incidents is given together with typical costs for R&D structural activities All aircraft structural design techniques are reviewed including stressing detail design, computer aided design and alternative methods of testing The use of value engineering in obtaining optimum cost aircraft is discussed Author

N76-17094 Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France)
EVOLUTION OF THE ROLE PLAYED BY THE STRESS ANALYSIS OFFICE IN THE DESIGN OF A PROTOTYPE [EVOLUTION DU ROLE DU BUREAU DES STRUCTURES DANS LA REALISATION D'UN PROTOTYPE]
Marcel Peyrony *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 8 p In FRENCH

Changes that have taken place in the work organization of the stress analysis and aircraft structures design office during the last few years due to the introduction of computer techniques were reviewed The relative advantages and disadvantages of plotters and interactive graphics terminals were summarized A number of computer programs used in the design of representative aircraft structures and elements were mentioned Problems related to computer running time and the inputting and retrieval of data into and from computers were described Applications to the Mercure and Falcon 50 aircraft were mentioned and illustrated Transl by Y J A

N76-17095 Westland Helicopters Ltd Yeovil (England)
THE STRUCTURAL DESIGN PROCESS FOR HELICOPTERS WITH EMPHASIS ON THE ROTOR
D A S Howell *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 18 p ref

The helicopter structural designer must develop an awareness of many potential design problems not encountered in the fixed wing field The solution of these problems invariably involves the three disciplines of dynamics aerodynamics and stress and is further complicated by the increasingly stringent demands of the overall performance requirements These particular aspects of helicopter design as well as the design process are introduced by the paper which also considers the role of the structural designer during the development phase of the helicopter The development of new analytical and experimental techniques the application of new materials and some structural design objectives are also presented with a view to enhancing further the capabilities of the helicopter Author

N76-17096 Technische Hogeschool Delft (Netherlands)
THE PROBLEMS ASSOCIATED WITH INTERNATIONAL DESIGN TEAMS AND THEIR SOLUTIONS
E J VanBeek *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 4 p

Some problems relating to international cooperation in design of aircraft and possible solutions for these problems are discussed The strong identity of experienced design organizations based on tradition and a long history initially results in many difficulties and differences of opinion before a smoothly running cooperation has been achieved Other important factors are variations in the drawing numbering systems affecting the modification system used during the design phase and thereafter There are the problems related to normalization and standardization of standard parts and there is still a large variation in national material specifications for basically the same material Variations in the national airworthiness requirements resulting in special conditions are an important feature in multi-national design cooperation Author

N76-17097 Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
THE INTRODUCTION OF NEW MATERIALS
V V Tein and P Selvaggi (Aeritalia Turin) *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 21 p refs

Besides a discussion of the state of the art concerning materials a summary is presented about work with new materials at AERITALIA and Messershmitt-Boelkow-Blohm Special attention is given to materials for fighter aircraft structures Author

N76-17098 General Dynamics/Fort Worth Tex
THE ROLES OF ANALYSIS IN RELATION TO STRUCTURAL TESTING
William C Dietz and Lawrence C Seth *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 14 p

The relationship between analysis and test is explained for a typical modern fighter aircraft The role each plays as a part of the total structural certification program is emphasized for each element of the structural design process These include the efforts involved in development of basic allowable stresses for design wind tunnel testing loads and stress analysis full scale test and flight test Currently used methods and procedures for solution of recent problems in achieving economically durable airframe structure and the approach to the application of composites are reviewed Author

N76-17099 British Aircraft Corp , Preston (England) Military Aircraft Div
THE USE OF COMPUTERS TO DEFINE MILITARY AIRCRAFT STRUCTURES
I C Taig *In* AGARD Specialists Meeting on Structural Design Technology Nov 1975 32 p refs

The use of the computer as a tool to aid structural design has become firmly established during the last twenty years In particular it is probably true that in no other area of computer operation has greater progress been made than in structural analysis The present state of the art in the related use of computers is surveyed and benefits and penalties which result therefrom are discussed Author

N76-17100 McDonnell Aircraft Co St Louis, Mo
WEIGHT CONTROL AND THE INFLUENCE OF MANUFACTURING ON STRUCTURAL DESIGN
R C Goran *In* AGARD Specialists Meeting on Structural

Design Technology Nov 1975 16 p

Practices of weight control and the influence of manufacturing on structural design are discussed for the F-4 series of aircraft the F-15 air superiority aircraft and the DC-10 wing for commercial aircraft Many of the problems are a result of the constant need to design efficient lighter weight structures by the introduction of new materials configurations and joining methods together with closer tolerances To some extent optimum design and minimum manufacturing cost appear divergent in nature Much of the interaction between design and manufacturing is to compromise or seek acceptance for seemingly conflicting requirements Author

N76-17101*# Lockheed-California Co Burbank
MINIMUM ENERGY, LIQUID HYDROGEN SUPERSONIC CRUISE VEHICLE STUDY Final Report, 21 Apr - 17 Oct 1975
G D Brewer and R E Morris Oct 1975 178 p refs
(Contract NAS2-8781)
(NASA-CR-137776 LR-27347) Avail NTIS HC $7 50 CSCL 01C

The potential was examined of hydrogen-fueled supersonic vehicles designed for cruise at Mach 2 7 and at Mach 2 2 The aerodynamic weight and propulsion characteristics of a previously established design of a LH2 fueled Mach 2 7 supersonic cruise vehicle (SCV) were critically reviewed and updated The design of a Mach 2 2 SCV was established on a corresponding basis These baseline designs were then studied to determine the potential of minimizing energy expenditure in performing their design mission, and to explore the effect of fuel price and noise restriction on their design and operating performance The baseline designs of LH2 fueled aircraft were than compared with equivalent designs of jet A (conventional hydrocarbon) fueled SCVs Use of liquid hydrogen for fuel for the subject aircraft provides significant advantages in performance cost noise pollution sonic boom and energy utilization Author

N76-17102# Bell Helicopter Co Fort Worth Tex
DYNAMIC TESTING OF A COMPOSITE MATERIAL HELICOPTER TRANSMISSION HOUSING
Roy A Battles Sep 1975 81 p refs
(Contract DAAJ02-73-C-0038 DA Proj 1F1-62208-A-170)
(AD-A015521, BHC-299-099-743 USAAMRDL-TR-75-47)
Avail NTIS CSCL 13/9

The program was carried out to investigate the integration of a GFE composite material gear housing into a UH-1 bench test transmission The composite material housing was designed to replace a conventional magnesium sand cast housing A test program using the composite housing was outlined to (1) investigate tooling parameters and finish machine a housing (2) determine the coefficients of thermal expansion and thermal conductivity (3) conduct a spiral bevel gear development test (4) thermal map a transmission (5) conduct a 50-hour overpower test and (6) conduct a fail-safe test GRA

N76-17134 Ferranti, Ltd Edinburgh (Scotland) Inertial Systems Dept
COMED A COMBINED DISPLAY INCLUDING A FUEL ELECTRONIC FACILITY AND A TOPOGRAPHICAL MOVING MAP DISPLAY
William M Aspin *In* AGARD Electron Airborne Displays Dec 1975 11 p refs

The design and construction of a new combined map and electronic display (COMED) developed for use in fighter/attack aircraft are described The operational advantages of this type of display are discussed in the context of earlier and alternative types of combined display The principle design aims of the COMED display are described and how these aims have been met is explained Author

N76-17137 Marconi-Elliott Avionic Systems Ltd Rochester (England)
A MULTI-SENSOR MULTI-FUNCTION DISPLAY FOR THE PANAVIA MULTI-ROLE COMBAT AIRCRAFT
D W Hussey *In* AGARD Electron Airborne Displays Dec 1975 12 p

The weapon system operator s principal access to the wide range of raw sensor and processed data available on the MRCA was implemented by the development of an integrated electronic display system The equipment is one of the first to solely utilize a standard television raster to display both synthetic tabular and graphical data in a form directly compatible with EO Sensor television video signals An electronically labelled multifunction keyboard allows the crew member to access and update the computing system data in a wide variety of modes using the minimum of controls and panel space The generation of synthetic symbols, directly in the raster by modulation of the video signal is achieved by a novel form of time-shared digital techniques providing high accuracy and resolution with a considerable economy of hardware A particular feature of the system is the elimination of staircasing of the raster generated graphics Other aspects include the achievement of high resolution and contrast under conditions of extreme cockpit ambient illumination The system forms the basis of a new range of head down displays which are being developed for a wide range of military aircraft types Author

N76-17143*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
ADVANCED TURBINE DISK DESIGNS TO INCREASE RELIABILITY OF AIRCRAFT ENGINES
Albert Kaufman 1976 32 p refs Proposed for presentation at Gas Turbine Conf New Orleans, 21-25 Mar 1976 sponsored by ASME
(NASA-TM-X-71804, E-8491) Avail NTIS HC $4 00 CSCL 21E

Results of analytical studies to improve the low cycle fatigue lives and reliability of turbine disks in high performance gas turbine engines are presented Advanced disk concepts were evaluated for the first stage high pressure turbines of the CF6-50 and JT8D-17 engines The advanced disk designs are compared to the existing disks on the bases of cycles to crack initiation and overspeed capability for initially unflawed disks, crack propagation cycles to failure for initially flawed disks, and available kinetic energy of disk burst fragments Author

N76-17144*# General Electric Co , Cincinnati Ohio
ADDITIONAL DESIGN STUDIES OF THE NASA/NAVY LIFT/CRUISE FAN
5 Jan 1976 34 p refs
(Contract NAS3-19411)
(NASA-CR-134928 R76AEG152) Avail NTIS HC $4 00 CSCL 21E

Additional preliminary design studies were performed for a turbotip lift/cruise fan propulsion system for a Navy multimission aircraft The LCF459/J97 propulsion system was previously designed for this application These studies extended the analysis in areas of (1) scroll commonality (2) increased engine-out contingency ratings, (3) mounting systems (4) manufacturing cost reductions, and (5) vulnerability Author

N76-17151*# Boeing Commercial Airplane Co Seattle Wash
A METHOD FOR PREDICTING THE STABILITY CHARACTERISTICS OF AN ELASTIC AIRPLANE VOLUME 1 FLEXSTAB THEORETICAL DESCRIPTION An Early Domestic Dissemination Report
A R Dusto, G W Brune, G M Dornfeld, J E Mercer S C Pilet, P E Rubbert R C Schwanz P Smutny, E N Tinoco, and J A Weber Oct 1974 652 p refs
(Proj FEDD Contract NAS2-5006)
(NASA-CR-114712 D6-41064-1-Vol-1) Avail NASA Industrial Applications Centers only to U S Requesters HC $16 25/MF $2 25 CSCL 01C

A theoretical development of the FLEXSTAB system is presented The development integrates the theoretical mechanics of a flexible body with a low frequency unsteady aerodynamic theory employing linear influence coefficients based on finite element approximations The theoretical mechanics resolve the dynamics of a flexible aircraft into structural dynamics of free

vibration modes superimposed on rigid body dynamics This resolution is made using a mean reference frame for structural motions and leads to two important features of the FLEXSTAB system one, a logical merger of quasi-steady and dynamic aeroelasticity through the residual flexibility approximation and two a logical basis for incorporating into the analysis empirical, rigid aircraft aerodynamic data The aerodynamic theory is applicable to subsonic and supersonic flow and multiple wing-body-tail-nacelle configurations Aerodynamic influence coefficients are derived using a paneling scheme which lends itself to empirical corrections Finally the theoretical aero-and structural dynamics are integrated conserving energy of the system and thereby yielding equations of motion appropriate to stability evaluation These equations are expressed for a steady reference motion to determine trim and static stability They are also expressed in terms of unsteady perturbations about the reference motion to determine dynamic stability by characteristic roots or by time histories following an initial perturbation or following penetration of a discrete gust flow field Author

N76-17152*# Boeing Commercial Airplane Co Seattle Wash
A METHOD FOR PREDICTING THE STABILITY CHARACTERISTICS OF AN ELASTIC AIRPLANE VOLUME 2 FLEXSTAB 1 02 00 USER'S MANUAL An Early Domestic Dissemination Report
G R Hink, R N Snow, K G Bhatia, R E Maier G R Bills, D M Henderson, D C Bailey G M Dornfeld, and P V DAuria Oct 1974 564 p refs
(Proj FEDD Contract NAS2-5006)
(NASA-CR-114713 D6-41064-2-Vol-2) Avail NASA Industrial Applications Centers only to U S Requesters HC $13 50/MF $2 25 CSCL 01C

A system of computer programs (FLEXSTAB) designed to predict the stability and control characteristics of an elastic airplane in the subsonic and supersonic flight regimes from geometry mass distribution and flexibility information is described The FLEXSTAB 1 02 00 User s Manual includes sufficient detail to enable the us ir to prepare input data decks execute programs and interpret results It is assumed that the user is knowledgeable in the dynamics of aircraft and has been introduced to computer programming applications Author

N76-17153*# Boeing Commercial Airplane Co , Seattle Wash
A METHOD FOR PREDICTING THE STABILITY CHARACTERISTICS OF AN ELASTIC AIRPLANE VOLUME 3 FLEXSTAB 1 02 00 PROGRAM DESCRIPTION An Early Domestic Dissemination Report
G R Hink, P V DAuria, D C Bailey G R Bills, and D M Henderson Oct 1974 753 p refs
(Proj FEDD Contract NAS2-5006)
(NASA-CR-114714 D6-41064-3-Vol-3) Avail NASA Industrial Applications Centers only to U S Requesters HC $18 75/MF $2 25 CSCL 01C

A computer program system (FLEXSTAB) developed from integrated aerodynamic structural, and flight control methods is described Static and dynamic stability trim state, structural loading and elastic deformation of aircraft configurations at subsonic and supersonic speeds are evaluated The architecture of the FLEXSTAB system is illustrated along with important internal blocks of logic within each program of the system General information flow schematics depicting major areas where data are input to and output from each program are also shown A guide to program maintenance updating and modification is provided Author

N76-17156*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif
SUMMARY OF FLIGHT TESTS TO DETERMINE THE SPIN AND CONTROLLABILITY CHARACTERISTICS OF A REMOTELY PILOTED, LARGE-SCALE (3/8) FIGHTER AIRPLANE MODEL
Euclid C Holleman Washington Jan 1976 126 p refs
(NASA-TN-D-8052 H-889) Avail NTIS HC $6 00 CSCL 01C

An unpowered large dynamically scaled airplane model was test flown by remote pilot to investigate the stability and controllability of the configuration at high angles of attack The configuration proved to be departure/spin resistant however spins were obtained by using techniques developed on a flight support simulator Spin modes at high and medium high angles of attack were identified and recovery techniques were investigated A flight support simulation of the airplane model mechanized with low speed wind tunnel data over an angle of attack range of + or - 90 deg and an angle of sideslip range of + or - 40 deg provided insight into the effects of altitude stability, aerodynamic damping, and the operation of the augmented flight control system on spins Aerodynamic derivatives determined from flight maneuvers were used to correlate model controllability with two proposed departure/spin design criteria Author

N76-17345# Naval Postgraduate School, Monterey, Calif
THEORETICAL INVESTIGATION OF THE FLUTTER CHARACTERISTICS OF SUPERSONIC CASCADES WITH SUBSONIC LEADING-EDGE LOCUS
James Keith Bell Jun 1975 195 p refs
(AD-A014636) Avail NTIS CSCL 20/4

Supersonic flow past a semi-infinite array of flat plate cascaded airfoils is analyzed using a linearized method of characteristics procedure For a cascade having subsonic leading-edge locus but otherwise arbitrary geometry frequency of blade oscillation, and interblade phase angle pressure distributions and lift forces and moments are determined These are used for flutter analysis and the determination of flutter boundaries In addition the linearized method of characteristics procedure is used to analyze supersonic flow through cylindrical shells Pressure distributions and generalized forces are computed for arbitrary radius-to-length ratios, axial and circumferential mode numbers and frequency of panel oscillation Author (GRA)

N76-17925*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
A COMPUTER PROGRAM FOR THE DETERMINATION OF THE ACOUSTIC PRESSURE SIGNATURE OF HELICOPTER ROTORS DUE TO BLADE THICKNESS
G H Mall and F Farassat Washington Jan 1976 80 p refs
(NASA-TM-X-3323 L-10437) Avail NTIS HC $5 00 CSCL 20A

A computer program is presented for the determination of the thickness noise of helicopter rotors The results were obtained in the form of an acoutic pressure time history The parameters of the program are the rotor geometry and the helicopter motion descriptors, and the formulation employed is valid in the near and far fields The blade planform must be rectangular but the helicopter motion is arbitrary, the observer position is fixed with respect to the ground with a maximum elevation of 45 deg above or below the rotor plane With these restrictions the program can also be used for the calculation of thickness noise of propellers Author

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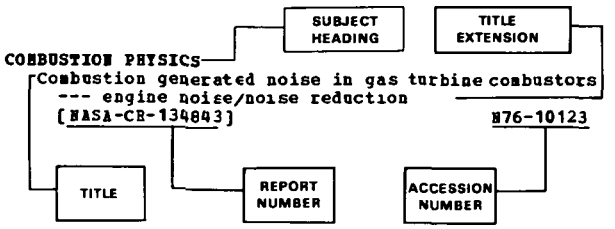

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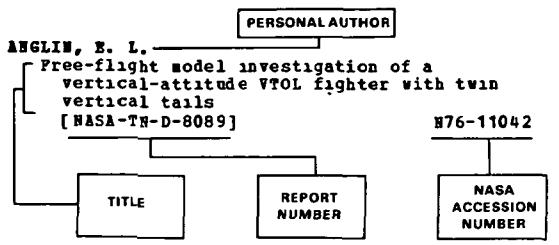

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