NASA SP-7037 (02)

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 2

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (02)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 2

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1971 in

- *Scientific and Technical Aerospace Reports (STAR)*
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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.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 394 reports, journal articles, and other documents originally announced in January 1971 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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

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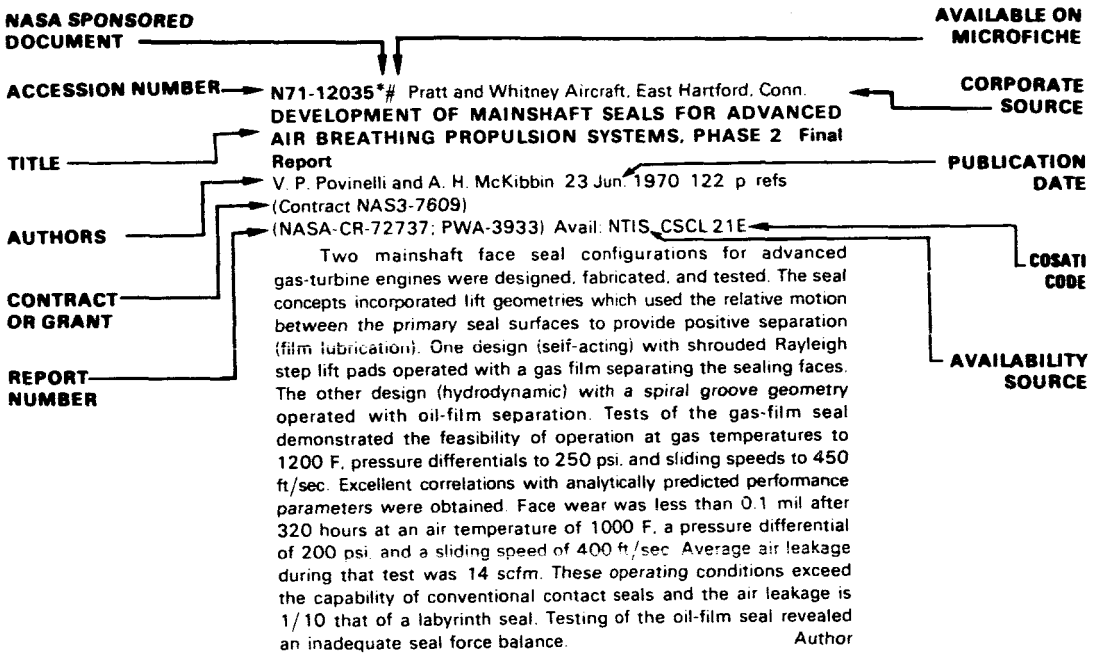

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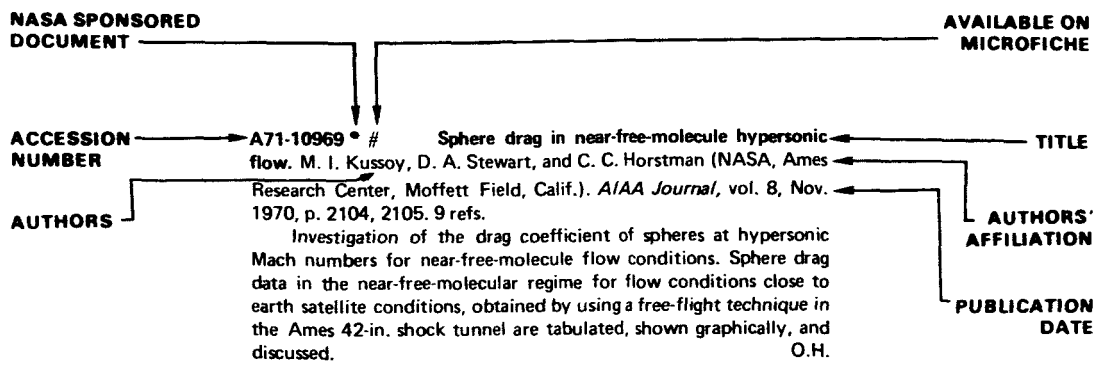

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AERONAUTICAL ENGINEERING

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IAA ENTRIES

A71-10015 **An appraisal of current shortcomings in the procurement and commissioning processes of flight simulators.** R. H. J. Bellm. In: Royal Aeronautical Society, Two-Day Symposium on Flight Training Simulators for the '70s London, England, October 14, 15, 1970, Proceedings. London, Royal Aeronautical Society, 1970, p. C.1-C.9.

Discussion of the steps involved in the procurement and commissioning of flight simulators taking into consideration certain difficulties and approaches to overcome these difficulties. Difficulties facing the simulator manufacturers because of different aircraft configurations are considered, and advantages to be derived by standardization of equipment and procedures are discussed. G.R.

A71-10022 **Training for low visibility landings.** B. D. Armstrong and G. Musker (Royal Aircraft Establishment, Bedford, England). In: Royal Aeronautical Society, Two-Day Symposium on Flight Training Simulators for the '70s, London, England, October 14, 15, 1970, Proceedings. London, Royal Aeronautical Society, 1970, p. K.1-K.16.

Discussion of some of the principles and practice of training for low visibility landings taking into consideration training in a ground-based simulator of comparatively modest dimensions. It is shown that worthwhile training can be imparted in such a simulator provided considerable care is taken with the visual attachment. The most important objectives of training for low visibility operations are believed to be to impress pilots with an understanding of the extreme variability of fog; to establish fully effective crew procedures; and to help pilots to acquire a grasp of the detailed meaning of the runway lighting patterns. G.R.

A71-10028 **Flight compartment glare.** *SAE Aerospace Information Report,* AIR 1151, Aug. 1, 1970. 3 p. 9 refs.

Description of the purpose, goal, basic concepts, and sources of flight compartment glare. The goal of this report is to improve visibility conditions for the flight crew by minimizing conditions which contribute to glare. Five recommendations are made for minimizing glare. M.M.

A71-10029 **Galley installations.** *SAE Aerospace Recommended Practice,* ARP 695A, Aug. 15, 1970. 7 p.

Description of the purpose, definition, and criteria of recommended practice 695A. The purpose of this practice is to provide criteria for design with respect to overall safety and particularly to afford minimum risk exposure to cabin attendants and passengers from injuries due to: (1) routine use of galley installations; (2) galley components becoming dislodged under routine or abnormal operating conditions and under survivable crash or ditching conditions; and (3) malfunctions of or defects in galley equipment. M.M.

A71-10030 **Emergency evacuation illumination.** *SAE Aerospace Recommended Practice,* ARP 503B, Aug. 1, 1970. 4 p.

Description of the purpose and provisions of practice ARP 503B recommended for emergency evacuation illumination. The purpose of the practice is to provide criteria which will lead to standards of illumination for emergency evacuation in passenger or cargo transport aircraft such that the emergency illumination will facilitate egress. M.M.

A71-10041 # **Equipment for gas-flame heating of heat-resistant materials during fatigue testing (Ustanovka dlia gazoplamennogo nagreva zharoprochnykh materialov pri ispytaniiakh na ustalost').** A. M. Pen'kov, B. N. Sinaiskii, A. M. Demchenko, A. D. Pogrebniak, and V. B. Mironov (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Fiziko-Khimicheskaia Mekhanika Materialov,* vol. 6, no. 4, 1970, p. 76-79. In Russian.

Description of a device for gas heating of samples of heat resistant materials subjected to fatigue tests at temperatures up to 1300 C. This device makes it possible to create environmental conditions which are similar to those in gas turbine engine during operation. A design layout diagram of the device is included. Z.W.

A71-10103 **Index of starting system specifications and standards.** *SAE Aerospace Information Report,* AIR 1174, July 15, 1970. 8 p.

Index of military and industry specifications and standards which are used in aerospace engine starting systems. Cartridge pneumatic, electric, gas turbine, hydraulic, mechanical, and pneumatic starting systems are included. Only those hardware standards which have been specifically designed for engine starting systems are listed. Revisions and amendments which are current for these applications and standards are not listed. O.H.

A71-10108 # **The flow through planar cylinder lattices in the range of transonic velocities (Über die Durchströmung von ebenen Zylindergittern im Bereich schallnaher Geschwindigkeiten).** C. Kramer (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Rheinisch-Westfälische Technische Hochschule, Aerodynamisches Institut, Abhandlungen,* no. 20, 1970, p. 25-30. 10 refs. In German.

Study of the phenomenological aspects of the flow through a lattice making use of lattices with cylinders having a diameter of 15 mm. Optical methods and recordings of the flow pattern by means of a high-speed camera were used for observing the flow through the lattice. The flow in the region of the vortex street is discussed, and

photographs and Mach-Zehnder-interferograms are presented. The phenomena involving the blocking of the flow when velocities near the sonic speed are reached are investigated. G.R.

A71-10109 # **The diffraction of shock waves at sharp corners (Über die Beugung von Stosswellen an scharfen Kanten).** S. Schultz (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Rheinisch-Westfälische Technische Hochschule, Aerodynamisches Institut, Abhandlungen,* no. 20, 1970, p. 31-35. In German.

Study of the shape of diffracting shock waves taking into consideration the temporal behavior of a disturbance involving a class of shock fronts produced by a diffraction at an angle of -165 deg. The physical principles of shock wave diffraction are examined giving attention to the effects of angles and pressure ratios. The results of a numerical computation for an angle of -165 deg are shown in a graph. The applicability of the results to other diffracting angles is investigated. G.R.

A71-10114 # **Investigation of maintenance systems for commercial jet aircraft and the factors which have an effect on them (Untersuchung von Instandhaltungssystemen für Strahlverkehrsflugzeuge und deren Einflussfaktoren).** Klaus Harling. Berlin, Technische Universität, Fakultät für Maschinenwesen, Dr.-Ing. Dissertation, 1969. 261 p. 90 refs. In German.

Discussion of the characteristics and the objectives of maintenance systems of commercial jet aircraft giving attention to the various individual factors which have to be considered in establishing maintenance programs. The characteristic aspects involved in the maintenance of commercial aircraft, and in changes and adaptations of the aircraft necessary to improve its performance are analyzed. Objectives and problems of aircraft maintenance systems are discussed. The various factors which are significant for such systems and the interaction of these factors are investigated taking into consideration questions of the reliability of the aircraft, its equipment, and its operation. Aspects of the deterioration of structural components are discussed, and the various types of costs involved in the operation of the aircraft are analyzed. The development of a maintenance system is considered and various types of maintenance systems are described. G.R.

A71-10115 # **System analysis of future jet and fan propulsion systems for vertically starting commercial aircraft (Systemanalyse zukünftiger Strahl- und Gebläseantriebe für vertikalstartende Verkehrsflugzeuge).** Horst Pakendorf. Berlin, Technische Universität, Fakultät für Maschinenwesen, Dr.-Ing. Dissertation, 1969. 194 p. 74 refs. In German.

Study of jet and fan propulsion systems of VTOL commercial aircraft intended for short and intermediate runs on the basis of the propulsion technology expected to be available during the time from 1975 to 1980. It is found that an optimal adaptation of propulsion system and aircraft design will make it possible to obtain a reduction in weight of 18% and savings in operating costs of 11% in comparison with the state of the technology of the Do 31. The adoption of a fuselage in the form of a spindle would result in further improvements of about 10%. Questions of the dimensioning of the propulsion system are examined and problems of the transition to the aerodynamic flight are investigated. The effects of noise minima specifications on the design of VTOL aircraft are discussed. G.R.

A71-10128 **Application of maintenance simulation techniques to commercial transport aircraft.** T. F. Weber, Jr. (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, National Air Transportation Meeting, New York, N.Y., Apr. 20-23, 1970, Paper 700345.* 7 p. Members, $1.00; nonmembers, $1.50.

Steadily increasing computer capabilities, accompanied by easily employed programming techniques, are providing maintenance and logistics analysts with powerful tools. Properly employed, these tools can serve a variety of applications at reasonable costs and will result in increased airline operations and maintenance effectiveness. This paper describes simulation modeling techniques (Monte Carlo) used to study and quantify reliability and maintainability interrelationships among large commercial transport aircraft. (Author)

A71-10129 **TIARA light aircraft engines - A new generation.** Wm. A. Wiseman and E. J. Ounsted (Teledyne, Inc., Hawthorne, Calif.). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 18-20, 1970, Paper 700205.* 24 p. Members, $1.00; nonmembers, $1.50.

The paper introduces a new family of air-cooled, opposed, light aircraft engines consisting of four, six, and eight cylinders, with and without turbosupercharging. The paper explains an evolutionary approach to sizeable improvements in horsepower per pound of engine weight, horsepower per cubic inch displacement, and horsepower per cubic foot of bulk. A unique method of torsional control eliminating pendulum dampeners and greatly reducing vibratory torque is also explained in detail. (Author)

A71-10132 # **Detailed measurements in the transition region of a two-dimensional wake.** Hiroshi Sato and Yoshio Onda (Tokyo, University, Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report no. 453,* vol. 35, Aug. 1970, p. 317-377. 10 refs.

Study of the laminar-turbulent transition of a two-dimensional wake with three kinds of imposed disturbances: the natural disturbance in a wind tunnel, a single-frequency sound, and an external sound of two frequencies. In all cases the transition to turbulence is gradual. When a sound of single frequency is introduced into the wake, the induced velocity fluctuation is regular and periodic and it persists, resulting in a transition delay. When a sound of two frequencies is introduced, two velocity fluctuations are induced. They grow independently while amplitudes are small. When amplitudes exceed certain values, two fluctuations interact and both amplitudes are reduced. The amplification of randomness in the transition process may be accomplished by the mutual suppression of amplitudes and by the generation of low-frequency components from high-frequency components. M.V.E.

A71-10166 **The fatigue strength of nickel-base superalloys.** M. Gell, G. R. Leverant, and C. H. Wells (United Aircraft Corp., Pratt and Whitney Aircraft Div., Middletown, Conn.). In: Achievement of high fatigue resistance in metals and alloys; American Society for Testing and Materials, Annual Meeting, 72nd, Symposium, Atlantic City, N.J., June 22-27, 1969, Proceedings.
Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 467), 1970, p. 113-153; Discussion, R. N. Wright (Allegheny Ludlum Steel Corp., Brackenridge, Pa.), p. 296; Authors' Closure, p. 296-298. 68 refs.

The service lives of nickel-base superalloy components in gas turbine engines are frequently limited by their fatigue properties. This paper reviews what is known about the fatigue behavior of nickel-base superalloys and suggests methods for improving their properties. Low-temperature crack initiation occurs preferentially at microstructural defects such as pores and brittle phases in cast materials and at defects such as brittle phases and annealing twin boundaries in wrought materials. The brittle phases may contain inherent cracks or be cracked during working operations or service exposures. Plastic deformation at low temperatures is concentrated in coarse planar bands, and as a result matrix cracking is predominantly transgranular and crystallographic. Techniques are discussed for increasing the low-temperature fatigue properties by minimizing

the role of microstructural defects and achieving a more homogeneous distribution of deformation. At elevated temperatures, intergranular cracking predominates and methods are discussed for improving fatigue properties through grain size control, the use of columnar-grained and single-crystal materials, and the application of oxidation-resistant and fatigue-resistant coatings. (Author)

A71-10170 Fatigue life improvement through stress coining methods. E. R. Speakman (Douglas Aircraft Co., Long Beach, Calif.). In: Achievement of high fatigue resistance in metals and alloys; American Society for Testing and Materials, Annual Meeting, 72nd, Symposium, Atlantic City, N.J., June 22-27, 1969, Proceedings. Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 467), 1970, p. 209-225; Discussion, C. S. Yen (Hughes Tool Co., Culver City, Calif.), p. 226; Author's Closure, p. 226, 227.

Description of the use of stress coining, a quick and economical new process for bringing about an aircraft structure with a more balanced fatigue strength than was previously possible. Basically, the stress coining procedure, a proprietary method, involves controlling the yielding material inside holes and in the material surrounding holes and slots. Stress coining induces residual compressive stresses that offset load-induced tensile stresses concentrated around these load-carrying areas. The procedure can be used in highly stressed areas to increase fatigue life and resistance to stress corrosion of structural members. Salvage rework by reaming, stress coining, and installing an oversize fastener increases the remaining fatigue life to approach that of a virgin stress-coined structure. The fatigue life of test specimens for various aircraft has been improved by a factor of approximately four. M.M.

A71-10228 A hybrid frequency response technique and its application to aircraft flight flutter testing. J. M. Simmons, J. W. Benson, and J. P. Fiedler (Lockheed-Georgia Co., Marietta, Ga.). In: American Federation of Information Processing Societies, Fall Joint Computer Conference. Las Vegas, Nev., November 18-20, 1969, Proceedings. Montvale, N.J., AFIPS Press (AFIPS Conference Proceedings. Volume 35), 1969, p. 801-807. 6 refs.

Description of the use of a hybrid computing system and a new rapid frequency response analysis technique in aircraft flight flutter testing. The theory of flight flutter testing is briefly reviewed, and the new data reduction system is described. In this system, twenty of the data signals which are telemetered from the aircraft to the ground receiving station are further transmitted in multiplexed frequency modulated form to the hybrid computing area. Z.W.

A71-10266 Contribution to the study of unsteady flows (Contribution à l'étude des écoulements instationnaires). Marcel Chabonat. *L'Aéronautique et l'Astronautique,* no. 23, 1970, p. 23-37. 9 refs. In French.

Review of early and recent research in the field of unsteady flows. Early theoretical research prompted a number of experimental studies, among which the one verifying the Katzmayr effect and performed at the Saint-Cyr Aeronautical Institute in 1923 is given special consideration. The analysis of the results then obtained made it possible to determine the conditions for an airborne test using a glider. The test was performed with positive results at Beynes in 1949. This, in turn, made possible the setup of a series of model tests performed in the Eiffel Laboratory wind tunnel from 1962 through 1968. In the course of these tests, the influence of each of the major parameters affecting the performance of a flapping wing was determined, and a considerable performance improvement was achieved by comparison with wings operating in steady airflow. M.V.E.

A71-10270 Dynamic aspects of cockpit temperature control on combat aircraft (Aspects dynamiques du contrôle de le température cabine d'un avion de combat). René Jaeger (Bréguet-Aviation, Vélizy-Villacoublay, Yvelines; Centre de Documentatior pour l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 23, 1970, p. 75-80. In French.

Discussion of the means required for: (1) adjusting the cockpit temperature to pilot-selected values (temperature control), (2) maintaining the selected temperature in the face of changing external-environment conditions (downstream regulation), as well as (3) in the face of varying jet-engine rpm-speed operation (upstream regulation). For the first two temperature-control varieties, an easily applicable solution consists in regulating the amplification factor of the control loop while, for the third variety, the introduction of a phase-advance corrective circuit is called for. M.V.E.

A71-10339 # Arbitrary plane cascade consisting of thin and slightly curved profiles in a potential flow (Beliebiges ebenes Gitter aus den dünnen und schwach-gewölbten Profilen in der Potentialströmung). Gheorghe Zidaru (Bucureşti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Bucureşti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Buletinul,* vol. 32, Mar.-Apr. 1970, p. 111-124. In German.

Extension of the Birnbaum-Glauert method to the study of plane, linear cascades of thin, slightly curved profiles. The application of the method makes it possible to obtain approximations for the circulation around the cascade profiles, the flow velocities at points infinitely upstream and downstream, the lifting force and pressure moment acting on the profile leading edge, and the influence coefficient of the cascade. M.V.E.

A71-10345 # Quantification of the noisiness of 'approaching' and 'receding' sounds. George Rosinger (Battelle Columbus Laboratories, Columbus, Ohio), Charles W. Nixon, and Henning E. Von Gierke (USAF, Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio). *Acoustical Society of America, Journal,* vol. 48, Oct. 1970, pt. 1, p. 843-853. 17 refs. USAF-supported research.

Description of three experiments designed to quantify subjective responses to time-varying sounds representative of those produced by aircraft flying over an observer at rest. The basic sound employed represented 'approaching' and 'receding' sources that continuously increased or decreased in frequency and/or intensity. The comparative noisiness of such sounds was evaluated by means of paired comparison and individual adjustment judgements. The results are discussed and summarized. O.H.

A71-10350 A new low-resistance nozzle for complete power compensation in variometers (Eine neue widerstandsarme Düse zur Totalenergiekompensation von Variometern). D. Althaus (Stuttgart, Universität, Stuttgart, West Germany). *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congrès, 12th, Alpine, Tex., 1970.) Aero-Revue,* Oct. 1970, p. 600, 601. In German.

Description of a low-resistance nozzle, a modification of the Irving nozzle, designed to produce a complete power compensation in rate-of-climb indicators. The modified nozzle, unlike the original Irving nozzle, can be effectively used in high performance aircraft. Specifications of this nozzle and suggestions for its installation in aircraft are given. V.Z.

A71-10359 Insurance- and liability questions in connection with the hijacking of aircraft, acts of sabotage, and armed attacks against an aircraft (Versicherungs- und Haftungsfragen bei

Flugzeugentführungen, Sabotagehandlungen und bewaffneten Angriffen gegen ein Luftfahrzeug). Alex Meyer. *Zeitschrift für Luftrecht und Weltraumrechtsfragen,* vol. 19, Oct. 15, 1970, p. 293-296. In German.

Discussion of questions of liability and insurance arising in connection with unlawful seizures of aircraft and the forcible diversion of civil aircraft in flight giving particular attention to conditions in the Federal Republic of Germany. It is pointed out that the general insurance of an aircraft does not cover damages which the aircraft suffers in connection with such cases. However, it is possible to obtain insurance which covers these cases. Questions of the liability of the airlines against passengers suffering damage in connection with the unlawful seizure of airlines are discussed. G.R.

A71-10399 # **Combating fire risks in aircraft.** R. W. J. Cockram (Pyrene Co., Ltd., Sunbury-on-Thames, England). *Tech Air,* vol. 26, Nov. 1970, p. 2-7.

Discussion of approaches to reduce the hazards posed by fires in aircraft taking into consideration problems of early fire detection, fire extinguishing equipment, and survival in emergency landings. The use and the further development of optical detectors including optical vision periscopes for detecting fires are discussed. The main fire risks in the fuselage area are examined and protective measures such as smoke detectors are considered. Various approaches and media for extinguishing fires are described. The reduction of fire risks due to electrostatic causes and lightning strikes is discussed. G.R.

A71-10409 # **Automated device for conducting fatigue tests with programmed load variation (Avtomat dlia provedennia utomlenisnikh viprobuvan' pri programnii zmini navantazhennia).** A. V. Grechukha. *Avtomatika,* vol. 15, July-Aug. 1970, p. 67-70. In Ukrainian.

Description of equipment for programmed control of electrical inputs to an electrodynamic vibration stand used in fatigue testing of aircraft structures. The system described can operate over a wide range of loading program variations both in terms of load durations and amplitudes. A block diagram of the entire system is explained, and circuits of switching functions are given. The equipment can be used to evaluate the effects of load cycle quantities and amplitudes on the fatigue strength and to verify hypotheses about damage accumulation. Applications of the control system are not limited to endurance testing, and usage in other fields of industrial process control is feasible. T.M.

A71-10425 # **Study of the interaction between plane supersonic off-design jets and obstacles by the hodograph method (Issledovanie vzaimodeistviia ploskikh sverkhzvukovykh neraschetnykh strui i pregrad metodom godografa).** V. A. Filimonov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol. 25, July-Aug. 1970, p. 134-136. In Russian.

Development of a scheme for constructing the flow pattern occurring during the interaction of a plane supersonic overexpanded jet with an obstacle. Both the case of normal incidence of the jet and the case of incidence at an angle to the direction of the velocity are considered. It is shown that the proposed scheme, which involves the use of hodographs, makes it possible to determine the location of the shock waves arising in the jet and to estimate the pressures on the obstacle. A.B.K.

A71-10456 **Investigating an aircraft disaster.** Ralph D. Barer (Defence Research Establishment Pacific, Victoria, British Columbia, Canada) and Thomas S. Sterling (Defence Research Establishment Valcartier, Quebec, Canada). *Metal Progress,* vol. 98, Nov. 1970, p. 84-86.

Investigation of the crash of an aircraft in which 52 passengers and crew members were killed. The methods used in the investigation are discussed taking into consideration conclusions reached and the evidence upon which the conclusions are based. It was found that the crash was caused by an explosion and that the explosion center was in a lavatory compartment on the floor. G.R.

A71-10461 # **On supersonic laminar boundary layers near convex corners.** K. Stewartson (Queensland, University, Brisbane, Australia; University College, London, England). *Royal Society (London), Proceedings, Series A,* vol. 319, no. 1538, Oct. 27, 1970, p. 289-305. 15 refs.

Examination of the structure of a laminar supersonic boundary layer near the convex corner, turning the flow through a given angle of incidence to flow, alpha, on the assumption that the product of alpha and the Reynolds number to the 1/4 power is about 1. In common with related problems already examined, the boundary layer takes on the character of a triple-deck with the initial pressure fall occurring upstream of the corner. Numerical studies show that as the product of alpha and the Reynolds number increases so does the proportion of the total pressure fall which occurs upstream of the corner, and an analysis is given which strongly suggests that as the product of alpha and the Reynolds number to the 1/4 power approaches infinity, the relative pressure fall downstream of the corner vanishes. The theory is carried over to include angles alpha which are small but finite and an earlier theory, due to Matveeva and Neiland, is made uniformly valid and completed. Comparisons with experiment are made which, while not being decisive, are encouraging. O.H.

A71-10465 **Light turbine helicopter Dornier Do 132 (Leichter Turbinen-Hubschrauber Dornier Do-132).** Gerhard Kannamüller (Dornier AG, Friedrichshafen, West Germany). *Flugrevue/Flugwelt International,* Nov. 1970, p. 31-34, 39. In German.

Technical analysis of the light five-seat tip-drive turbine-powered helicopter Do 132. It is pointed out that the aircraft is suitable for a wide range of civil and military applications. Three prototypes are being built under a Federal Defense Ministry contract. Flight testing will be started in 1971. The market situation is examined, and the design criteria are considered. The rotor drive system, the hot-gas generator, landing gear, fuel system, the electric system, and the instrument panel are discussed. G.R.

A71-10466 **Basis development - VFW-Fokker VC 400 (Basisentwicklung VFW-Fokker VC 400).** H. Räbel (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Flugrevue/Flugwelt International,* Nov. 1970, p. 40-42. In German.

Discussion of the component and system development and of the testing phase of VFW-Fokker's VC 400 tilt-wing VTOL cargo and passenger transport project. The VC 400 development history is briefly considered. The advantages of the tilt-wing concept and of the tandem wing layout of the aircraft are examined. The future development schedule is discussed giving attention to the completion of the VC 400 test rig at the end of 1971 and the rollout of the V1 and V2 prototypes in 1973. G.R.

A71-10479 * # **Use of the computer in design of gas turbine mainshaft seals for operation to 500 ft/sec (122 m/sec).** L. P. Ludwig, J. Zuk, and R. L. Johnson (NASA, Lewis Research Center, Cleveland, Ohio). *Illinois Institute of Technology and Fluid Power*

Society, National Conference on Fluid Power, Chicago, Ill., Oct. 13-15, 1970, Paper. 37 p. 10 refs.

Computer programmed analyses of the seal temperature field, elastic displacements and seal force balance were used in an iterative design procedure to arrive at a final mainshaft seal design. For high speeds, temperatures and pressures in advanced engines, the sealing surfaces must not operate with rubbing contact. Hence, self-acting lift pads were incorporated to achieve positive separation of the sealing surfaces. Therefore, a small gas film separating the sealing surfaces is achieved and the associated high gas-film-stiffness forces the seal nosepiece to dynamically track the runout motion of the seal face. Analysis revealed that the pressure profile across the sealing dam was significantly affected by sealing face deformation and that choked flow occurs at pressure ratio of greater than 4 to 1. The effect of this face deformation and choked flow was considered in establishing the seal force balance. Further, to mitigate the effects of thermal deformation it was necessary to structurally isolate the seat from the shaft. The role of the computer in the seal design is discussed. Tests confirm operation as predicted by the design analysis. (Author)

A71-10485 * # Research in U.S.A. on LNG as an airplane fuel. Richard J. Weber (NASA, Lewis Research Center, Cleveland, Ohio). *International Gas Union, International Institute of Refrigeration, and International Institute of Gas Technology, International Conference on Liquefied Gas, 2nd, Paris, France, Oct. 19-23, 1970, Paper.* 11 p.

Methane, the principal constituent of liquefied natural gas, is an attractive fuel for advanced airplanes. In particular, the commercial supersonic transport derives considerable benefit from methane's improved heating value and cooling capacity compared to conventional kerosene. Potential increases of about 30 per cent in payload and a like reduction in direct operating cost have been predicted. However, the characteristics of liquid methane, such as its low boiling temperature and relatively low density, cause practical problems in airplane design and operation. Research is being conducted by NASA in an attempt to illuminate and solve these problems. The work includes such areas as fuel tanks and insulation, engine fuel systems, combustors, and turbines. (Author)

A71-10486 # Air transportation constraints - Their implication on short haul. Kearney G. Robinson, H. C. Tinney, and L. L. Leisher (Boeing Co., Renton, Wash.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 7th, Houston, Tex., Oct. 19-22, 1970, Paper 70-1309.* 8 p. Members, $1.50; nonmembers, $2.00.

Examination of the economic contribution attributable to the U.S. domestic airline industry in the 1970-1980 time period, and the economic significance of airport-facility-constrained growth of passenger travel, with particular emphasis on the economic impact on short haul. The national economic contribution attributable to the U.S. domestic airline industry is shown to be 3% to 4% of expected 1970-1980 personal consumption expenditures. It is also shown that this contribution may be reduced if necessary airport and airway development does not occur. This analysis indicates that the magnitude of this reduction is minimized if resultant growth constraints are satisfied by reducing the frequency on short-haul flight segments. The expected impact of such action is found to be a 45% reduction in 1980 short-haul airline revenue and a 25% reduction in the 1970-1980 accumulated short-haul revenue. The potential of using a STOL system to recover this reduced market potential is investigated and compared to the requirements imposed by continued expansion of the existing conventional system. No clear investment requirement superiority of one system over the other is indicated. It is concluded that the case for or against use of STOL rests on the validity of several key assumptions and on customer and public service issues regarding both short haul and STOL. O.H.

A71-10501 The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970. 550 p. Members, $15.; nonmembers, $25.

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Man-machine considerations in system design for all-weather, low-level navigation. G. V. S. Raju and D. L. Horwitz (Ohio University, Athens, Ohio), p. 270-280. 5 refs.

Navigation training in current spaceflight. F. Hughes and C. Floyd (NASA, Manned Spacecraft Center, Kennedy Space Center, Fla.), p. 281-291.

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Fix expansion and the 3rd dimension in submerged navigation. W. G. Clautice (U.S. Navy, Naval Submarine School, Groton, Conn.), p. 352-357.

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The Ben Franklin Gulf Stream Drift Mission. W. Rand (Grumman Aerospace Corp., Bethpage, N.Y.), p. 400-407.

Navigator training. J. R. Burgess (USAF, Air Training Command, Randolph AFB, Tex.), p. 408-415.

Navigator training analysis. R. E. Hull (Douglas Aircraft Co., Long Beach, Calif.), p. 416-428.

Aircraft navigator training system design. J. A. Benson and W. A. DeTally (Douglas Aircraft Co., Long Beach, Calif.), p. 429-465. 7 refs.

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Improved crew member training through multi-media instruction or - The process. M. E. Wood (USAF, Human Resources Laboratory Williams AFB, Ariz.), p. 477-485. 6 refs.

Software - Man's ultimate aid to navigation. J. W. Rigdon (Grumman Aerospace Corp., Bethpage, N.Y.), p. 486-500.

Summary of project THEMIS study on automatic navigation. A. P. Sage and J. L. Melsa (Southern Methodist University, Dallas, Tex.), p. 501-521. 9 refs.

The future role of man in the repair of navigation systems. R. M. Genet (USAF, Aerospace Guidance and Meteorology Center, Newark, Ohio), p. 522-528.

The pole of simulators in navigational training - Past, present, and future. B. R. Groves (Goodyear Aerospace Corp., Akron, Ohio), p. 529-540. 10 refs.

A71-10502 # **The role of man in navigation.** Ralph J. Astrella (USAF, Bombing and Navigation Branch, Offutt AFB, Neb.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings.
Washington, D.C., Institute of Navigation, 1970, p. 58-64.

Discussion of the basic theme of 'The role of man in navigation' from a Strategic Air Command point of view. Attention is focused on the three primary areas of mission, machine, and man. Mission profiles are presented for past, present, and future operations and are followed by a review of the machinery or equipment required to support the mission concerned. The demands of the special environment upon man are discussed in order to determine his role in navigation during the coming decade. M.V.E.

A71-10503 # **The role of man in tactical air navigation.** Clark H. Allison (USAF, Tactical Air Command, Langley AFB, Va.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 65-70.

Discussion of the role of the navigator in the Air Force since the introduction of navigators into the tactical forces weapon systems. Navigational precision in tactical reconnaissance and fighter aircraft is shown to have become mandatory in order to meet the challenge of sophisticated hostile environments and the wide spectrum of operational requirements. Rapid technological advances in sensors and navigational systems enable the navigator to attain a precision previously unknown in tactical fighter and reconnaissance missions, but have also increased the traditional dimensions of his role to that of a highly trained and versatile Weapon System Officer. M.V.E.

A71-10504 # **The role of man in the Military Airlift Command.** John R. Livingstone (USAF, Military Airlift Command, Altus AFB, Okla.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 71-87. 5 refs.

Discussion of the range of responsibilities of the Military Airlift Command (MAC) navigator. Advances in MAC aircraft equipment include inertial navigation systems, multimode radar operating in the X and Ku frequency bands, new loran-C equipment, and an energy management analog computer to monitor enroute fuel requirements. The MAC navigator is employed by the Command not only to navigate, but to serve as a staff officer for the aircraft commander. As such, he acts in a variety of roles. He is a navigator, weather analyst, fuel manager, and flight planner. He has significantly enhanced the Command's safety record by monitoring approaches and departures. In order to perform his assigned combat duties, he has become an expert at low level pilotage and aerial delivery. M.V.E.

A71-10506 # **Operational aspects of advanced avionics.** Kenneth G. Conner (North American Rockwell Corp., Autonetics Div., Anaheim, Calif.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 101-104.

Discussion of the requirements placed on modern avionics by the designer's task of maximizing the pilot's chances of surviving the mission and destroying a selected target. Man's vital importance to aerial warfare is obviously his mental capacity. Aerial warfare is tactics, and tactics involve clever on-the-spot judgment which in turn requires man's mind despite his inherent limitations. All of the system design should be for the purpose of removing those limitations to enhance the effectiveness of the pilot's irreplaceable mental processes. This must be accomplished by increasing survivability, by extending the sources of pertinent input data, and by eliminating preoccupation with routine computations and reactions. When properly designed, the system supports man and augments his unique judgmental capacity and response to novel situations. A few highlights of current system mechanizations are presented. M.V.E.

A71-10507 # **Mechanization and test of DME updated inertial.** Robert J. Holm (Litton Industries, Inc., Woodland Hills, Calif.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 105-110.

A Litton LTN-51 inertial navigation system augmented by two digital DMEs was flown in an FAA flight inspection aircraft for

evaluation of performance in the domestic area. The LTN-51 inertial computer received range inputs from two separate DME stations. The geographic fix of the two DME ranges was used to update the inertial system. Data were recorded automatically every four seconds, and performance was validated by comparison with flight inspection data. A total of 150 successful flight hours covering the western United States were achieved in 2-1/2 months. The data show that the deviation at 1150 ft was 50%; at 1410 ft, 68%; at 2400 ft, 95%; and at 3100 ft, 100% (50th percentile points). Terminal approaches were also demonstrated. (Author)

A71-10508 # **Inertial systems and area navigation in the U.S. domestic airspace.** Joseph M. Del Balzo (FAA, Systems Research and Development Service, Washington, D.C.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 111-123. 6 refs.

Discussion of the performance requirements for airborne area navigation systems as proposed in FAA Advisory Circular 90-45, and projection of these performance requirements through 1995. The application prospects of an inertial navigation system with position updating from conventional ground referenced navigation aids to meet these present and forecast performance requirements are assessed, and the effects on pilot workload are discussed. Also included is a brief discussion of a planned flight evaluation assessing the effects of an integrated inertial/DME-DME/map display area navigation system on aircraft navigation performance and pilot workload. M.V.E.

A71-10509 # **Operating experiences using dual inertial navigation systems as the sole means of navigation.** Jefferson Z. Amacker (American Airlines, Inc., Tulsa, Okla.). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 124-133.

Discussion of some major inferences drawn from American Airlines' experience with dual inertial navigation systems in the North Pacific as the sole means of navigation. The important facts brought to light by this experience include the following. Equipment reliability is the foremost element in obtaining crew confidence and promoting operational success. Design of the cockpit panels is crucial, and should be done painstakingly using both operational and engineering inputs. Adequate system training is required on a recurring basis for both flight and line maintenance personnel. Operational problems can generally be traced back to one of the three elements just mentioned and, therefore, are the responsibility of the engineer rather than the flight or maintenance crews. M.V.E.

A71-10515 # **Man-machine considerations in system design for all-weather, low-level navigation.** G. V. S. Raju and D. L. Horwitz (Ohio University, Athens, Ohio). In: The role of man in navigation; Institute of Navigation, Anniversary Year Meeting, 25th, U.S. Air Force Academy, Colorado Springs, Colo., July 1-3, 1970, Proceedings. Washington, D.C., Institute of Navigation, 1970, p. 270-280. 5 refs. DOD-supported research.

This paper is concerned with man-machine considerations in system design for low-level navigation. In particular, computer generation of command information and visual display presentation are described. Simulated results are presented which indicate that the pilot's ability to fly on a given route is improved with the roll command display. (Author)

A71-10567 # **Measurement of clear air turbulence in the lower stratosphere using the Millstone Hill L-band radar.** R. K. Crane (MIT, Lexington, Mass.). In: American Meteorological Society, Radar Meteorology Conference, 14th, Tucson, Ariz., November 17-20, 1970, Proceedings. Boston, American Meteorological Society, 1970, p. 101-106. USAF-sponsored research.

Discussion of the thin turbulent layer detections made at heights above the tropopause, using the Millstone Hill L-band radar, complemented by radiosonde soundings and a few U-2 aircraft probes. The information obtained on the structure of scattering layers in the upper troposphere and lower stratosphere is expected to prove useful in the prediction of tropospheric and stratospheric layers. M.V.E.

A71-10587 # **Development of procedures for vectoring aircraft around thunderstorms.** William Lewis (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.). In: American Meteorological Society, Radar Meteorology Conference, 14th, Tucson, Ariz., November 17-20, 1970, Proceedings. Boston, American Meteorological Society, 1970, p. 301-304. 7 refs.

Discussion of the use of traffic-radar-generated weather contours by air traffic controllers in helping aircraft avoid severe weather. It is shown that in using these weather contours, controllers must allow an additional clearance distance obtainable from historical radar weather data made available by the National Severe Storms Laboratory. Peripheral contour clearance distances are presented. With their help, a vectoring plan based on a reasonable assessment of all factors involved can be worked out for the guidance of air traffic controllers. M.V.E.

A71-10606 # **Solution of the problem of flutter of a wing with a rigid aileron by the method of electronic modeling (Reshenie zadachi o flattere kryla s zhestkim eleronom metodom elektronnogo modelirovaniia).** S. A. Bidikhov and Iu. V. Ponomarev (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia III - Fizika, Astronomiia,* vol. 11, July-Aug. 1970, p. 415-421. In Russian.

Outline of a procedure for solving the problem of flutter of a wing with a rigid aileron with the aid of an analog computer. The problem is solved by a method based on the reduction of the solution of the corresponding boundary value problem to the solution of a certain set of Cauchy problems. The values of the critical flight velocity and the critical vibration frequency for a given value of the aileron suspension elasticity are determined. A comparison is made with the results obtained by the Bubnov-Galerkin method. A.B.K.

A71-10613 # **Flow field associated with the impingement of an overexpanded jet against a cone (Pole techeniia pri natekanii pererasshirennoi sverkhzvukovoi strui na konus).** M. V. Sushchikh and V. I. Pogorelov (Leningradskii Mekhanicheskii Institut, Leningrad, USSR). *Inzhenerno-Fizicheskii Zhurnal,* vol. 19, Aug. 1970, p. 269-271. In Russian.

Application of the method of characteristics to the calculation of a supersonic overexpanded flow past a cone. It is shown that a semibounded supersonic jet with a barrel-type structure forms at the cone surface. This jet possesses only one period within the limits of which the flow attains supersonic speeds. The barrel-type structure leads to the formation of a trailing shock and can be reflected from the cone surface in a regular or irregular way. The coordinate of the point of irregular reflection is determined from the condition of minimum static pressure behind a trailing shock. V.P.

A71-10718 # **Synthesis of selective multidimensional invariant systems (K voprosu sinteza selektivnykh invariantnykh mnogomernykh sistem).** N. P. Kolpakova. In: Theory of invariance of automatic systems; All-Union Conference on Invariance Theory and Its Application in Automatic Control Systems, 3rd, Kiev, Ukrainian SSR, May 31-June 5, 1966, Transactions. Volume 1 (Teoriia invariantnosti avtomaticheskikh sistem; Vsesoiuznoe Soveshchanie po Teorii Invariantnosti i ee Primeneniiu v Sistemakh Avtomaticheskogo Upravleniia, 3rd, Kiev, Ukrainian SSR, May 31-June 5, 1966, Trudy. Volume 1). Edited by Iu. G. Gurevich. Moscow, Izdatel'stvo Nauka, 1970, p. 220-224. 8 refs. In Russian.

Theoretical study of the couplings between the control coordinates as a factor in designing multidimensional invariant control systems. The selection of a root control channel and of the number of controlled couplings to make a control system of this class selectively invariant is discussed. A theorem is formulated and proved to determine these variables when constructing an optimal invariant control system. The results are applied to the optimization of a turboprop engine with a differential reductor. V.Z.

A71-10748 **Air traffic control by satellites - End of the 1970 test programs (Contrôle aérien par satellites - Fin des campagnes d'essais 1970).** Pierre Langereux. *Air et Cosmos,* vol. 8, Oct. 24, 1970, p. 14, 15. In French.

Results of the second and last test program conducted at Aire-sur-Adour within the framework of the Dioscures project of satellite control of air traffic. The CNES-SGAC and ESRO experiments are briefly described, and attention is given to a possible 1971 experiment with the Concorde. F.R.L.

A71-10749 **The Bertin company proposes a new formula for a short takeoff aircraft (La société Bertin propose une nouvelle formule d'avion à décollage court).** Jacques Morisset. *Air et Cosmos,* vol. 8, Oct. 24, 1970, p. 26, 27. In French.

Description of the Aladin 2 STOL transport concept, developed by Bertin, which would be used for very short interurban flights (30 to 60 mi). The concept could incorporate bypass Rolls-Royce-SNECMA M 45 H engines associated with Bertin-designed silencers. The resulting jet would be deflected by flaps on the blown wings. It is proposed to test the formula on a Nord 262 fuselage. Special attention is given to noise reduction. F.R.L.

A71-10750 **The Thomson-CSF IEP validates the possibilities of the human pilot (L'I.E.P. de Thomson-C.S.F. met en valeur les possibilités de pilote humain).** Jean-Claude Trichet. *Air et Cosmos,* vol. 8, Oct. 24, 1970, p. 32, 33. In French.

Description of the IEP (Indicateur Electronique de Pilotage/Electronic Pilotage Indicator) developed by Thomson-CSF for airline use. The equipment consists of a seven-in. cathode ray indicator. It is possible to present information actually furnished by seven different instruments: heading, roll and pitch, speed and speed tendency, altitude and altitude tendency, glide and localizer patterns, and flying control orders. The system divides the symbols into three colors - red for symbols related to the aircraft, green for those related to the ground, and yellow for the others. F.R.L.

A71-10751 **The development of small gas turbines for aircraft auxiliary power (Tenth Halford Memorial Lecture).** C. H. Paul (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Aeronautical Journal,* vol. 74, Oct. 1970, p. 797-805.

Discussion of the history of the development of small gas turbines for aircraft auxiliary power giving particular attention to the activities at the Garrett Corporation. The significant events in the auxiliary power unit (APU) field from 1948 to the present are discussed. The technical evolution of the APU and the operational requirements that have dictated the APU design are described. The advancements in compressors and combustor design, the decrease in noise level, the decreased fuel consumption and the improvements in specific weight over the past 23 years are discussed. The units that today are being designed for the next generation of aircraft are considered. G.R.

A71-10752 **A comparative study of aircraft gust analysis procedures.** R. A. Cox (Imperial College of Science and Technology, London, England). *Aeronautical Journal,* vol. 74, Oct. 1970, p. 807-813. 6 refs.

Review of the various currently available methods of calculating the response of an aircraft to turbulence and of obtaining design loads. The power spectral methods, which are expected to form the basis of a future airworthiness requirement, are discussed in some detail. Only static strength (rather than fatigue) aspects are considered. Preliminary results obtained in a recent series of calculations for a typical T-tail aircraft are presented and discussed. G.R.

A71-10753 **Collision avoidance systems.** G. L. Perry (Royal Air Force College, Cranwell, England). *Aeronautical Journal,* vol. 74, Oct. 1970, p. 814-816.

Discussion of the technique employed in prototype equipment designed to prevent aircraft collisions taking also into consideration an original principle as a design basis for a collision avoidance system. The presently investigated American system for avoiding mid-air collisions is evaluated. It is found that the weak point of this system stems from the fact that it is a cooperative system, and relies on the presence and serviceability of other equipment. A system is proposed which is non-cooperative. The principle of the system is based on the mechanics of the collision situation. G.R.

A71-10754 **Direct lift control.** W. J. G. Pinsker (Royal Aircraft Establishment, Bedford, England). *Aeronautical Journal,* vol. 74, Oct. 1970, p. 817-825. 12 refs.

Discussion of the feasibility of direct lift control (DLC) for aircraft taking into consideration the results of flight and simulator experiments available to date. The possible role of DLC in the aircraft is discussed and the various design aspects raised by its introduction are analyzed. Questions of coordination with conventional elevator control are considered. The theory of aircraft response to direct lift application and the repercussions in such fields as stall margins and piloting are discussed. G.R.

A71-10774 # **Supersonic wing-body interference.** R. W. Clark (University College, London, England). *Cambridge Philosophical Society, Proceedings,* vol. 68, Nov. 1970, p. 719-729. Research supported by the Science Research Council.

Consideration of the supersonic inviscid flow past a wing-body combination consisting of a semiinfinite plane wing symmetrically placed about an infinite convex cylinder. When the cylinder is circular in cross section, a formal solution for the Laplace transform of the velocity potential exists. This solution is given in the form of a series which is only slowly convergent near the boundary surface separating the disturbed and undisturbed regions. However, this slow convergence has been overcome by Waechter (1969) using the Poisson summation formula on the series solution. The solution to the problem in the neighborhood of this boundary surface is mathematically related to short wave diffraction by a cylinder, and this relationship is exploited in the solution given. Using this analogy, combined with boundary-layer analysis, Stewartson (1966) examined the solution again for the circular case. An alternative approach is

given by Jones (1967), who develops the problem for an arbitrary cylinder using electromagnetic diffraction theory based on the method of Green's functions. The results obtained are in agreement with those of Jones (1967) for the general cylinder, and with Stewartson (1966) and Waechter (1969) for the circular cylinder.
M.V.E.

A71-10818 # **Aerodynamics low and slow (The W. Rupert Turnbull Lecture).** R. J. Templin (National Aeronautical Establishment, Ottawa, Canada). *(Canadian Aeronautics and Space Institute, Annual General Meeting, Ottawa, Canada, May 18, 19, 1970.) Canadian Aeronautics and Space Journal,* vol. 16, Oct. 1970, p. 318-328. 16 refs.

Survey of Canadian research on low-speed air motions at altitudes below about 2000 ft. Laboratory-scale simulation studies of the gusty and irregular motions in the earth's surface wind layer are described, and some results are given in the form of wind turbulence spectra. The efficiency of slow powered-lift aircraft flight is examined in terms of thrust requirements, and miscellaneous aspects of biological aerodynamics are treated. T.M.

A71-10819 # **Noise reduction - A must for air transportation progress.** R. Dixon Speas (R. Dixon Speas Associates, Inc., Manhasset, N.Y.). *(Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Toronto, Canada, July 9, 10, 1970.) Canadian Aeronautics and Space Journal,* vol. 16, Oct. 1970, p. 333-337. 18 refs.

A plea is made for a concentration of technological attention upon noise reduction, as a primary task for those concerned with the advancement of air transportation in the seventies. Acknowledgement is given to quiet engine programs currently being accomplished by aircraft and engine manufacturers under government sponsorship. A need is cited for intensified research supported by cost-benefit analyses of economic benefits to communities, users of air transportation, and the aircraft industry. The economic benefits which would accrue are considered more substantial than usually estimated. A program of three positive steps forward in noise reduction is proposed: (1) development of objectives which will provide a reasonable balance between the costs of technological improvements and noise reduction benefits received; (2) projection of the quest for quieter engines into major programs of intensified research and development; (3) establishment of a realistic and practical timetable for research and development, engineering flight testing, operational flight testing in a real life airport-community relationship, and certification of achieved objectives. Alleviation of aircraft noise problems as currently experienced in airport operations and airport planning is considered the major technological challenge of air transportation in the seventies. (Author)

A71-10820 # **Air pollution by gas turbines - Is control possible.** J. Odgers (Université Laval, Quebec, Canada). *(Canadian Aeronautics and Space Institute, Annual General Meeting, Ottawa, Canada, May 18, 19, 1970.) Canadian Aeronautics and Space Journal,* vol. 16, Oct. 1970, p. 339-344. 15 refs.

The paper takes a very practical look at the removal of the major pollutants present in gas turbine exhausts. Two of these, carbon (smoke) and hydrocarbons, are nonequilibrium compounds and there is no theoretical reason why they cannot be eliminated by improvements in engineering design. Carbon monoxide, because of its rapid rate of decomposition, should also be capable of being reduced in quantity. Nitrogen oxides present a much more difficult problem because of their extreme dependence upon temperature as a rate controlling factor. The main solution to this form of pollution lies in preventing its formation, rather than trying to reduce the content after formation. If complete control of pollutants is required, then there will have to be radical changes in the design of combustors. In particular, there is a requirement for a chamber operating with a weak mixture in the primary zone, at all engine conditions. (Author)

A71-10821 # **A rapid method for the matching of two-spool turbojets.** H. I. H. Saravanamuttoo (Carleton University, Ottawa, Canada). *Canadian Aeronautics and Space Journal,* vol. 16, Oct. 1970, p. 345, 346.

Description of a method for the matching of two-spool turbojet engines, assuming that both the high- and the low-pressure turbines are choked and that the turbine flow characteristics are independent of rotational speed. The procedure involves superposition of the low-pressure turbine choking line on the high-pressure compressor characteristic. The results are valid over most of the running range provided both turbines remain choked, and the method can be readily extended to include secondary effects. T.M.

A71-10825 **Electronic flight control is getting set to take off.** J. P. Sutherland and R. C. Hendrick (Honeywell, Inc., Aerospace Div., Minneapolis, Minn.). *Electronics,* vol. 43, Nov. 9, 1970, p. 87-92.

Discussion of the current flight-test stage in the field of electronic control of the actuators of aircraft flaps, ailerons and other flight control surfaces as a promising alternative to the present mechanical linkages. The history and the future prospects of the new control systems are surveyed. The high complexity of the current mechanical control systems is pointed out as a condition urging improvement. The tradeoffs involved in the selection of redundant designs for new electric wire control systems are analyzed. It is expected that the new systems will eventually permit a higher aircraft maneuverability and a superior reliability in flight. V.Z.

A71-10844 **Approximate solution of a singular integral equation relating to the subsonic flow past oscillating wings.** S. N. Chaudhuri (Tennessee, University, Tullahoma, Tenn.). *International Journal of Engineering Science,* vol. 8, Oct. 1970, p. 829-842. 8 refs.

An approximate method has been developed to solve the singular integral equation occurring in the theory of three-dimensional wings oscillating harmonically in subsonic flow with arbitrary frequencies. If the oscillations are slow enough and the Mach number not too near unity, Garner has shown that the governing differential equation of the complex amplitude of the enthalpy can be approximated by the Laplace equation. However, if the frequency of the oscillating wing is not low, the acceleration potential satisfies the homogeneous form of the Helmholtz equation. The solution of this differential equation with the known oscillatory boundary condition then leads to the complicated singular integral equation obtained by several authors. The presence of the exponential term in the chordwise integrals together with the infinite limit of integration complicates matters. By splitting up the range of integration in a particular manner it is shown in the present paper that the integral equation can be solved for any arbitrary frequency. The method has been applied to the calculation of pitching derivatives with first order frequency effects for sweptback wings in subsonic flow and the results compared with those given by Garner to check the accuracy of the calculations. (Author)

A71-10859 # **Scale length in atmospheric turbulence as measured from an aircraft.** R. J. Taylor, N. E. Bacon (Commonwealth Scientific and Industrial Research Organization, Div. of Meteorological Physics, Aspendale, Victoria, Australia), and J. Warner (Commonwealth Scientific and Industrial Research Organization, Div. of Radiophysics, Epping, New South Wales, Australia). *Royal Meteorological Society, Quarterly Journal,* vol. 96, Oct. 1970,

p. 750-755. 10 refs.

Scale lengths, defined in four different ways, have been derived from previously reported spectra and autocorrelations of vertical air velocity component measured from an aircraft at heights between 10 and 1310 m. Below about 200 m the scale length increases with height more slowly than linearly and it does not seem possible to attribute this result to stability effects. At higher levels, no systematic height dependence can be shown. The results offer some support for the suggestion that the scale length is greater in lapse conditions than otherwise. (Author)

A71-10875 # **The status of federal involvement in short haul air transportation.** Richard D. FitzSimmons and William E. Thurman. *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 7th, Houston, Tex., Oct. 19-22, 1970, Paper 70-1286.* 3 p.

The paper discusses the interagency cooperation that could lead to a short haul air transportation program taking into account the realities of fiscal restraints and the somewhat overlapping agency responsibilities. Some of the aspects of federal involvement are discussed. Some thoughts on the interaction of civilian and military agencies and the private industry and municipalities are described. Finally, the impact of this new involvement of the government is developed in view of the many benefits which should accrue to the nation. (Author)

A71-10926 # **Compressible laminar boundary layer on a cone at high angle of attack.** Russell A. Smith and Paul K. Chang (Catholic University of America, Washington, D.C.). *AIAA Journal,* vol. 8, Nov. 1970, p. 1921-1927. 19 refs. Contract No. N 00017-67-C-0008.

An approximate integral method is applied to the three-dimensional laminar boundary-layer equations, including the energy equation for Prandtl number equal to unity, to obtain a solution to the attached boundary layer on slender cones in hypersonic flight at high angles of attack. The velocity and total enthalpy profiles are of the Timman type. The crossflow velocity profile is a two-parameter family allowing for nonzero crossflow at streamline inflection points. Because of the high angles of attack considered, the solution includes the effect of large crossflow velocity on the boundary layer. Using the pressure data available in the literature, results for the heat transfer coefficient, surface shear stress direction, and position of separation are computed. The computations compare favorably with data from the literature. (Author)

A71-10927 # **Statics and aerodynamics of lifting decelerators.** L. H. Townend (Royal Aircraft Establishment, Farnborough, Hants., England). *(American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, El Centro, Calif., Sept. 23-25, 1968, Paper 68-945.) AIAA Journal,* vol. 8, Nov. 1970, p. 1928-1935. 27 refs.

At supersonic and hypersonic speeds, lifting decelerators may take the form of parawings or two-dimensional "sails." For free-stream Mach numbers between 10 and 4, an analysis is made of the profiles assumed and isentropic waves produced in nonviscous flows by two-dimensional sails, under pure tension and of finite weight. At the higher free-stream Mach numbers, large parts of the compression flow are virtually centered, and even for long sails (e.g., 100-ft chord) at a high Mach number (e.g., 10) and low stress (e.g., 5 tons/in.^{2}), the weight of such a membrane need not exceed 1 lb/ft^2. The two-dimensional analysis can include the effects of skin friction and is extended to singly-curved "caret" sails, which allow leading edges to be swept but can still produce two-dimensional waves; equilibrium can still be maintained by appropriately applied tensile forces. Experimental evidence on two-dimensional, rectangular sails tends to support the theoretical predictions that much of the sail compression flow will be nearly centered. (Author)

A71-10930 * # **Results from a new wind-tunnel apparatus for studying coning and spinning motions of bodies of revolution.** Lewis B. Schiff and Murray Tobak (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal,* vol. 8, Nov. 1970, p. 1953-1957. 6 refs.

Description of an apparatus which reproduces either separate or combined coning and spinning motions of a body of revolution in a wind tunnel, using a six-component strain gage balance to measure the aerodynamic forces and moments. Results of experiments with a slender cone in coning motion show that at small angles of attack the side-force and side-moment coefficients normalized by the coning rate are linear functions of the angle of attack, the slopes of which are in excellent agreement with the damping-in-pitch coefficients. This agreement, predicted by linearized theory, indicates that at small angles of attack the dynamic damping-in-pitch coefficients of a body of revolution can be measured as the steady side force and moment coefficients of the body undergoing coning motion. For larger angles of attack, where vortices appear on the leeside of the body, the normalized side force and moment coefficients become nonlinear functions of angle of attack. Photographs of vortices reveal that they are displaced from the angle-of-attack plane by coning motion. O.H.

A71-10931 # **Drag of rectangular cavities in supersonic and transonic flow including the effects of cavity resonance.** O. Wayne McGregor (General Dynamics Corp., Fort Worth, Tex.) and Robert A. White (Illinois, University, Urbana, Ill.). *AIAA Journal,* vol. 8, Nov. 1970, p. 1959-1964. 21 refs. NSF Grant No. GK-2053.

The drag of relatively short rectangular cavities (length-to-depth ratios of 0.50-3.0) with turbulent shear layers has been measured at transonic and supersonic Mach numbers (0.3-3.0). Of particular importance is the effect of pressure oscillations within the cavity (commonly referred to as cavity resonance) which is shown to increase the drag as much as 250%. Cavity resonance is found to occur over the entire Mach number range investigated and other work has shown it to occur at both lower and higher Mach numbers. The frequency of the pressure oscillations is best predicted by the vortex-wave interaction model presented by Rossiter. The effects of external reinforcement of resonance by reflection of radiated pressure waves are examined both experimentally and analytically. Existing methods for predicting cavity drag are inadequate to cope with this phenomena. A new model for predicting the lower bound of cavity drag (nonresonating cavity) is presented and agrees well with experimental data. Analytical considerations are utilized to indicate the qualitative effect of resonance on cavity drag. (Author)

A71-10932 # **Kinetic theory analysis for the flowfield of a two-dimensional nozzle exhausting to vacuum.** A. A. Peracchio (United Aircraft Research Laboratories, East Hartford, Conn.). *(American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, San Francisco, Calif., June 16-18, 1969, Paper 69-658.) AIAA Journal,* vol. 8, Nov. 1970, p. 1965-1972. 12 refs. Research supported by the United Aircraft Corp.

Analytical study based on the Bhatnagar-Gross-Krook (BGK) equation. The nonlinear BGK equation is solved iteratively by integration through use of the method of characteristics. A computer program based on the resulting equations is described, and plots of density, temperature, and velocity for the exhaust region are shown for two nozzle Reynolds numbers (or chamber pressures). As expected, the results deviate from continuum predictions. The flowfield exists everywhere, not only within the limiting streamline predicted by continuum theory. An unexpected rise in static temperature is noted in the expansion flowfield near the corner of the nozzle where the largest deviations from the assumptions of continuum fluid mechanics occur. (Author)

A71-10939 # **Discrete element approach to flutter of skew panels with in-plane forces under yawed supersonic flow.** Kariappa, B. R. Somashekar, and C. G. Shah (National Aeronautical Laboratory, Bangalore, India). *AIAA Journal,* vol. 8, Nov. 1970, p. 2017-2022. 12 refs.

The flutter problem of skew panels, with in-plane forces under yawed supersonic flow, has been considered in this paper through the application of matrix displacement methods. Necessary kinematically consistent aerodynamic influence coefficient matrices (AIC), which are applicable to yawed supersonic flows, have been developed and are employed in the formulation of the dynamic equations of motion. The results have also been compared with the other available results and the agreement is found satisfactory. This approach makes it possible to tackle flutter problems of panels with practically any boundary condition including cut-outs, if any, and subjected to thermal or other midplane forces. (Author)

A71-10940 * # **Comparison of theory and experiment for nonlinear flutter of loaded plates.** C. S. Ventres and E. H. Dowell (Princeton University, Princeton, N.J.). (American Institute of Aeronautics and Astronautics, Structural Dynamics and Aeroelasticity Specialist Conference, New Orleans, La., April 16, 17, 1969, Proceedings, p. 285-295.) *AIAA Journal,* vol. 8, Nov. 1970, p. 2022-2030. 17 refs. Grant No. NGR-31-001-124.

Theoretical analysis of the flutter behavior of plates with in-plane boundary support flexibility exposed to transverse pressure loadings, or buckled by uniform thermal expansion. Quasi-steady aerodynamic theory and Von Kármán's plate equations are employed. Two sets of in-plane boundary conditions are considered: (1) zero in-plane motion normal to the edges, and (2) zero in-plane stress at the edges. A modal expansion of the transverse deflection is used in conjunction with Galerkin's method to obtain a set of nonlinear ordinary differential equations which are integrated numerically to determine the flutter motion. It is shown that the stability boundaries of low aspect ratio plates with zero edge restraint are more sensitive to pressure loads than are those of plates with complete edge restraint. Moreover, comparisons with available experimenta data indicate that zero edge restraint is a good assumption for some panel configurations. Finally, it is indicated that fair agreement between theory and experiment can be obtained for buckled plates. (Author)

A71-10948 # **Nonaffine similarity laws inherent in Newtonian impact theory.** Howard Jaslow (Technik, Inc., Jericho, N.Y.). *AIAA Journal,* vol. 8, Nov. 1970, p. 2062-2064. 5 refs.

Derivation of nonaffine similarity laws and transformations subject to the limitations of Newtonian impact theory. Applying these transformations to different configurations, the lift and drag coefficients of complementary configurations can then be related through the appropriate similarity laws. It is pointed out that the results obtained may be extended to three-dimensional configurations and generalized to configurations which are not complementary. O.H.

A71-10956 # **Application of Whitham's theory to sonic boom in the mid- or near-field.** Y. S. Pan (Tennessee, University, Tullahoma, Tenn.). *AIAA Journal,* vol. 8, Nov. 1970, p. 2080-2082. 7 refs. Contract No. FA-70-WA-2260.

Discussion of the validity of Whitham's (1952) theory of supersonic flow in the modified and near field of a slender body. The consideration of this theory is related to sonic-boom research in large-model wind tunnel work where only mid-field and near-field simulation is done. General quantitative and qualitative modifications of Whitham's theory are attempted, and an extrapolation of a known disturbance signature to the far field is performed. M.V.E.

A71-10969 * # **Sphere drag in near-free-molecule hypersonic flow.** M. I. Kussoy, D. A. Stewart, and C. C. Horstman (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal,* vol. 8, Nov. 1970, p. 2104, 2105. 9 refs.

Investigation of the drag coefficient of spheres at hypersonic Mach numbers for near-free-molecule flow conditions. Sphere drag data in the near-free-molecular regime for flow conditions close to earth satellite conditions, obtained by using a free-flight technique in the Ames 42-in. shock tunnel are tabulated, shown graphically, and discussed. O.H.

A71-10971 # **Comment on 'A method for extracting aerodynamic coefficients from free-flight data.'** Charles H. Murphy (U.S. Army, Ballistic Research Laboratories, Aberdeen Proving Ground, Md.). *AIAA Journal,* vol. 8, Nov. 1970, p. 2109-2111. 5 refs.

Comment on the recent Chapman-Kirk iterative technique of finding the parameters of various differential equations from free-flight data. A comparison is made of this technique with a simpler quasi-linear technique for the case of a missile with nonlinear damping and static moments. Moreover, a discrepancy in the Chapman-Kirk fit to the motion of the missile is explained. O.H.

A71-10979 **Modeling an air traffic control environment.** Eli J. Dalabakis and Timothy R. Holmes (Electronic Communications, Inc., St. Petersburg, Fla.). In: NTC 70; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Los Angeles, Calif., April 27-30, 1970, Proceedings.
New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 31-36. Contract No. AF 33(615)-69-C-1127.

The problem of simulating an Air Traffic Control (ATC) communication environment is investigated. A mathematical model is developed using actual (ATC) statistics. The model consists of defining the statistical properties of the airborne message generators which represent the airborne terminals, and the statistical properties of the ground based generator representing the tower. This is accomplished by taking raw ATC data from transcribed tapes and reducing such data into meaningful statistics. The second element is the development of a computer algorithm that accepts the input statistics and performs the necessary scheduling of events. A polling subroutine is also developed, to accommodate a burst data link, to compare traffic (number in queues, waiting times, channel utilization) with and without polling, where the polling time shares the voice channel. (Author)

A71-11014 **Solution of the equations of motion of coupled-bending torsion vibrations of turbine blades by the method of Ritz-Galerkin.** J. S. Rao and W. Carnegie (Surrey, University, Guildford, England). *International Journal of Mechanical Sciences,* vol. 12, Oct. 1970, p. 875-882. 15 refs.

In this paper Galerkin's procedure is applied to determine the natural frequencies of a straight cantilever blade with an asymmetric aerofoil cross-section executing coupled-bending torsion vibrations. The results obtained are compared with the calculations made by a numerical procedure developed by Rao and the theoretical and experimental results of Carnegie and Dawson. The results obtained by Galerkin's process are shown to be in good agreement with the theoretical and experimental results mentioned above. (Author)

A71-11016 **A review of methods for assessing loss coefficients in radial gas turbines.** Rowland S. Benson (Manchester, University, Manchester, England). *International Journal of Mechanical Sciences,* vol. 12, Oct. 1970, p. 905-932. 22 refs. Research supported by CAV, Ltd.

A number of methods for representing the losses in radial gas turbines for predicting the off-design performance are reviewed. It is shown that reasonable predictions of the turbine performance may be made using one-dimensional theories if the nozzle gas exit angle is based on the 1/cos(o/s) rule with some deviations due to rotor speed and if the rotor exit angle is based on the 1/cos(o/s) rule at the mean radius. The rotor losses may be divided into two parts. The first part is an incidence loss and the second part the rotor passage loss. A number of methods for representing these separate losses are reviewed. It is shown that the shock loss method is satisfactory to represent the incidence loss, and that the method suggested by Futral and Wasserbauer gives the simplest method for predicting the rotor passage loss. (Author)

A71-11019 # Pressure field induced on a lifting surface by an isotropic atmospheric turbulence (Pression induite sur une surface portante par une turbulence atmosphérique isotrope). Gabriel Coupry (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(International Council of the Aeronautical Sciences, Congress, 7th, Rome, Italy, Sept. 14-18, 1970, Paper ICAS 70-30.) La Recherche Aérospatiale,* Sept.-Oct. 1970, p. 241-249. 5 refs. In French.

Discussion of the aerodynamic theory of a lifting surface and of the integral equation which relates the pressure field to the angle of attack of a wing. The solution of this integral equation is shown to give an approximate Green function of the problem. This provides a method for computing the cross power spectrum of the pressure field induced by an isotropic atmospheric turbulence, once the cross power spectrum of the vertical component of the turbulence is given. The method is not more complicated than the one which relies on the assumption of uniformity of turbulence in span. As an example, the transfer function of the CONCORDE to turbulence has been computed by both techniques. M.M.

A71-11020 # Calculating the kernel of the lifting surface integral equation in unsteady subsonic flow (Sur le calcul du noyau de l'équation integrale de la surface portante en écoulement subsonique instationnaire). Roland Dat and Jean-Pierre Malfois. *La Recherche Aérospatiale,* Sept.-Oct. 1970, p. 251-259. In French.

The kernel of the integral equation linking the pressure on the lifting surface to the downwash includes an integral difficult to compute with the usual numerical integration processes, and most authors faced with this problem calculate this kernel neglecting a logarithmic singularity. A method is proposed which, while remaining reasonably fast, respects this singularity. (Author)

A71-11022 # Computation of aircraft wing and turbomachine or helicopter blade airfoils for the exact compressibility law (Calcul de profils d'ailes d'avions, de pales d'hélicoptères ou d'aubes de turbomachines pour la loi de compressibilité exacte). Robert Legendre. *La Recherche Aérospatiale,* Sept.-Oct. 1970, p. 269. In French.

Attempt to remove a certain limitation on a method of calculating a reversible transonic flow proposed by Bévierre and Bados (1970). The method proposed by Bévierre and Bados suffers from the fact that it is difficult to perform the calculation of the correction functions with the required accuracy. As a result, these authors limited their method to the calculation of profiles such that no correction was necessary. An attempt is therefore made by the author to substitute for the finite-difference procedure proposed by Bévierre and Bados a classical Fredholm procedure which lends itself to the solution of the Dirichlet problem within a given contour. A.B.K.

A71-11024 # Experimental determination of pressure fluctuations on stationary blades of a high power axial-flow compressor (Détermination expérimentale des fluctuations de pression sur les aubes fixes d'un compresseur axial de grande puissance). Guy Fasso and Robert Larguier. *La Recherche Aérospatiale,* Sept.-Oct. 1970, p. 272, 273. In French.

Summary of the results obtained from a series of wind-tunnel tests carried out for the purpose of studying periodic pressure fluctuations occurring on the fixed blades of a high-power axial-flow compressor. An attempt is made to determine the dynamic characteristics of three different types of pressure sensors used in these studies. It is shown that it is possible to obtain periodic steady random values of the pressures on the stator blades of a large-size axial-flow compressor. The results obtained provide a tentative idea of the amplitude of the forces exciting the vibrations and also shed light on the behavior of the rotor wakes and their effect on the stator blades. A.B.K.

A71-11048 # Construction and design of high-pressure balloons made from fiberglass-reinforced plastics (Konstruirovanie i raschet ballonov vysokogo davleniia iz stekloplastika). B. A. Bigula, A. T. Vasilenko, Ia. M. Grigorenko, V. S. Gumeniuk, A. A. Kritsuk, and A. I. Shinkar' (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 6, Aug. 1970, p. 117-120. In Russian.

Development of a method of calculating the stress-strain state of balloons made from fiberglass-reinforced plastics. The method makes use of a numerical technique (programmed for the 2M computer) proposed by Vasilenko et al. (1970) for calculating the stress-strain state of orthotropic multilayer shells of revolution with layers of variable rigidity. The method is shown to be suitable for obtaining optimum designs of balloons and similar structures made from fiberglass-reinforced plastics. V.P.

A71-11063 # Experimental study of rotating stall in high-pressure stages of an axial-flow compressor (Eksperimental'noe issledovanie vrashchaiushchegosia sryva v vysokonapornykh stupeniakh osevogo kompressora). V. S. Beknev, A. V. Zemlianskii, and R. Z. Tumashev (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR). *Mashinostroenie,* no. 8, 1970, p. 116-122. In Russian.

Results of an experimental study of rotating stall in axial-flow compressor stages with different types of profiling along the blade height and with different calculated regimes of flow past a profile in the cascade. It is found that, in spite of the different safety margins with respect to boundary layer separation in the cascades of the different stages, their boundaries of stable operation are almost the same. It is shown that profiling taking into account end effects has a stabilizing influence and leads to a smoother transition to the rotating stall regime. The flow in rotating stall zones is shown to be of three-dimensional nature. It is shown that this three-dimensional structure can be detected with the aid of straight and L-shaped tensoanemometer probes. A.B.K.

A71-11167 Radiation from a dipole near a conducting cylinder of finite length. Julius Goldhirsch, Dennis L. Knepp, and Richard J. Doviak (Pennsylvania, University, Philadelphia, Pa.). *IEEE Transactions on Electromagnetic Compatibility,* vol. EMC-12, Aug. 1970, p. 96-105. 10 refs. Contract No. DA-28-043-AMC-02411.

Antennas radiating in free space or above a reflecting plane produce radiation patterns which are in general predictable. When these same antennas are mounted on bodies such as aircraft, submarines, or satellites, secondary currents may be induced on the fuselages and nearly conducting members. These secondary currents often result in unpredictable radiation in the forms of newly introduced polarizations or unwanted lobe structures which together may manifest themselves in the form of radio-frequency interference.

As a model of the fuselage of either of the aforementioned conducting bodies, a cylinder of finite length is considered and the radiation fields of a radial dipole in the immediate vicinity of such a cylinder are determined by a theoretical-numerical technique. A cross-polarized field due to axial currents induced along the cylinder is found to represent a predominant feature of the radiation characteristics of the dipole-cylinder configuration. (Author)

A71-11178 # **SST environmental effects - Some considerations.** Gerald M. Daniels (Avco Everett Research Laboratory, Everett, Mass.). *Astronautics and Aeronautics,* vol. 8, Nov. 1970, p. 22-25, 80. 32 refs.

Discussion of the modification of the radiation balance of the earth produced by water vapor, carbon dioxide, carbon monoxide, nitric oxide, and dust which would be deposited by a fleet of 400 to 500 supersonic transports (SST) in the altitude region from 16 to 22 km. Stratospheric air motions are examined and stratospheric-water-vapor mixing ratios are considered. The determination of the temperature increase at the earth's surface is discussed. Estimates obtained indicate that routine SST commercial operation can increase the water-vapor content of the lower stratosphere by 60% and the surface temperature of earth by 0.6 C in a latitude band from 45 to 60 deg N. The scheduling of SST flight paths to involve stratospheric regions where the residence time for the pollutants deposited by the aircraft is short is considered. G.R.

A71-11180 # **On turbine engine development policy.** Benjamin Pinkel and J. R. Nelson (RAND Corp., Santa Monica, Calif.). *Astronautics and Aeronautics,* vol. 8, Nov. 1970, p. 52-63.

Discussion of methods for reducing the risk of mismatch between engine and airframe when the airplane enters the flight-test phase. The Advanced Turbine Gas Generator program established by the Air Force is discussed. Categories of R and D activities and sources of funding for R and D are considered. Programs for demonstrating competitive technologies for engine development, called austere demonstrator programs are examined, and the establishment of prototype demonstrator programs designed to ensure that precise specifications are met is reported. G.R.

A71-11181 # **Evolution of the jet engine.** Edward S. Taylor. *Astronautics and Aeronautics,* vol. 8, Nov. 1970, p. 64-72.

Discussion of the evolution of the jet engine taking into consideration increases in size and efficiency made during the past 25 years. Continuous improvements of takeoff thrust per unit weight for jet engines are considered and changes in combustion chamber design are discussed. Fans, high-pressure-ratio compressors, and high turbine-inlet temperature are cited as the major contributors to improvement in efficiency. Efforts to control jet noise and reduce emission of pollutants are discussed. G.R.

A71-11227 # **A unified theory for linearized shock-on-shock interaction problems.** Narendra Lal Arora. Delft, Technische Hogeschool, Technische Natuurkunde, Doctor in de Technische Wetenschappen Dissertation, 1969. 168 p. 9 refs.

Analysis of a nonuniform flow field produced by the interaction of a plane shock wave of arbitrary strength and two-dimensional thin aerofoils, slender bodies of revolution, or three-dimensional thin wings moving at supersonic speed. The boundary value problem concerning the pressure produced by perturbation is solved by applying a sequence of integral transforms. The flow density field and the shock wave shape are obtained as a result. The more specific applications of the results of this study include a slender conical projectile, a flat delta wing with supersonic leading edges, and thin wedges with or without yaw. V.Z.

A71-11248 # **The promise of the supersonics.** John M. Swihart (Boeing Co., Supersonic Transport Div., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 7th, Houston, Tex., Oct. 19-22, 1970, Paper 70-1217.* 8 p. Members, $1.50; nonmembers, $2.00.

Discussion of the current status of the U.S. SST program as it relates to airline operation in the late 1970s and early 1980s. The initial production configuration, performance, economics, and operations are presented and compared with contemporary subsonics. A review of the payload/range growth of subsonic jet transports is presented as groundwork for the prediction of payload/range growth for the SST's. The economic potential of both subsonic and supersonic transportation is reviewed, highlighting the complementary nature of supersonic aircraft in providing improved passenger service in the years to come, particularly in the area of long-haul intercontinental passenger transportation. M.V.E.

A71-11252 **ECM manufacturing process to produce aircraft engine components.** T. A. Welte (United Aircraft of Canada, Ltd., Montreal, Canada). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Detroit, Mich., Apr. 13-17, 1970, Paper MR 70-206.* 14 p. Members, $1.50; nonmembers, $2.00.

Discussion of electrochemical machining (ECM), a metal removal process based on reversed plating which involves rapid metal dissolution by electrolysis. ECM has been developed and accepted as a production and manufacturing technique for a large variety of aircraft engine components. Many weight reduction problems with aircraft engines can be resolved by employing ECM, especially where elaborate conventional contouring costs become excessive, as in the case of superalloy materials of low machinability ratings. Time comparisons with conventional methods and description of various ECM tooling techniques are presented, and the evaluation criteria for ECM applications are discussed. A few specific ECM applications reviewed include turbine and compressor disks of a turboprop engine, a low turbine rotor of a JT-15D jet engine, and an impeller for a turboprop engine. M.V.E.

A71-11253 **Electrochemical machining promise and realisation.** A. H. Meleka (Rolls-Royce, Ltd., Derby, England). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Detroit, Mich., Apr. 13-17, 1970, Paper MR 70-193.* 14 p. Members, $1.50; nonmembers, $2.00.

Review of the experience gained to date in the application of electrochemical machining to contouring operations, blade aerofoil machining, turning, drilling, grinding, and deburring. The basic principles of electrochemical machining are discussed. Special attention is given to the use of this method for turbine blade drilling and contouring operations in large castings. It is concluded that the process and productivity of electrochemical machining can be considerably improved. Z.W.

A71-11263 **Polyimide/boron reinforced plastic structures.** Lloyd E. Hackman (North American Rockwell Corp., El Segundo, Calif.). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Detroit, Mich., Apr. 13-17, 1970, Paper EM 70-133.* 19 p. Members, $1.50; nonmembers, $2.00.

Discussion of the development of polyimide/boron reinforced structures, and description of their use in the fabrication of leading edge structure. A system of vacuum bag processing of these materials was developed to achieve the lowest cost potential. To protect the

polyimide/boron structure from temperatures of 750 F and to reduce the operating temperature to 500 F for long-term operation, a ceramic insulation system was developed. Z.W.

A71-11267 Recent developments in high velocity metalworking. E. J. Breznyak (Macrodyne Chatillon Corp., Doylestown, Pa.). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Detroit, Mich., Apr. 13-17, 1970, Paper MF 70-228.* 17 p. 10 refs. Members, $1.50; nonmembers, $2.00.

Description of some of the more common parts, both symmetrical and nonsymmetrical, that have been produced using controlled energy flow forming equipment, recent progress in forging airfoil configurations, and results of a development program for the ausforging of bearing race blanks. Tooling lives for the various parts are given, and the more prominent features of successful tooling design for high velocity metalworking applications are outlined. It is shown that high velocity metalworking techniques are coming of age and can be considered as useful production tools. Although high velocity processing should not be considered a metalforming panacea, ever further applications continue to be developed as more experience and knowledge are gained. Considerable interest has been generated for scaling up present high velocity forming capabilities 4 to 5 times. Designs have been completed for a 1,800,000 foot-pound counterblow high velocity metalworking machine under Air Force sponsorship, and these designs are presently being evaluated. M.V.E.

A71-11277 # The age of composites. W. M. Powers (General Technologies Corp., Reston, Va.). *SAMPE Quarterly,* vol. 2, Oct. 1970, p. 9-15.

Advanced composites are being used in a wide variety of aerospace prototype hardware. Although current filament prices are high, projected reductions should provide the necessary cost effectiveness for an ever increasing number of applications. Boron filaments are already scheduled for two new production aircraft, and graphite fiber composites will go into commercially manufactured sporting goods this year. (Author)

A71-11281 # Development of advanced composite structures for aircraft. R. T. Beall, G. W. Burton, and W. V. Rich (Lockheed-Georgia Co., Marietta, Ga.). *SAMPE Quarterly,* vol. 2, Oct. 1970, p. 41-45.

The Lockheed-Georgia Research Laboratory has built two 35-square-foot relief crew compartment panels to demonstrate the cost-effectiveness of unique advanced-composite structures. The experimental panels have only 3/5 the weight and 1/2 the thickness of the aluminum structure presently being used. A single-stage layup using adhesive prepregged graphite fibers bonded to Nomex honeycomb core, guarded by fiberglass edge members and titanium doublers, represents an unusual marriage of advanced materials. Unusually simple tooling concepts and manufacturing techniques clearly demonstrate the adaptability of this technology to mass-produced aircraft systems. Detailed descriptions of the tests to which the panel was subjected are included. (Author)

A71-11302 # The hypersonic transport - The technology and the potential. Maxwell W. Hunter, II and Dietrich W. Fellenz (Lockheed Missiles and Space Co., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 7th, Houston, Tex., Oct. 19-22, 1970, Paper 70-1218.* 48 p. Members, $1.50; nonmembers, $2.00.

Evaluation of hypersonic 'conventional' and rocket transport craft in terms of production technology and application potential. The rocket guide range, propellant and airframe costs, and exhaust and noise pollution are discussed. Special attention is given to nuclear powered cruise hypersonic transport aircraft. Hypersonic transports are considered a natural continuation of supersonic transport development, and their payload carrying ability and range characteristics are believed to be attractive. It is also indicated that the use of current space shuttle designs in a point-to-point transportation mode may be economically competitive with supersonic transports. It is further maintained that new nuclear propulsion techniques make nuclear engines capable of driving hypersonic transports and that nuclear transports powered by gaseous nuclear reactors should be inherently safer than nuclear subsonic aircraft. V.Z.

A71-11311 • # Televised graphic displays for steep approach-to-landing research. Henry C. Elkins and Jack J. Hatfield (NASA, Langley Research Center, Hampton, Va.). *Society for Information Display, National Symposium on Information Display, 11th, New York, N.Y., May 26-28, 1970, Paper.* 3 p.

An integrated, graphic, situation display concept for low-visibility, noise-abatement, steep approach-to-landing is presented. A terminal area display research facility for studying this concept under actual flight conditions is described. Symbols and graphic images are generated in a television format by ground-based equipment and transmitted to the aircraft for display. Initial flight results, including kinescope recordings and radar plots, are presented. Continuing efforts to improve the graphic display format are described. (Author)

A71-11320 # Aviation fuels, lubrication materials, and special fluids (Aviatsionnye topliva, smazochnye materialy i spetsial'nye zhidkosti) (2nd revised and enlarged edition). A. F. Aksenov. Moscow, Izdatel'stvo Transport, 1970. 256 p. 12 refs. In Russian.

Aviation fuels, lubrication materials, and special fluids are described in terms of fabrication, composition, operational characteristics, and control procedures. The refining of petroleum fuels is examined, and the fractional and chemical compositions are discussed. Requirements posed for fuels are treated in terms of the important physicochemical properties, and engineering aspects of application are examined, including stability, filtration, pumping, corrosion, wear-inhibiting characteristics, mixibility, combustibility, and deposit formation. Special characteristics and operational requirements are outlined for fuels used in jet and piston engines, supersonic aircraft, and rockets. Fabrication, properties, and behavior of lubricants for aerospace applications are extensively examined, together with similar aspects of hydraulic fluids, deicing liquids, and cleansing compounds. T.M.

A71-11322 # Antenna radomes of flight vehicles (Obtekateli antenn letatel'nykh apparatov). B. A. Prigoda and V. S. Kokun'ko. Moscow, Izdatel'stvo Mashinostroenie, 1970. 288 p. 8 refs. In Russian.

Information dealing with the calculation, design, and fabrication of antenna radomes for aircraft and missiles is presented in a systematic textbook form. Initial chapters are devoted to the passage of electromagnetic radiation through various dielectric media, and methods are described for fabricating radomes which will retain the original properties of the dielectric material. Different types of radomes are described in categories based on position, structure, and useful wavelengths. The operational factors acting on the radomes are outlined for the purpose of illustrating the effects of aerodynamic forces, heating, and climatic phenomena. Fabrication techniques are examined for plastic reinforced glass, ceramics, and other radome materials. Calculations of radome losses are explained, together with methods of compensating for the resulting angular propagation errors. Quality control and reliability aspects of radome fabrication are also treated. T.M

A71-11377 * **History of NACA/NASA rotating-wing aircraft research, 1915-1970. IV.** Frederic B. Gustafson (NASA, Langley Research Center, Hampton, Va.). *VertiFlite,* vol. 16, Nov. 1970, p. 6-9. 8 refs.

Description of events and views concerning rotating-wing aircraft research during the 1955-1970 segment of the 1915-1970 period. It is considered that major attention by NACA and NASA on nonrotor VTOL work had a deleterious effect on rotating wing research. On the favorable side, heavy use of the full-scale wind tunnel for rotor work began early in this period, and is continuing. The general view now seems to be that the horizons are unlimited both for rotating-wing aircraft and for other vertical-lift aircraft types. Rotor flow studies, rotor-blade pressure distribution, and airfoil behavior in rotors are discussed, as well as methods for performance improvement. F.R.L.

A71-11392 # **The track-while-scan technique for search radar. I - Acquisition and processing of aircraft radar data.** Takashi Iida, Moriyuki Mizumachi, and Minoru Higashiguchi. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin,* vol. 6, Sept. 1970, p. 652-688. In Japanese, with abstract in English.

Discussion of a design philosophy and basic experiments for processing radar data for digital tracking computation. Aircraft search radar data, obtained scan by scan, are recorded on perforated tapes through a radar video digitizer (RVD) and buffer memory devices. The track-while-scan technique is investigated by an off-line computer using these recorded data. M.M.

A71-11393 # **The track-while-scan technique for search radar. II - The theoretical analysis of aircraft tracking by the application of Kalman filter.** Takashi Iida, Moriyuki Mizumachi, and Minoru Higashiguchi. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin,* vol. 6, Sept. 1970, p. 689-700. In Japanese, with abstract in English.

Description of a theoretical model for the analysis of the track-while-scan technique for search radar. The Kalman filter is introduced on condition that the root-mean-square tracking error be minimized, and assuming the input signal to be stochastic. The model is analyzed by computing gain functions on different types of input signals. It is concluded that the Kalman filter theory can be applied to the linear tracking computation. M.M.

A71-11395 # **Mechanical degradation of aeroplane materials by their fatigue and its detection. I.** Kozo Kawata, Shozo Hashimoto, and Akira Hondo. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin,* vol. 6, Sept. 1970, p. 716-728. In Japanese, with abstract in English.

Investigation of possible changes in the mechanical properties of the static stress of specimens previously repeatedly loaded at various stress levels. An appreciable decrease in the breaking strain at different stress levels and a slight decrease in the breaking stress at specific stress levels are found, denoting that embrittlement begins before the appearance of macroscopic defects. M.M.

A71-11406 # **The Göttingen Aerodynamic Test Institute from 1945 to 1969 (Die Aerodynamische Versuchsanstalt Göttingen von 1945 bis 1969).** Göttingen, Aerodynamische Versuchsanstalt, 1969. 144 p. 592 refs. In German.

Summary of the accomplishments of the various divisions of the Göttingen Aerodynamic Test Institute during the period from 1945 to 1969. The development, organizational changes, and major research findings of the Aerodynamic and Gasdynamic Divisions are outlined, emphasizing, in particular, the results of wind tunnel investigations. Work done by the Institute in the field of space aerodynamics is described. The findings of the Aeroelasticity Division during the period from 1953 to 1969 are reviewed, and the development of the electronic computer equipment of the Institute is assessed. The tasks completed by the Operation and New Test Equipment Division during the period from 1945 to 1969 are enumerated. A.B.K.

A71-11468 **Influence of retarded time on jet noise.** Ian S. F. Jones (Sydney, University, Sydney, Australia). *Physics of Fluids,* vol. 13, Nov. 1970, p. 2629-2633. 7 refs. Research supported by the Boeing Co.

The acoustic radiation from a region of turbulence can be expressed in terms of the fluctuating turbulent stresses and for estimates of the noise, it is common to neglect the change in retarded time between different regions of correlated turbulence. From measurements of the wavenumber frequency spectrum of one of the turbulent stresses in a jet, the influence of retarded time on the acoustic radiation is shown to be small for sound radiated at right angles to the jet axis but to be significant at small angles to the jet axis. This provides a partial explanation of the success of Lighthill's U super 8 law even when convection is important. (Author)

A71-11539 **Beryllium - An aircraft and spacecraft structural material (Beryllium - Ein Werkstoff für die Luft- und Raumfahrt).** F. Gerhard (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Luftfahrttechnik Raumfahrttechnik,* vol. 16, Oct. 1970, p. 243-247. 13 refs. In German.

Brief review of the mining and metallurgy of beryllium, and discussion of its mechanical and physical properties, corrosion behavior, toxicity, fabrication processes and applications. Beryllium metal is shown to possess a combination of special properties such as cannot be found or duplicated in any other material. It is uniquely fit for applications in parts requiring high stiffness combined with great buckling strength and low weight. The relatively high price of such parts, caused by the complex and costly processing of beryllium manufactured products, is offset by the only thus achievable combination of end-product properties. M.V.E.

A71-11540 **Evaluation of some new aircraft structure materials by methods of fracture mechanics (Bewertung neuer Flugzeugbauwerkstoffe mit den Methoden der Bruchmechanik).** H. Leis (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany) and W. Schütz (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany). *Luftfahrttechnik Raumfahrttechnik,* vol. 16, Oct. 1970, p. 247-251. 21 refs. In German.

Discussion of the significance and implications of certain fatigue cracks and structural failures due to cracks that have recently occurred in several military and civilian aircraft. The inferences of these accidents are discussed in detail. Crack propagation, residual static strength, and fracture toughness have been determined for two high-strength aluminum alloys of the Al-Zn-Mg-Cu type. Both alloys showed an excellent combination of mechanical properties, quite competitive with that of titanium alloys so important for modern fail-safe design. Crack propagation data derived with the aid of Forman's formula proved to be in good agreement with experimentally obtained results. M.V.E.

A71-11545 **Synthesis of future high lift systems.** Richard Scherrer (Lockheed-California Co., Burbank, Calif.). *Society of Automative Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Oct. 5-9, 1970, Paper 700811.* 11 p. 29 refs. Members, $1.00; nonmembers, $1.50.

Discussion of possible high lift systems for four-engine turbofan, M = 0.8, commercial and military, STOL aircraft capable of operation from 1800-foot fields. Both first- and second-generation vehicle concepts are considered. Propulsion, aerodynamics, and design trends of these aircraft are examined. The propulsion trends are projected as the effect of STOL requirements on engine weight, shape, and thrust deflection efficiency. Aeropropulsion, low speed interference effects are discussed briefly in relation to acceptable engine locations. Aerodynamic trends are limited to those regarding achievement of theoretical limit circulation lift values by use of leading and trailing edge flaps with blowing boundary layer control. The objective of future flap designs is not so much to indicate how to get high lift but to find plausible means for minimizing the amount of blowing per unit circulation lift. The discussion of design trends is oriented toward bringing the projected aerodynamic and propulsion trends together into a possible family of aircraft. Three particular members of the family are then rationalized as being most representative of future vehicles and one of these is illustrated. O.H.

A71-11546 **Electric thrust control system for supersonic transport power plant.** Richard F. Gorman and Donald L. Morrow (Boeing Co., Supersonic Transport Div., Renton, Wash.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Oct. 5-9, 1970, Paper 700819.* 9 p. Members, $1.00; nonmembers, $1.50.

The design of the propulsion control system for the supersonic transport (SST) is a culmination of three years of design trade studies. An analysis was made of the throttle systems of the Boeing 747, XB-70, Concorde, and other airplanes with a view toward the applicability of these systems for use on the SST. The major considerations that led to selection of a redundant channel electro-hydraulic propulsion control system are: safety, operational-reliability, performance, and weight. Presented here is a description of the SST propulsion control system which is composed of two subsystems, the thrust control subsystem and the mode control subsystem. (Author)

A71-11550 **Peen forming.** Davis L. Baughman (Carborundum Co., Hagerstown, Md.). *Machine Design,* vol. 42, Nov. 12, 1970, p. 156-160.

Discussion of the advantages and the technology of peen forming. It is pointed out that peen forming is a potentially cheaper way to form sheet and plate where the required part is large and where only gentle curvatures are needed. Moreover, peen forming easily produces compound curvature, which is often quite difficult to produce with press forming. The main attraction of peen forming is that no dies or presses are required. Some of the considerations involved in peening complex shapes are illustrated by the techniques used to produce a dihedral break in an airplane wing skin. G.R.

A71-11578 # **Aerodynamic design of axisymmetric hypersonic wind-tunnel nozzles.** James C. Sivells (ARO, Inc., Arnold Air Force Station, Tenn.). *(American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 4th, Cincinnati, Ohio, Apr. 28-30, 1969, Paper 69-337.) Journal of Spacecraft and Rockets,* vol. 7, Nov. 1970, p. 1292-1299. 29 refs.

Description of a unified approach to nozzle design in which an inviscid contour is first determined and then corrected to account for the growth of a turbulent boundary layer along the contour. The inviscid contour is obtained by the axisymmetric method of characteristics from a prescribed distribution of velocity along the nozzle axis. The velocity distribution matches theoretical transonic conditions at the throat, conical-source flow conditions through an intermediate region, and design flow conditions at the nozzle exit. The second derivative of the axial velocity is continuous throughout and is zero at the sonic point and at the exit point. The interdependence of some of the nozzle parameters is discussed. A semiempirical method is presented for calculating the boundary-layer correction. Calculated values agree within about 15% with experimental values obtained in 50-in. diameter water-cooled nozzles over a Mach number range of 6 to 12. (Author)

A71-11580 • # **An approximate method for predicting pressure distributions on blunt bodies at angle of attack.** Robert L. Stallings, Jr. and James F. Campbell (NASA, Langley Research Center, Hampton, Va.). *(American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 8th, New York, N.Y., Jan. 19-21, 1970, Paper 70-208.) Journal of Spacecraft and Rockets,* vol. 7, Nov. 1970, p. 1306-1310. 16 refs.

An approximate method, based on Love's $\sin^2$ deficiency method for zero angle of attack, is described; and results, both in the form of pressure distributions and force and moment coefficients, are critically assessed by comparison with experimental measurements for two families of blunt bodies. These families consist of: (1) bodies of revolution having variable nose and shoulder radii varying from a flat disk to a hemisphere, and (2) large angle cones having apex angles ranging from 120 to 180 deg. Hand calculations for both families have been made for angles of attack up to 15 deg and for a free-stream Mach number of 4.63. Good agreement is generally shown between experiment and calculated values through the range of variables investigated. Sonic-point and stagnation-point locations are required inputs of the approximate method. An iteration scheme is presented which adequately predicts the sonic-point locations, however, it was necessary to use experimental stagnation-point locations in the approximate method. (Author)

A71-11624 # **An ultrasonic altitude-velocity sensor for airplanes in the vicinity of the ground.** I. Hiroshi Maeda, Yoshikuni Umeda, and Norio Arihara (Kyoto University, Kyoto, Japan). *Kyoto University, Faculty of Engineering, Memoirs,* vol. 32, Apr. 1970, p. 249-259.

Discussion of the properties and merits of an ultrasonic sensor for detecting from the ground the altitude and vertical velocity of low flying aircraft. The results of preliminary experiments and simulation studies indicate that an ultrasonic sensor should make it possible to detect the accurate altitude of a low flying aircraft, and that this instrument would be much simpler than a radar altimeter. By differentiating the altitude signal with respect to time, it should be possible to detect the vertical velocity of the aircraft. This instrument could be used as a sensor for the automatic control systems of aircraft. An inherent weakness of this instrument is, however, the time lag due to ultrasonic wave propagation. Fundamental data of potential usefulness for the design of an ultrasonic altimeter are presented. M.V.E.

A71-11627 **Solid-state switching for aircraft electric systems.** Lee D. Dickey and Clyde M. Jones (LTV Aerospace Corp., Dallas, Tex.). *IEEE Spectrum,* vol. 7, Nov. 1970, p. 73-79.

Discussion of an application of semiconductor technology to the management and control of aircraft electric systems giving particular attention to problems of separating power switching from signal switching and of switching power through a minimum number of semiconductor devices. A conventional electric system in an A-7 aircraft is compared with an electric system on a solid state basis and advantages in weight, volume, reliability, and maintenance for the solid-state system are shown. An advanced control logic, power controllers, a dc-load power controller, an ac-load power controller, a bus-switching power controller, and aspects of package design are discussed. G.R.

A71-11628 **Exploiting AR.** R. A. Cole. *Shell Aviation News,* no. 387, 1970, p. 10-15.

Consideration of the direct relationship between the aspect ratio of a civil aircraft and its commercial viability. The requirement for as generous an aspect ratio as possible stems from the need for minimum induced drag at any wing loading. Comment is made on the ultralow aspect ratio design approach, as applied to the Concorde and the Canberra. When supersonic transports become commonplace it is considered to be doubtful if their maximum aspect ratios will be much above four. Within the range of subsonic transports, the aspect ratio values will probably rise slightly. F.R.L.

A71-11641 # **Determination of wheel trajectories.** Ezra Hauer (Technion - Israel Institute of Technology, Haifa, Israel). *ASCE, Transportation Engineering Journal,* vol. 96, Nov. 1970, p. 463-470. 5 refs.

Analytical determination of the main gear trajectory when the front wheel of a taxiing aircraft follows straight or circular paths or any combination thereof. The differential equation describing the motion of a vehicle with a steerable front wheel is presented. This equation can be used to determine numerically the position of the vehicle when the front wheels follow any curve of known curvature. Analytical solutions of the differential equation for a vehicle negotiating circular curves and straight lines are given. The resulting formulas are not so simple as to hold an advantage over the use of graphs and tables. They may be of practical importance when programmed for the computer, when aircraft position has to be determined at isolated locations, when tables are either unavailable or inadequate in their range of accuracy. Some results for transition curves are also given. M.V.E.

A71-11642 # **Environmental aspects of airport system planning.** John F. Brown (Landrum and Brown, Cincinnati, Ohio). *(American Society of Civil Engineers, Transportation Engineering Conference, Chicago, Ill., Oct. 13-17, 1969.) ASCE, Transportation Engineering Journal,* vol. 96, Nov. 1970, p. 543-559. 5 refs.

Discussion of some fundamental criteria pertaining to judgments as to the alternatives involved in the planning of airport systems that are to serve a community or region. It is suggested that the proper role of the professional airport planner should be that of measuring these criteria concretely and objectively so that they may be properly weighted in considering a final solution. In summary, these criteria are: (1) local air travel market characteristics and distribution; (2) effect of airport accessibility on the realization of the air travel potential; (3) air space utilization and control; and (4) present and planned land use. With meaningful objective measures of these environmental aspects, the planner, the community, and the civil engineers can make better and more meaningful judgments in regard to the proper location of airports and the compromising of these locations for other purposes. M.V.E.

A71-11643 **The estimation of loss of echoing area with very high resolution radars.** D. C. Cooper (Birmingham, University, Birmingham, England). *(Aerospace, Maritime, and Military Systems Group, Symposium on High Resolution Radar Systems, London, England, Apr. 8, 1970.) Radio and Electronic Engineer,* vol. 40, Oct. 1970, p. 159-164. 5 refs.

The paper considers the use of recently published experimental data in estimating the manner in which the echoing area of an aircraft is reduced when the range resolution cell of the observing radar is smaller than the aircraft dimensions. A simple mathematical model of the echoing process is postulated and the experimental results are used in selecting the model parameters. The model is then used to predict the behaviour of the echoing area, and in addition, the echoing properties for a resolution cell which embraces the whole aircraft are shown to be in excellent agreement with the widely accepted 'one dominant' model proposed by Swerling. (Author)

A71-11658 **LAMS - A technology to control aircraft structural modes; Institute of Electrical and Electronics Engineers, Case Studies in System Control, Georgia Institute of Technology, Atlanta, Ga., June 23, 1970, Proceedings.** New York, Institute of Electrical and Electronics Engineers, Inc., 1970. 126 p.

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Introduction and summary (LAMS). R. P. Johannes (USAF, Flight Dynamics Laboratories, Wright-Patterson AFB, Ohio), p. 2-12.

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A71-11659 # **Introduction and summary (LAMS).** R. P Johannes (USAF, Flight Dynamics Laboratories, Wright-Patterson AFB, Ohio). In: LAMS - A technology to control aircraft structural modes; Institute of Electrical and Electronics Engineers, Case Studies in System Control, Georgia Institute of Technology, Atlanta, Ga., June 23, 1970, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 2-12.

Discussion of the present stage of a R & D program initiated in 1966 at the Air Force Flight Dynamics Laboratory to demonstrate the capability of an advanced flight control system to alleviate gust loads and to control structural modes on a large flexible aircraft using conventional aerodynamic control surfaces. The major elements of this program are described as (1) establishment of performance criteria applicable at all phases of the program, (2) analysis of the B-52 to select the control techniques to be developed, (3) demonstration of the applicability of analytical techniques by applying them to the C-5A, (4) production of an operable LAMS-FCS, (5) conversion of an existing B-52 to an appropriate test bed to demonstrate the LAMS-FCS, and (6) demonstration of the performance of the LAMS-FCS during flight through a turbulence. The results of various tests conducted within this program are evaluated, noting the positive turbulence test results for fatigue damage rates, maximum expected stresses, and rms accelerations. V.Z.

A71-11660 # **LAMS flight control system analysis and design.** G. O. Thompson (Boeing Co., Wichita, Kan.). In: LAMS - A technology to control aircraft structural modes; Institute of Electrical and Electronics Engineers, Case Studies in System Control, Georgia Institute of Technology, Atlanta, Ga., June 23, 1970, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 13-41.

Analysis of the design features of LAMS flight control systems aimed at the reduction of turbulence-induced fatigue damage rates in the B-52 and C-5A aircraft. The B-52 and C-5A mathematical models used in structural performance and stability analysis are discussed. Problem identification, system synthesis, and performance evaluation are considered as basic elements of the analytical technique used in the study. Block diagrams are given for B-52 and C-5A LAMS flight control systems. V.Z.

A71-11661 # **LAMS test vehicle modification and system tests.** G. J. Kass (Boeing Co., Wichita, Kan.). In: LAMS - A technology to control aircraft structural modes; Institute of Electrical and Electronics Engineers, Case Studies in System Control, Georgia Institute of Technology, Atlanta, Ga., June 23, 1970, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 42-96.

Discussion of the B-52 test vehicle modification and instrumentation used in the flight demonstration phase of the LAMS vehicle and system test program. The modified features of the B-52 test vehicle include structural changes in the aft fuselage and vertical tail section, a gust probe installed in the vehicle nose, new hydraulic activators to the elevators, ailerons and rudder, a new servo valve for spoiler panels, a fly-by-wire pilot station, a copilot station converted into a safety monitor station, and a bomb-nav station modified to a flight engineer station. System and component evaluations performed within the framework of this program are reviewed. V.Z.

A71-11662 # **LAMS flight demonstration.** J. B. Dempster (Boeing Co., Wichita, Kan.). In: LAMS - A technology to control aircraft structural modes; Institute of Electrical and Electronics Engineers, Case Studies in System Control, Georgia Institute of Technology, Atlanta, Ga., June 23, 1970, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 97-125.

Discussion of the results of the flight demonstration phase of the LAMS program, designed to validate the analytical techniques used in the system design by comparing test data with analytical performance predictions. It is shown that the LAMS test vehicle with powered controls with or without the Baseline SAS has an adequate flutter boundary. Repeatable sinewave and step function transients were introduced into the control surfaces at selected frequencies and amplitudes to verify the functional operation of the control systems. Transient testing data were used to define open and closed loop responses of the aircraft and its systems. The control surface authority and effectiveness data obtained by tests agreed well with the predicted analytical values. The LAMS-FCS provided reductions in the stress and fatigue damage rates equal to or greater than the ones predicted by the analysis. V.Z.

A71-11676 **Situation of aerospace industry in the European Community (La situation de l'industrie aérospatiale de la Communauté européenne).** Louis Gravigny and Daniele Verdiani. (*Eurospectra,* vol. 9, no. 2, 1970.) *Schweizerische Technische Zeitschrift,* vol. 67, Nov. 5, 1970, p. 870-874. In French.

Analysis of the achievements and future tasks of the European Economic Community in the development of aerospace projects. The role played by the aerospace industry in the economy is briefly discussed. The organizational problems of the aerospace industry are examined, and the current projects are discussed. The prospects for the years 1970 to 1980 are examined. Z.W.

A71-11682 **RB.211 - Transatlantic bridgehead.** Peter Middleton. *Flight International,* vol. 98, Nov. 5, 1970, p. 708-714, 720.

Description of the Rolls-Royce RB.211 engine, which will represent 60% of the British civil powerplant business during its 15 years' production lifetime. Because of its use in the Lockheed TriStar, the engine should represent a massive export potential for the U.K. The engine is also expected to find application in the BAC Three-Eleven, and possibly the A-300B Airbus. Emphasis has been on combustion development, and lightweight fans are undergoing a critical analysis. The three-shaft layout results in good handling and low vibration levels. The engine was designed from the outset with noise reduction in mind. F.R.L.

A71-11686 # **Aerodynamic problems of re-entry (The Daniel and Florence Guggenheim Memorial Lecture).** Carlo Ferrari (Torino, Politecnico, Turin, Italy). *International Council of the Aeronautical Sciences, Congress, 7th, Rome, Italy, Sept. 14-18, 1970, Paper ICAS 70-01.* 20 p. 80 refs.

Review of the following aerodynamic problems of spacecraft reentry: (1) lifting bodies at hypersonic speeds and high altitude; (2) shock wave and flow field development in hypersonic reentry; (3) aerodynamic heat transfer; (4) radiative contribution to the mass and energy transfer, equation of the radiative energy transfer in non-equilibrium, boundary conditions of the equations of the photon's gas; and (5) problems connected with the ionization in reentry, and reentry blackout suppression. M.M.

A71-11698 **A conflict prediction algorithm for use in procedural domestic airspace.** F. N. D. Gilbert and P. L. Battrum. *Journal of Air Traffic Control,* vol. 12, Nov. 1970, p. 18-21.

Discussion of a six-step conflict prediction algorithm based on the principle that an aircraft can only be assigned airspace if it is free of conflict with respect to other aircraft, and that each aircraft entering the system will be paired and checked sequentially for conflict with all other aircraft in the control area. The first two steps, a gross time sort and a gross level sort, are conducted on the basis of the overall flight plan. The remaining steps are conducted on the basis of comparison of route segments. The technique proposed is to conduct simple gross sorts first, in order to identify potential conflict situations in the shortest possible time. Fine sorts and detailed analyses, which take longer but are much fewer in number, are conducted after to minimize the response time of the algorithm. V.P.

A71-11699 **Procedural changes for a better ATC system.** John P. Woods. *(Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., Nov. 20, 21, 1969.) Journal of Air Traffic Control,* vol. 12, Nov. 1970, p. 22-25.

Discussion of possible means of improving the FAA's 'positive control' ATC procedure, which is currently pressed beyond capacity. Considerations (based on an approach in which aviation safety is stated in terms of probabilities rather than in terms of absolutes) concerning steps that would unload the control system are outlined. A separate system, directing traffic into procedurally ordered streams, is advocated. V.P.

A71-11700 • # **Technological factors in short haul air transportation.** George C. Kenyon and Hubert M. Drake (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 7th, Houston, Tex., Oct. 19-22, 1970, Paper 70-1287.* 7 p. 15 refs. Members, $1.50; nonmembers, $2.00.

Identification of some of the important technological factors affecting short haul transportation from the standpoints of the operator, the passenger, and the community. The aircraft concepts of CTOL, VTOL, STOL, and light aircraft are considered for five missions. A hypothetical commute mission example shows the dominance of indirect over direct costs for the short range mission. Technology is considered from three points of view: the operator, who needs competitive economics, the passenger who wants attractive service, and the community, which demands low impact on the environment, particularly for new transportation systems. The elements that provide competitive economics, attractive service, and low environmental impact are presented, along with the accompanying technological factors. Indirect operating costs are shown to dominate the economics for these short range missions. The distribution of airports within short distances from metropolitan centers is discussed, and noise comparisons are made for these aircraft concepts with background noise. Projections are made as to date of availability of new aircraft for these missions. M.M.

A71-11777 **Summer Computer Simulation Conference, Denver, Colo., June 10-12, 1970, Proceedings. Volume 1.** Conference sponsored by the Association for Computing Machinery, S.H.A.R.E., and the Simulation Councils. New York, Association for Computing Machinery, 1970. 749 p. $15.

Contents:

Symbolic partial differentiation - A simulation tool. G. Fischer and L. Patmore (ESL, Inc., Sunnyvale, Calif.), p. 12-20.

DARE II - Fast on-line digital simulation on a small computer. T. A. Liebert (Arizona, University, Tucson, Ariz.), p. 21-28. 5 refs.

DIHYSYS . . . A hybrid systems simulator. J. Léon, C. O. Alford, and J. L. Hammond, Jr. (Georgia Institute of Technology, Atlanta, Ga.), p. 42-48. 10 refs.

A standard structural description for nonlinear differential equations. R. D. Gustafson, p. 49-55.

Modeling the performance of a satellite system. E. Gordon and T. P. Jackson (Aerojet-General Corp., Azusa, Calif.), p. 113-120. 6 refs.

The use of digital simulation for the nonlinear analysis of an integrated actuator package. H. E. Harschburger (McDonnell Douglas Corp., St. Louis, Mo.), p. 393-400.

Technique for fast, in-depth use of computer simulation data in tactical missile flight test planning. J. K. Wright, Jr. and W. H. Gilbert, Jr. (Martin Marietta Corp., Orlando, Fla.), p. 433-439

Tactical missile control system performance analysis using hybrid computer simulation methods. H. S. Steinmetz and W. H. Gilbert, Jr. (Martin Marietta Corp., Orlando, Fla.), p. 450-461. 6 refs.

A real-time 6 degree of freedom aircraft simulation with SL-1. S. Schram and J. Boren (Xerox Data Systems, El Segundo, Calif.), p. 471-480.

The use of C.S.M.P. digital simulation language in manual flight control analyses. M. S. Eden (Lockheed-California Co., Burbank, Calif.), p. 481-493.

The use of TRANSIM in the simulation of POGO in the Saturn V second stage. I. Y. Bar-Utzhack (Bellcomm, Inc., Washington, D.C.), p. 494-503. 9 refs.

A general six-degree-of-freedom simulation using CSSL II. C. D. Brown (Programming Sciences Corp., Los Angeles, Calif.), p. 504-509.

Hybrid computer structural response simulation. L. M. Landry, Jr. (Bell Helicopter Co., Fort Worth, Tex.), p. 510-515.

Apollo Command and Service Module visual display simulation. D. Hernandez (North American Rockwell Corp., Downey, Calif.), p. 524-540.

Apollo Command and Service Module simulation program - Block II. A. J. Maureri (North American Rockwell Corp., Downey, Calif.), p. 541-551.

N-body real time simulation of the Apollo Command and Service Module's G&C systems and mission. T. L. Mason (North American Rockwell Corp., Downey, Calif.), p. 552-564. 8 refs.

Considerations for the hybrid computation of trajectories for missiles and aircraft. A. I. Rubin (Electronic Associates, Inc., Princeton, N.J.), p. 602-609.

Computer simulation of the Apollo electrical power system on Skylab Program missions. L. Ule (North American Rockwell Corp., Downey, Calif.), p. 610-629. 5 refs.

A digital simulation of radar systems and the environment. G. D. Halushynsky (Vitro Laboratories, Silver Spring, Md.) and D. H. Cook (TRW Systems Group, Washington, D.C.), p. 641-649.

An all digital hybrid simulation. J. Sheehan and J. De Veber (Raytheon Co., Bedford, Mass.), p. 650-656. 9 refs.

Hybrid techniques in the development of a missile simulation. J. Smith and E. Mitchell (Raytheon Co., Bedford, Mass.), p. 657-664. 5 refs

A71-11783 # **The use of digital simulation for the nonlinear analysis of an integrated actuator package.** H. E. Harschburger (McDonnell Douglas Corp., St. Louis, Mo.). In: Summer Computer Simulation Conference, Denver, Colo., June 10-12, 1970, Proceedings. Volume 1. Conference sponsored by the Association for Computing Machinery, S.H.A.R.E., and the Simulation Councils. New York, Association for Computing Machinery, 1970, p. 393-400.

Description of the use of digital simulation in studying the nonlinear characteristics of a prototype integrated actuator package. A complete dynamic mathematical model is developed which includes the surface inertia, the mass of the package, the structural and oil spring rates, and the aerodynamic force. The nonlinear portion of the simulation includes the soft cutoff hydraulic pump characteristics, position and flow limits, linkage freeplay, the stalling of the actuator by the aerodynamic force, and changes in the flow gain due to changes in pressure drop across the valve. Corroboration of simulation accuracy was obtained through testing of an actual package on a test stand. The presented mathematical model and simulation should be useful in the analysis of any future integrated actuator package using soft cutoff pumps. M.V.E.

A71-11786 # **A real-time 6 degree of freedom aircraft simulation with SL-1.** Sanford Schram and Jim Boren (Xerox Data Systems, El Segundo, Calif.). In: Summer Computer Simulation Conference, Denver, Colo., June 10-12, 1970, Proceedings. Volume 1. Conference sponsored by the Association for Computing Machinery, S.H.A.R.E., and the Simulation Councils. New York, Association for Computing Machinery, 1970, p. 471-480.

Description of a recent successful implementation of a significant aircraft simulation study. Its importance lies in that it shows how SL-1, a CSSL-based language, can be applied to a large scale problem in real time. The problem used in the demonstration was to simulate an aircraft and its control system in real time - i.e., to provide 8 seconds of flight within 8 seconds of computer run time. The simulation had previously been implemented and the results were known, therefore the accuracy of the SL-1 simulation and the accuracy of the techniques used could be evaluated. To effect the execution in real time, the problem equations were divided into three groups: (1) the translational equations of motion; (2) the rotational equations of motion; and (3) the control system. Different integration rates and algorithms were used for each group. After experimentation with various step sizes and algorithms at run time, the goals of accuracy and computation efficiency were achieved. M.V.E.

A71-11787 # **The use of C.S.M.P. digital simulation language in manual flight control analyses.** M. S. Eden (Lockheed-California Co., Burbank, Calif.). In: Summer Computer Simulation Conference, Denver, Colo., June 10-12, 1970, Proceedings. Volume 1. Conference sponsored by the Association for Computing Machinery, S.H.A.R.E., and the Simulation Councils. New York, Association for Computing Machinery, 1970, p. 481-493.

Discussion of closed loop piloted simulations in low speed longitudinal flight maneuvers. A continuous mathematical pilot model is used to close the aircraft pitch attitude loop, which responds to simple rational commands appropriate to the particular maneuver. The pilot model has some roots in manual control theory, which indicates the likely crossover characteristics (closed loop frequency and stability criteria) which would obtain in the piloted situation. The development of a speed schedule and takeoff technique consistent with the intricacies of Federal Aviation Requirements (FAR) and analyses of the FAR stall maneuver are discussed in detail. The advantages of using CSMP language in these simulations are reviewed. M.V.E.

A71-11794 # **Considerations for the hybrid computation of trajectories for missiles and aircraft.** A. I. Rubin (Electronic Associates, Inc., Princeton, N.J.). In: Summer Computer Simulation Conference, Denver, Colo., June 10-12, 1970, Proceedings. Volume 1. Conference sponsored by the Association for Computing Machinery, S.H.A.R.E., and the Simulation Councils. New York, Association for Computing Machinery, 1970, p. 602-609.

Demonstration of how time sharing and hybridization may reduce analog equipment count. A good deal of hybridization can reduce the digital computation time significantly in a typical trajectory calculation. This leads to the postulation of a hybrid split of the translational portion of the trajectory to minimize digital computation time, retain necessary and/or reasonable accuracy in the displacement calculation, and at the same time produce continuous velocity variables for control systems studies. In order to take full advantage of the proposed hybrid split, it is necessary to have a large number of MDACs (DAMs) for fast, continuous generation of the aerodynamic coefficients. Thus, effective hybrid computation of trajectories rests ultimately on the size, speed, and quality of the D/A interface. F.R.L.

A71-11809 # **Airlines maintenance model.** Elroy M. Smith (IBM Corp., San Francisco, Calif.). In: Summer Computer Simulation Conference, Denver, Colo., June 10-12, 1970, Proceedings. Volume 2. Conference sponsored by the Association for Computing Machinery, S.H.A.R.E., and the Simulation Councils. New York, Association for Computing Machinery, 1970, p. 1125-1133.

The Airlines Maintenance Model is a simulation model using the GPSS language. The model simulates the maintenance performed on aircraft. The purpose of the model is to study the utilization of equipment, work forces and physical areas such as terminals and aircraft parking spaces. The model gives important information on the effects of maintenance operations on departure schedules. Arriving aircraft are generated as transactions, based on predetermined arrival schedules. The aircraft then undergo a maintenance check. Upon completion of the maintenance check, the aircraft become available for departure, and depart when the departure schedule requires it. The model produces statistics on the availability and occupancy of terminals, the utilization of men and equipment, the frequency of departures. The model contains approximately 800 blocks. (Author)

A71-11821 # **An inflatable restraint collar for balloons.** Karl Stefan (National Center for Atmospheric Research, Boulder, Colo.). *Facilities for Atmospheric Research,* June 1970, p. 2-6.

Description of an inflatable restraint collar which both clamps the uninflated balloon material below the launch bubble and serves as an attachment point for a restraining cable during single-cell balloon launch operations. The inflated collar is held by a restraint cable connected to the winch. After balloon inflation, the cable is paid out, and a fastener connecting it to the collar is released at the desired height. Upon release of the fastener, the collar opens and imparts a forward momentum to the balloon and rearward momentum to itself, yielding a clean separation of the two. The collar consists of two double-walled, inflatable half-cylinders hinged together at one side and equipped with a releaseable fastener at the other. The developmental studies are summarized, and the forces acting on the collar are illustrated. T.M.

A71-11822 # **Evaluation of reverse flow temperature probe.** *Facilities for Atmospheric Research,* June 1970, p. 11-14.

Results of tests conducted with a reverse flow temperature probe used to provide accurate temperature measurements and vertical soundings from aircraft. The probe housing consists of a cylindrical radiation shield with a conical Teflon front tip and with a nylon insert that thermally isolates an unshielded platinum wire sensor. Reverse flow into the housing is induced by the conical tip which develops a negative pressure in the flow field. The sensor can be influenced by static pressure differences and by flow angles at the probe site. The local static pressure, measured by a pitot-static tube, is higher than the free stream static pressure. Wind tunnel and flight tests were conducted to measure the local total and static pressures ahead of the probe tip, static pressure within the probe cavity, static and dynamic pressures corresponding to aircraft and environmental conditions, reverse flow temperatures, and reference temperatures. These tests defined systematic sources of error which can be corrected during data reduction. T.M.

A71-11870 # **A simple model of the pseudo-shock mechanism.** R. Yamane, Y. Tomita, and S. Itaya (Tokyo Institute of Technology, Tokyo, Japan). *Tokyo Institute of Technology, Bulletin,* no. 100, 1970, p. 1-13. 7 refs.

Description of a tentative model of the mechanism of the pseudoshock, based on the idea that in the upstream region the shock wave repeats a kind of reflection on the boundary surface between the main flow and the low speed region near the wall, and that the expansion waves and the oblique shock waves emanate near the reflection points. This model can explain the fact that the static pressure in the main flow increases and decreases alternately in the upstream region while that on the wall increases monotonously. The calculated pressure change and the distance between the successive shock waves are in good agreement with experimental results. O.H.

A71-11884 **Heat transfer and frictional drag in the longitudinal flow of a gas with variable physical properties past a plate.** V. N. Popov (Moskovskii Energeticheskii Institut, Moscow, USSR). (*Teplofizika Vysokikh Temperatur,* vol. 8, Mar.-Apr. 1970, p. 333-345.) *High Temperature,* vol. 8, Mar.-Apr. 1970, p. 311-321. 11 refs. Translation.

Description of a method of calculating the heat transfer and friction drag during turbulent flow past a plate by a gas the physical properties of which depend arbitrarily on temperature. The proposed method can be applied not only to a chemically homogeneous gas but also to a gas in dissociated or ionized equilibrium. Moreover, this method takes more accurate account of the variation of the tangential stress and heat flux density over the boundary layer cross section, it does not involve an arbitrary division of the boundary layer into a viscous sublayer and a turbulent core, no artificial assumptions are made regarding the mixing length in the case of constant physical properties, and more accurate account is taken of the cross-sectional variation of the turbulent transport coefficient. In the case of variable physical properties it is necessary to introduce a certain hypothesis concerning the mixing length. On the basis of this hypothesis a relation is obtained which relates the turbulent transport coefficients for the cases of constant and variable physical properties. A.B.K.

A71-11949 **Improvements in fatigue testing of sailplanes.** Jozsef Gedeon (Budapesti Müszaki Egyetem, Budapest, Hungary). *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 12th, Alpine, Tex., June 27-July 4, 1970.) Aero-Revue,* Nov. 1970, p. 665-668. 17 refs.

Combining data from the more detailed analysis of sailplane G records with some recently published theoretical results gives the possibility to calculate more exact load spectra taking into account some dynamical characteristics of the type in the design stage already. In view of a life safety factor of at least 5 for safe-life designs dictated by the impossibility of making more than a sole full-scale complete fatigue test in most cases, the development of fail-safe structures is of prime economic importance. The possibility

of developing fail-safe light metal sailplane wings has been proved by successful preliminary tests. The relatively weakest part in fatigue testing is damage calculation. Limitations of the Palmgren-Miner theory applied so far by us are well understood, but several other formulas tried hitherto failed to come up to expectations. A series of two-stress level rotating bending and axial tensile fatigue tests were run to investigate the adaptability of some new ideas to dural type alloys. (Author)

A71-11950 Wind-tunnel measurement on profiles with flaps for moderate Reynolds numbers. I (Windkanalmessungen an Profilen mit Klappen bei mittleren Reynoldszahlen. I). D. Althaus (Stuttgart, Universität, Stuttgart, West Germany). *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 12th, Alpine, Tex., June 27-July 4, 1970.) Aero-Revue,* Nov. 1970, p. 669, 670. In German.

Discussion of wind tunnel tests performed at moderate Reynolds numbers with a variety of cambered and symmetric wing profiles and flap configurations. The aerodynamic data obtained for various flap chords, aspect ratios, and deflections are intended to serve as reference data in wing-flap design. Measurements obtained with a laminar wing profile are plotted vs the angle of attack. V.P.

A71-11958 # Supersonic flow around a circular cone equipped with cross-shaped wings (Mişcarea supersonică in jurul unui con circular prevăzut cu aripi cruciforme). Rodica Chirilă Socolescu (Academia Română, Institutul de Matematică, Bucharest, Rumania). *Studii şi Cercetări Matematice,* vol. 22, no. 10, 1970, p. 1415-1425. 5 refs. In Rumanian.

Investigation of a circular cone with cross-shaped wings in the middle of a supersonic flow. A linearization method proposed by Germain (1948, 1949) is used to determine the characteristics of the flow, velocities, pressure, and the pressure resultant. The results obtained are compared with those obtained by Socolescu (1966) and Iacob (1961). M.M.

A71-11959 # Sandwich structures in aircraft and space vehicles (Le strutture sandwich nei veicoli aerei e spaziali). Giuseppe Surace (Torino, Politecnico, Turin; Bari, Università, Bari, Italy). *Società degli Ingegneri e degli Architetti in Torino, Atti e Rassegna Tecnica,* vol. 24, Oct. 1970, p. 255-264. In Italian.

Critical evaluation of sandwich structures. The characteristics of sandwich structure components, manufacturing processes, and mechanical testing are examined. A bibliographic search of sandwich structure applications in the latest space vehicles is provided, together with the curves of the goodness index of commercially standardized sandwich structure components. M.M.

A71-12044 A synthetic aperture at 10.6 microns. T. S. Lewis and H. S. Hutchins (United Aircraft Research Laboratories, East Hartford, Conn.). *IEEE, Proceedings,* vol. 58, Oct. 1970, p. 1781, 1782.

Description of an experimental demonstration of synthetic aperture radar principles using a CO_2 laser. The experiment consisted of the feasibility of operating a synthetic aperture system at a wavelength of 10.6 microns. The most important aspect of the experimental results shown is that an essentially point target was well resolved within an approximately 2-in. diam beam at the target using synthetic aperture techniques. M.M.

A71-12050 Grumman prepares the F-14A for its first flight. Douglas Cornell. *Interavia,* vol. 25, Nov. 1970, p. 1384-1387.

Detailed examination of the design and production program leading up to the first flight of the Grumman F-14A twin-engine, variable geometry, carrier-based jet fighter designed for the U.S. Navy to provide air superiority and fleet air defense. A fully proven F-14A weapon system is scheduled to undergo fleet introduction only 51 months after contract award to Grumman. The development program receives extensive attention, followed by description of manufacturing techniques and processes. Comment is made on production and systems testing, program commitments, maintenance, and future prospects. F.R.L.

A71-12162 Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970. 78 p.

Contents:

Aircraft development in relation to pavement design. K. V. Bonney (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England), p. 1-6.

Undercarriage effects on (a) rigid pavements (b) flexible pavements. J. L. Dawson (Roskill Commission) and R. L. Mills (Ministry of Public Building and Works, London, England), p. 7-20. 9 refs.

Developments in pavement design in the USA - Rigid pavements. E. R. Breihan (Horner and Shifrin, Inc., St. Louis, Mo.), p. 21-29.

Developments in pavement design in the USA - Flexible pavements. R. G. Ahlvin (U.S. Army, Engineer Waterways Experiment Station, Vicksburg, Miss.), p. 31-36. 13 refs.

Developments of pavement design both rigid and flexible on the continent of Europe. G. Moraldi (Roma, Università, Rome, Italy), p. 37-46. 32 refs.

Current British pavement design. F. R. Martin (Ministry of Public Building and Works, London, England) and A. R. Macrae (British Airports Authority, London, England), p. 47-58.

Strengthening of pavements. H. Jennings (Ministry of Public Building and Works, London, England) and F. L. H. Straw (Public Works Department, Birmingham, England), p. 59-68.

Design and construction of aircraft pavements in unusual conditions. F. W. Spencer and J. K. Holt (Scott Wilson Kirkpatrick and Partners, London, England), p. 69-74.

A71-12163 Aircraft development in relation to pavement design. K. V. Bonney (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 1-6.

Discussion of the limitations of tire pressures and multiwheeled landing gears for transport aircraft of the 1960's and those being developed for the 1970's. Various locations for installing the main gear are described, and comparisons are made between old and new forms of wheel arrangements. Possible improvements in pavements and aircraft to obtain a smoother ride are considered. Procedure for takeoff and landing, and design requirements for devices on the aircraft are described, followed by a review of problems resulting from inadequacies in pavement design. The hazards of ingestion into an engine of stones, water, and slush are dealt with in some detail. Aquaplaning and poor tire adhesion are real problems when excessive quantities of water are present. F.R.L.

A71-12164 Undercarriage effects on (a) rigid pavements (b) flexible pavements. J. L. Dawson (Roskill Commission) and R. L.

Mills (Ministry of Public Building and Works, London, England). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 7-20. 9 refs.

Description of current multiwheel undercarriages, with consideration of future trends in undercarriage design. Observed modes of failure in flexible and rigid pavements are examined, and criteria are suggested for different categories of pavements. For each category graphs are presented of load vs tire pressure for a range of undercarriage arrangements and for different subgrade characteristics. The graphs are based on test and experimental work and computer calculations. Their derivation and validity is discussed. The concept of the equivalent single wheel load and the load classification number is briefly described, and some incompatibilities are identified. F.R.L.

A71-12165 Developments in pavement design in the USA - Rigid pavements. E. R. Breihan (Horner and Shifrin, Inc., St. Louis, Mo.). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 21-29.

Review of the processes currently used in the design of rigid pavements for the Lambert-St. Louis Municipal Airport, considering the supporting effects of the soil subgrade, the asphaltic concrete sub-base, and the basic strength of the pavement itself. The criteria used in the design are those of the FAA and of the Portland Cement Association. The different types of joints that are presently used for rigid pavements in the U.S. are discussed. Since there have been joint failures, it is evident that additional research is required in this area, as well as in many other areas of rigid pavements, to determine the causes of failures and to recommend remedial measures. F.R.L.

A71-12166 Developments in pavement design in the USA - Flexible pavements. R. G. Ahlvin (U.S. Army, Engineer Waterways Experiment Station, Vicksburg, Miss.). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 31-36. 13 refs.

Discussion of trends in flexible pavement design concepts, including theoretical developments and applications, treatments of load repetitions, total systems, environmental effects, etc. Current emphasis on providing for the new giant transports is recognized, and the effects of the heavy loads and many-wheeled gear on flexible pavements are treated. Expedient airport pavements in support of military trends toward greater air mobility are discussed. Attention is given to civil use of austere or expedient airports. Various ancillary developments such as pavement compaction, failure criteria, skid resistance, quality control, and vibratory testing are considered. F.R.L.

A71-12167 Developments of pavement design both rigid and flexible on the continent of Europe. G. Moraldi (Roma, Università, Rome, Italy). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 37-46. 32 refs.

Review of various pavement design and construction practices followed by European nations. Unreinforced or crack-reinforced slabs, designed according to Westergaard's theory, are the most commonly used for rigid pavements. There is a definite tendency to avoid expansion joints and to adopt stabilized base courses. Prestressed pavements have been frequently applied in Germany. Structurally reinforced slabs are common practice in Sweden. For flexible pavements the most common design procedure is the CBR method. Rational methods of design, based on the multilayer elastic theory and the method of equivalents, are rapidly gaining favor. Aggregate or crushed stone bases have been generally superseded by bitumen-bound layers. Plate bearing tests and impact methods are used to evaluate pavements. Some suggestions are given for overlay procedures. F.R.L.

A71-12168 Current British pavement design. F. R. Martin (Ministry of Public Building and Works, London, England) and A. R. Macrae (British Airports Authority, London, England). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 47-58.

Brief examination of the history of aircraft pavements which have been designed, built, and borne traffic in the past 30 years, with explanations of why particular decisions have been taken which have led to the design methods currently used. Types of pavement recommended are plain unreinforced concrete (rigid), continuous reinforced concrete surfaced with bituminous courses (composite), and cement, bitumen, or tar-bound bases surfaced with bituminous courses (flexible). In addition to strength requirements the need to provide pavement surfaces of high stability and acceptable texture is discussed. F.R.L.

A71-12169 Strengthening of pavements. H. Jennings (Ministry of Public Building and Works, London, England) and F. L. H. Straw (Public Works Department, Birmingham, England). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 59-68.

Consideration of various methods of strengthening existing runways, aprons, and taxiways to accommodate higher tire pressures, heavier aircraft, higher landing speeds, and to provide improved standards of surface riding quality. The specification and use of concrete and bituminous materials is discussed. In view of the fact that many airports have to be kept in operation while the paved areas are strengthened, emphasis is placed on the difficulties which arise in practice while carrying out civil engineering works. Reference is also made to the surface treatment of the concrete and asphalt to minimize the risk of standing water causing aircraft to aquaplane during adverse weather conditions. F.R.L.

A71-12170 Design and construction of aircraft pavements in unusual conditions. F. W. Spencer and J. K. Holt (Scott Wilson Kirkpatrick and Partners, London, England). In: Aircraft pavement design; Institution of Civil Engineers, Symposium, London, England, November 12, 1970, Proceedings. London, Institution of Civil Engineers, 1970, p. 69-74.

Study of three sets of circumstances in which soil or other conditions create pavement design and construction problems requiring special solutions. These are: (1) the construction of airport pavements over deep deposits of soft, compressible soils, (2) the construction of pavements on subgrades composed of expansive soils, and (3) the construction of pavements on subgrades which vary in engineering properties and distribution. Illustrative examples of solutions adopted in the past are quoted for various airport projects. F.R.L.

A71-12192 # Heat exchange and drag in a circular pipe during laminar flow of a gas with variable properties. II - Results of calculations at constant wall temperature (Teploobmen i soprotivlenie v krugloi trube pri laminarnom techenii gaza s peremennymi

svoistvami. II - Rezul'taty rascheta pri postoiannoi temperature stenki). V. D. Vilenskii, B. S. Petukhov, and B. E. Kharin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 8, July-Aug. 1970, p. 817-827. In Russian.

Results of heat-exchange and drag calculations for laminar flow of air in a circular pipe at constant wall temperature in cases of parabolic and uniform velocity profiles at the inlet. The study involves both cooling and heating of air at atmospheric pressure and is limited to situations where the effects of free convection, compressibility, and kinetic-energy dissipation can be neglected. The calculations involved numerical integration of the equations of motion and energy in a boundary-layer approximation for ratios of the wall to inlet temperatures ranging from 1/9 to 9. A substantial influence of the variable properties of the gas on the flow and heat transfer characteristics is discovered. Nusselt numbers and drag coefficients obtained differ by several orders of magnitude from those in the case of constant gas properties. T.M.

A71-12274 Autoland all-weather progress. J. W. Wilson. *Flight International,* vol. 98, Nov. 12, 1970, p. 750-752.

Discussion of the present consolidation phase of automatic landing development. The search for minimum component weights allied to maximum reliability is related to developments connected with the ultimate problem areas such as ground-roll guidance. Recent developments in the Smiths system installed in the Hawker Siddeley Trident 3B are discussed. Some results obtained by the French internal airline Air Inter with Caravelle aircraft operating to 15 m decision height and 150 m RVR are presented. F.R.L.

A71-12275 Technology for better all-weather landings. Malcolm Moulton (Elliott Flight Automation, Ltd., Rochester, Kent, England). *Flight International,* vol. 98, Nov. 12, 1970, p. 753-755, 758.

Description of the Elliott Flight Automation landing systems for the VC10, BAC One-Eleven, and Concorde. During the past decade there has been a virtual explosion in electronic technology, and this has produced a breakthrough in mechanizing automatic landing systems more quickly, more reliably, and with more repeatable performance. It is considered that it should be possible to land the VC10 automatically in 97% of all weather encountered at Heathrow. F.R.L.

A71-12299 Non-metallic aircraft materials. Peter Jowitt (Royal Aircraft Establishment, Farnborough, Hants., England). *Shell Aviation News,* no. 388, 1970, p. 10-13.

Survey of the advantages and perils of using wood and synthetic resin as aircraft materials. The timber species used in aircraft construction, and the requirements placed on them are examined, and the types of failure that occur are illustrated. The selection of timber for repair is shown to be a highly complex business. The use of epoxy and polyester resins as aircraft materials is described, and the various failures which have to be watched for are outlined. V.P.

A71-12300 Experience with static dissipator additive in aviation fuels. R. G. Davies (Shell International Petroleum Co., Ltd., London, England) and R. W. Knipple (Shell Oil Co., Houston, Tex.). *Shell Aviation News,* no. 388, 1970, p. 14-24.

Discussion of experience gained with fuel-soluble conductivity-improving static dissipator additives in aviation fuels as a means of eliminating electrostatic charging hazards. Results obtained in laboratory and in flight tests with the ASA-3 static dissipator additive, a three-component mixture of equal parts of the chromium salt of an alkylated salicylic acid, calcium dodecyl succinate, and a vinyl/methacrylate copolymer, are given. The effect of static dissipator additives on fuel properties is examined, together with means being devised to counteract the tendency of ASA-3 to lose its potency with time. V.P.

A71-12368 Air transport (Le transport aérien). J. Muffang (Union de Transports Aériens, Paris, France). *Revue Française de Mécanique,* 2nd Quarter, 1970, p. 23-28. In French.

Description of a method for controlling the reliability of turbojet engines by comparing the performance data indicated by on-board devices with a gauge of normal performance using a special slide rule. This method makes it possible to reveal any anomaly in the operation of the engine as soon as it occurs. The following advantages are obtained: (1) optimization of the maintenance methods, (2) increase of the performance and mean time between failures, (3) decrease of accident toll and flight breaks, (4) substantial decrease of repair costs, and (5) decrease of risks of nonscheduled exchanges of engines. Z.W.

A71-12376 # Boundary-layer separation at a free streamline. I - Two-dimensional flow. R. C. Ackerberg (Brooklyn, Polytechnic Institute, Farmingdale, N.Y.). *Journal of Fluid Mechanics,* vol. 44, Nov. 11, 1970, p. 211-225. 13 refs. Contract No. DA-31-124-ARO(D)-444.

Study of the boundary-layer flow just upstream of the trailing edge of a flat plate when a free streamline is attached to the edge. The separation of the edge occurs with an infinitely favorable pressure gradient and is characterized by a skin friction which is proportional to the inverse eighth power of the distance from the edge. The proportionality factor for the first-order term is independent of the upstream boundary-layer flow. The streamwise velocity profile at separation is nonanalytic near the wall $Y = 0$, and starts with the term Y to the 2/3 power. (Author)

A71-12377 # The aerodynamic noise of small-perturbation subsonic flows. Roy Amiet and W. R. Sears (Cornell University, Ithaca, N.Y.). *Journal of Fluid Mechanics,* vol. 44, Nov. 11, 1970, p. 227-235. 13 refs.

Application of the method of matched asymptotic expansions to simplify calculations of noise produced by aerodynamic flows involving small perturbations of a stream of nonnegligible subsonic Mach number. This technique is restricted to problems for which the dimensionless frequency is small. By combining Lorentz and Galilean transformations, the problem is transformed to a space in which the approximation appropriate to the inner region is found to be incompressible flow and that appropriate to the outer, classical acoustics. This approximation for the inner region is the unsteady counterpart of the Prandtl-Glauert transformation, but is not identical to use of that transformation in a straightforward quasi-steady manner. For wings in oscillatory motion, it is the same approximation as was given by Miles. To illustrate the technique, two examples are treated, one involving a pulsating cylinder in a stream, the other the impinging of plane sound waves upon an elliptical wing in a stream. O.H.

A71-12380 # Extension of Goldstein's series for the Oseen drag of a sphere. Milton Van Dyke (Stanford University, Stanford, Calif.). *Journal of Fluid Mechanics,* vol. 44, Nov. 11, 1970, p. 365-372. 17 refs. Contract No. AF 44(620)-69-C-0036.

Extension of Goldstein's expansion of the Oseen drag of a sphere in powers of Reynolds number to 24 terms by computer. The

convergence is found to be limited by a simple pole at R = -4.18172. The series is recast using a Euler transformation and other devices to yield accurate results for large R. O.H.

A71-12408 # **Considerations on the wave drag of a delta thin wing with leading edge separation.** Elie Carafoli and Ştefan Staicu (Bucureşti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *(Conférence Nationale de Mécanique Appliquée, Bucharest, Rumania, June 23-27, 1969.) Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée,* vol. 15, no. 5, 1970, p. 1101-1124. 11 refs.

Calculation of the aerodynamic characteristics of a thin delta wing with allowance for the vortex streets at the tip wings resulting from flow separation at the subsonic leading edges. Lift and rolling moment coefficients are obtained from the pressure distribution on the wing. Drag coefficients are determined both for a thin delta wing and for a system of wings of symmetrical thickness. V.P.

A71-12420 # **Superpressure balloon and precise pressure radio-sonde system for the research of vertical air-motion.** Shoji Ohta and Tomoyuki Ito (Ministry of Transportation, Meteorological Research Institute, Tokyo, Japan). *Papers in Meteorology and Geophysics,* vol. 21, Apr. 1970, p. 45-72. 14 refs. In Japanese, with abstract in English.

Description of a superpressure balloon and a precise pressure radiosonde system for studying airflows over mountainous regions. The balloon is about 1.7 m in diam and is made of 50-micron thick film. The sphere consists of 12 segments. Field observations were carried out, and over 30 balloons have been successfully landed so far. It was found that vertical air current within a height of 5 km and a range of 100 km or more could be measured with an accuracy of plus or minus 1 mb. The system proved to be quite stable and practical for the field measurement of vertical air motion. M.M.

A71-12439 **Skynet traffic systems.** J. W. Gunning (Signals Research and Development Establishment, Christchurch, Hants., England). In: Skynet; Institution of Electrical Engineers, Meeting, London, England, April 20, 1970, Proceedings.
London, Institution of Electrical Engineers (IEE Conference Publication No. 63), 1970, p. 137-145.

Description of the Skynet communications system and of its main control organs and control center. A technical description of a typical trunk is given, together with details of the engineering and systems control. The Skynet satellite repeater has been equipped with wide-band and narrow-band pathways which provide long distance strategic communication links between a number of earth stations on permanent sites. In addition, a number of mobile air/helicopter portable stations are also provided which enable a mobile force headquarters, or similar unit, to gain entry into the strategic system. The overall control of the system is exercised by the Master Engineering Control Center whose facilities and functions are outlined. Communications trials so far conducted indicate that the traffic capacity of the Skynet system may be expected to measure up to specification. M.V.E.

A71-12449 **NDT techniques for airline maintenance inspection.** W. J. Weldon (American Airlines, Inc., New York, N.Y.). *Quality Progress,* vol. 3, Nov. 1970, p. 22-24.

Description of the application of the various methods of nondestructive testing to insure the integrity of aircraft. Airline maintenance inspection as performed by American Airlines, Inc., is considered. Specific areas in which ultrasonic and eddy current maintenance inspection is used to insure the integrity of various flight equipment are outlined and the specific procedures adopted for testing the individual equipment or items are discussed. The areas of application of other nondestructive inspection methods, such as magnetic particle, penetrant, and X-ray inspection, are also shortly reviewed. O.H.

A71-12477 **Development and test of carbon epoxy fibre composite for helicopter tail rotor applications.** Bernd Bongers, Klaus Brunsch, and Wolfgang Jonda (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: British Plastics Federation, International Reinforced Plastics Conference, 7th, Brighton, England, October 20-22, 1970, Proceedings.
London, British Plastics Federation, 1970, p. 1/1-1/7.

Discussion of the development and testing of tail rotor blades for the Messerschmitt-Bölkow-Blohm BO-105 helicopter using carbon fiber reinforced composites (CFC). An evaluation and analysis of various fibers with regard to this specific application is made, showing the outstanding mechanical properties of carbon fibers. The design features of the semirigid two-blade tail rotor for the BO-105 helicopter with CFC blades are presented. In order to determine the effect that various grades of stiffness have on the dynamic behavior, the flapwise, chordwise and torsional frequencies of a tail rotor blade with filament-wound carbon skin were tested in comparison to a glass-reinforced plastic rotor blade. The approach selected to improve the processing techniques to such an extent that specifications could be established for production of a blade which could be flight-tested is described. Finally fatigue tests and a fight test conducted on the CFC tail rotor blade are discussed. O.H.

A71-12487 **Polyimides in advanced composites for aerospace applications.** M. C. Cray (British Aircraft Corp., Ltd., Stevenage, Herts., England). In: British Plastics Federation, International Reinforced Plastics Conference, 7th, Brighton, England, October 20-22, 1970, Proceedings. London, British Plastics Federation, 1970, p. 27/1-27/4. 10 refs.

Discussion of the various aspects of polyimide composites developed for high strength and random aerospace applications. Following an outline of the chemistry of polyimides, their commercial applications are briefly reviewed. Composite manufacture with the British resin is then described, and the results of tests of glass fiber, carbon fiber, and asbestos composites are presented. A comparison with a foremost American polyimide resin is then made. Finally, some problem areas, such as void content, volatiles, and moisture absorption are reviewed, and the future of polyimides in aerospace applications is considered. O.H.

A71-12488 **Carbon fibre in aviation** : Frav (Hawker Siddeley Aviation, Ltd., Kingston-upon-Thames, Surrey, England). In: British Plastics Federation, International Reinforced Plastics Conference, 7th, Brighton, England, October 20-22, 1970, Proceedings. London, British Plastics Federation, 1970, p. 28/1-28/5.

Discussion of the use of carbon fiber/synthetic resin, particularly epoxy resin composites in aircraft industry. Following a brief review of the historical background, specific strengths and specific moduli of carbon fiber/epoxy resin composites made with high-strength and high-modulus fibers at 60% fiber volume fraction are compared with the equivalent properties of the common aircraft materials. The high fatigue life of these composites, meeting exactly the requirements of aircraft structural materials, is emphasized. On the other hand, several problems resulting from some of the properties of these composites are also discussed. Some examples of a variety of experimental aircraft structures from these composites are presented. Finally, future utilization and the influence of cost is considered. O.H.

A71-12551 # **Influence of forward speed on the aerodynamic characteristics of an air-cushion vehicle (Vliianie skorosti postupatel'nogo peremeshcheniia na aerodinamicheskie kharakteristiki apparata na vozdushnoi podushke).** L. F. Kalitievskii. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 3-9. 6 refs. In Russian.

Development of an analytical method of determining the influence of forward horizontal speed on the aerodynamic characteristics of an air-cushion vehicle employing a circular nozzle and cylindrically or conically shaped curtains. The method proposed makes it possible to determine the distortion of the curtain by the oncoming flow and the velocity distribution at various cross sections of the curtain. Using these data, it is then possible to calculate the principal aerodynamic characteristics in horizontal flight. V.P.

A71-12553 # **Approximate method of calculating the minimum suction rate preventing boundary layer separation for a semibounded jet (Priblizhennyi metod rascheta minimal'noi skorosti otsasyvaniia, iskliuchaiushchei otryv pogranichnogo sloia poluogranichennoi strui).** A. M. Mkhitarian and A. P. Girol'. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 14-18. In Russian.

Development of a method of calculating the lowest suction rate that would prevent laminar boundary layer separation from a curvilinear porous surface situated in a jet flow expelled from a thin slot into a slipstream. The method is based on the use of a dimensionless momentum equation for the boundary layer and of a velocity profile in the form of a fourth-order polynomial. The maximum velocity at the interface between the boundary layer and the main flow is determined from an integral momentum relation for the main flow. V.P.

A71-12554 # **Laminar boundary layer on a wing and a body of revolution in the presence of blowing (Laminarnyi pogranichnyi sloi na kryle i tele vrashcheniia pri nalichii vduvaniia).** L. F. Kozlov and A. I. Tsyganiuk. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 19-25. In Russian.

Development of a method of calculating the characteristics of a two-dimensional axisymmetric incompressible boundary layer on a blown wing, using a sixth-order polynomial for approximating the velocity distribution across the boundary layer. An arbitrary velocity distribution at the outer boundary of the layer is assumed. A solution to the problem is obtained with the aid of Kármán's integral relation. The method proposed is essentially an extension of the Schlichting-Ulrich (1942) method to include porous surfaces. Using Stapanov's (1947) transformation, the method can be readily extended to the calculation of blown laminar boundary layers on bodies of revolution. V.P.

A71-12555 # **Determination of the point of laminar-turbulent transition with the aid of a traveling indicator (Opredelenie tochki perekhoda laminarnogo pogranichnogo sloia v turbulentnyi skol'ziashchim koordinatnikom).** V. B. Zozulia and O. R. Cheranovskii. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 26-30. In Russian.

Description of a device employing a hot-wire anemometer and an oscilloscope to determine the point of laminar-turbulent transition on a wing. With the aid of an electrically driven mechanism, the sensor is made to move in the boundary layer in opposite direction to the flow. The point of laminar-turbulent transition is determined (by linear measurements) from oscillograms of the velocity pulsations in the boundary layer. V.P.

A71-12558 # **Influence of the aspect ratio of guide vanes on the characteristics of axial-flow compressor stages with small aspect-ratio vanes (Vliianie udlineniia lopatok napravliaiushchego apparata na kharakteristiki stupenei osevogo kompressora s lopatkami malogo udlineniia).** A. D. Griga, V. V. Kovalevskii, and A. E. Poliakov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 38-40. In Russian.

Analysis of the results of an experimental investigation of the influence of the aspect ratio of guide vanes on the efficiency of high-pressure stages of two axial-flow compressors (K-70-10C and OKVD-50). It is shown that, for small aspect ratio vanes, stage efficiency can be increased in many cases by using guide and rotor vanes with different aspect ratios. V.P.

A71-12559 # **Utilization of continuous fuel feed in a rotary-piston engine with planetary motion of the rotor (Primenenie nepreryvnoi podachi topliva v rotorno-porshnevom dvigatele s planetarnym dvizheniem rotora).** A. M. Frid, Iu. S. Shoshin, and P. P. Pershin. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 41, 42. In Russian.

Discussion of an internal mixing scheme for a Wankel engine, in which the fuel is injected continuously by means of a nozzle into the working cavity during the intake-compression cycle. By placing the injection nozzle close to the major axis of the chamber, the time mixing time is increased and the fuel losses (of the next charge) due to overlapping of the intake and exhaust openings are eliminated. Experiments performed with a swirl injector at injection pressures of less than 15 kg/sq cm revealed the effectiveness of the scheme proposed. V.P.

A71-12562 # **Determination of the cross-sectional dimensions of load-carrying elements of delta wings from the static strength and weight conditions (Opredelenie razmerov sechenii nesushchikh elementov treugol'nykh kryl'ev po usloviiam staticheskoi prochnosti i vesa).** V. M. Riabchenko and M. P. Tepenitsyn. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 63-70. 5 refs. In Russian.

Consideration of delta wings with a skin reinforced by longitudinal and transverse thin-walled longeron beams and ribs. A method of designing wings with symmetrical upper and lower panels is described, and an algorithm for minimizing the theoretical weight is developed. It is shown that the proposed method, provided certain assumptions are made, makes it possible to solve the problem of optimal designation of the parameters of load-carrying elements of a delta wing, if the structural complexity of the wing does not make solution on serial-type computers difficult. A.B.K.

A71-12570 # **Influence of the test time and contact stresses on the antiwear properties of jet fuels under conditions of rolling friction (Vliianie prodolzhitel'nosti ispytaniia i kontaktnykh napriazhenii na protivoiznosnye svoistva reaktivnykh topliv pri trenii kacheniia).** A. F. Aksenov and A. A. Litvinov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 17, 1970, p. 130-133. In Russian.

Experimental investigation of the influence of various factors on the wear of jet fuels (T-1, TS-1, T-7, and T-7 with antiwear additions), using the magnitude of wear and the increment in fuel temperature as criteria for evaluating the antiwear properties of the fuels. Particular attention is given to the influence of contact stresses, the rate of rolling friction, and time. It is shown that these factors can have a substantial influence on the quantitative and qualitative relationships between friction and wear. This indicates that the antiwear properties of such fuels should be studied in the laboratory for a wide range of external effects. V.P.

A71-12606 # **Research on swept-back blades laid between parallel walls. II - Experimental research on Clark Y 8% and NACA 6509 blades with aspect ratio of 2.0.** H. Murai, T. Narasaka (Tohoku

University, Sendai, Japan), Y. Hirata (Akita University, Akita, Japan), and Y. Aoki. *(Japan Society of Mechanical Engineers, Meeting for Hydraulics and Hydraulic Machines, 792nd, Tokyo, Japan, Sept. 26, 1969.) Tohoku University, Institute of High Speed Mechanics, Reports,* vol. 21, 1969-1970, p. 189-252.

Experimental study of the effects of the thickness, camber, and leading edge radius of sweptback blades placed between parallel walls on the flow patterns and other characteristics of these wings. In the experiments, sweptback blades with cross-sectional forms of Clark Y 8% and NACA 6509 aerofoils and the aspect ratio of 2.0 were examined. The results are given graphically, tabulated, and discussed. O.H.

A71-12607 **M49 Larzac testing under way.** Donald E. Fink. *Aviation Week and Space Technology,* vol. 93, Nov. 23, 1970, p. 40, 41, 43, 44.

Discussion of the M49 Larzac turbofan engine under development by SNECMA and TURBOMECA. It will have an initial thrust rating of 2300 lb, which will be increased to 2965 lb in the first development phase. The engine has an ultimate potential of 4400 lb thrust without afterburner. One version will be used on some models of the Aerospatiale SN-600 Corvette utility jet, and the Dassault Falcon 10 executive jet. Another version has been selected for the Franco-German Alphajet trainer. The intent of the design effort was to develop an engine which is relatively simple and is inexpensive to buy and operate. Current versions of the engine are constructed from a combination of steel, light alloy, and titanium. F.R.L.

A71-12609 **The future of aeronautics.** Edited by J. E. Allen (Hawker Siddeley Aviation, Ltd., Kingston-upon-Thames, Surrey, England) and Joan Bruce. London, Hutchinson and Co., Ltd., 1970. 575 p. $12.60.

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Air traffic and navigation in the second century. A. Stratton (Defence Operational Analysis Establishment, England), p. 474-500.

Looking ahead in aeronautics and astronautics - A US view. R. Smelt (Lockheed Aircraft Corp., Burbank, Calif.), p. 501-529.

Looking forward again - Notes on the needs, probabilities and possibilities in aeronautics. H. R. Cox (Berger, Jenson, and Nicholson), p. 530-543.

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A71-12629 # **Inviscid ideally conducting fluid flow past a thin foil in a transverse magnetic field (Obtekanie tonkogo profilia neviazkoi ideal'no provodiashchei zhidkost'iu v poperechnom magnitnom pole).** G. B. Sher'iazdanov. *Magnitnaia Gidrodinamika,* vol. 6, July-Sept. 1970, p. 67-73. 10 refs. In Russian.

Derivation of a closed-form solution to the problem of inviscid ideally conducting fluid flow past an arbitrary thin foil in a transverse magnetic field. The unknown functions are represented in the form of an asymptotic expansion in powers of a small parameter, and in the first approximation the problem coincides with the approximation of Sears and Resler (1959). The determination of the rotational and irrotational parts of the solution is reduced to finding an unknown harmonic function. In contrast to Sears and Resler and other authors, a closed-form solution for an arbitrary thin foil is obtained which depends on the Alfvén number. A flow past a three-parameter profile is considered as an example; the aerodynamic force coefficients and the load distribution are determined. In the case of the absence of a magnetic field the results obtained coincide with the results for an ordinary hydrodynamic flow. A.B.K.

A71-12676 # **Size effects in conventional aircraft design.** F. A. Cleveland (Lockheed Aircraft Corp., Burbank, Calif.). *(American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 2nd, Los Angeles, Calif., July 20-22, 1970, Paper 70-940.) Journal of Aircraft,* vol. 7, Nov.-Dec. 1970, p. 483-512. 27 refs.

As subsonic aircraft size has increased, the useful-load/gross-weight ratio has improved despite the so-called square/cube 'law;' despite increasing requirements for such things as safety, reliability, and maintainability; and despite demands for greater comfort, speed, range, and productivity per dollar. Though future growth potential appears unlimited if adequate technology improvement time obtains,

the economic advantage gain rate is flattening and further increases are likely in smaller increments. Nonetheless, one gross weight doubling, and possibly two, is predicted by 1985; nuclear power can drive the optimum weight to five or ten million pounds before the year 2000. (Author)

A71-12677 # **Evaluation of the design parameters for optimum heavily loaded ducted fans.** Terry Wright (Georgia Institute of Technology, Atlanta, Ga.; Westinghouse Fluid Systems Laboratory, West Lafayette, Ind.). *Journal of Aircraft*, vol. 7, Nov.-Dec. 1970, p. 512-517. Grant No. DA-HC-04-68-C-004.

A consistent mathematical model for the ultimate vortex system of an optimum heavily loaded ducted fan has been developed for zero hub diameter and neglecting compressibility, viscosity, and tip clearance. The compatability relationships to be satisfied are presented with a brief description of the model. For any choice of blade number and pitch angle, it is shown that the blade bound vortex strength distribution for the heavily loaded ducted fan may be extracted from the lightly loaded case through the use of a simple scaling factor. In addition, expressions are developed for the power, thrust, and induced efficiency for the heavily loaded system which may also be extracted from the lightly loaded results. Some sample results are presented for a ducted fan with 2, 4, 6, and 8 blades with loadings from a light load to the static thrust condition. (Author)

A71-12678 # **New longitudinal handling qualities data - Carrier approach.** George E. Miller (Princeton University, Princeton, N.J.). *(American Institute of Aeronautics and Astronautics, Guidance, Control, and Flight Mechanics Conference, Princeton, N.J., Aug. 18-20, 1969, Paper 69-897.) Journal of Aircraft*, vol. 7, Nov.-Dec. 1970, p. 519-522. 9 refs.

Results of an aircraft flying qualities research program sponsored by the Naval Air Systems Command. Navy test pilot evaluations in the form of Cooper ratings and specific comments of several longitudinal handling characteristics were obtained for a simulated carrier landing task. The investigation made use of a variable stability aircraft which accurately simulated the longitudinal short period response characteristics and the effects of atmospheric turbulence. The flying qualities associated with variations in short period frequency, lift curve slope, and the use of direct lift control are presented. The data are compared with similar data obtained from flight and ground simulator tests. A gradual decline in good handling qualities was noted for reductions in short period frequency and lift curve slope. Direct lift control using a thumb controller was found to be desirable for this task on all configurations. (Author)

A71-12679 # **Transonic buffet characteristics of a 60-deg swept wing with design variations.** J. F. Mayes, M. E. Lores, and H. R. Barnard (LTV Aerospace Corp., Dallas, Tex.). *Journal of Aircraft*, vol. 7, Nov.-Dec. 1970, p. 524-530. 13 refs.

Results of wind-tunnel tests of a typical swept-wing fighter aircraft conducted to determine the improvement in the buffet-onset lift coefficient resulting from wing camber and from leading and trailing edge deflection. The coefficient was determined from trailing edge pressure, wing-root bending moment, fluorescent oil flow photographs, and force data. All four types of data are arranged in a composite graphical form to insure proper selection of the coefficient and to identify the location on the wing where separation first occurs. Results at Mach 0.9 showed that 0.2 increase in camber (airfoil design lift coefficient) increased the coefficient approximately 0.08; a 5-deg leading edge droop 0.15; and a 5-deg inboard trailing edge flap 0.12. Analysis of design trends shown by previous experimental results are described for the effects of wing thickness ratio, sweep, aspect ratio, and camber on the coefficient. Specific buffet problems related to variable swept wings are discussed. (Author)

A71-12680 # **Numerical investigations of an airfoil in a nonuniform stream.** F. Chow, E. Krause, C. H. Liu, and J. Mao (New York University, New York, N.Y.). *Journal of Aircraft*, vol. 7, Nov.-Dec. 1970, p. 531-537. 11 refs. Contract No. DA-31-124-ARO(D)-464.

Solution of the nonlinear differential equation for the flowfield around an airfoil in a two-dimensional nonuniform parallel stream by the finite difference method. The numerical results show that even for a thin airfoil at small angle of attack, the stagnation pressure and the vorticity carried by the streamline passing around the airfoil are significantly different from the corresponding values carried by the undisturbed streamline through the body under the linearized approximation. When the deviation upstream from the uniform flow is represented by a Gaussian profile to simulate the velocity increment behind a propeller, the numerical results show that there is an optimum vertical location of the airfoil relative to the upstream profile for maximum lift. A correlation between the maximum lift and a nonuniformity parameter of the upstream profile is obtained. This parameter is a combination of two parameters, the maximum velocity deviation and the spread of the nonuniformity. When the upstream velocity profile changes from one uniform stream to another through a layer with a steep velocity gradient, there is a significant gain (loss) in lift, if the vorticity is in the same (opposite) sense as the circulation around the wing. A more drastic change in lift occurs, however, when the circulation is in the opposite sense as the vorticity. This occurs when the layer with a steep velocity gradient passes over the upper surface of the airfoil. This phenomenon of a sudden change in lift is of importance when an airplane encounters an atmospheric disturbance. M.M.

A71-12682 * # **A new model performance index for engineering design of flight control systems.** Herman A. Rediess (NASA, Flight Research Center, Edwards, Calif.) and H. Philip Whitaker (MIT, Cambridge, Mass.). *(American Institute of Aeronautics and Astronautics, Guidance, Control, and Flight Mechanics Conference, Princeton, N.J., Aug. 18-20, 1969, Paper 69-885.) Journal of Aircraft*, vol. 7, Nov.-Dec. 1970, p. 542-549. 12 refs. Grant No. NGR-22-009-229.

Description of the theory and application of a new performance index, the Model PI, that brings engineering design specifications into the analytical design process. A parameter optimization design procedure is established that starts with practical engineering specifications and uses the Model PI as a synthesis tool to obtain a satisfactory design. The Model PI represents a new criterion for approximating one dynamical system by another, based on a novel geometrical representation of linear autonomous systems. It is shown to be an effective performance index in designing practical systems and to be substantially more efficient than a comparable model-referenced integral squared error performance index. The design procedure is demonstrated by designing a lateral-directional stability augmentation system for the X-15 aircraft. (Author)

A71-12683 # **Aircraft performance benefits from modern control systems technology.** Richard B. Holloway, Paul M. Burris (Boeing Co., Wichita, Kan.), and Robert P. Johannes (USAF, Wright-Patterson AFB, Ohio). *(American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, Los Angeles, Calif., July 14-16, 1969, Paper 69-767.) Journal of Aircraft*, vol. 7, Nov.-Dec. 1970, p. 550-553.

In conventional approaches to aircraft design, the flight control system is designed to meet specified handling requirements after the configuration is optimized to meet the mission performance requirements. The performance benefits which accrue by considering the control system design throughout the configuration studies are discussed. The approach employed to integrate control system design into aircraft design engineering, the discussion of control techniques

and their impact on the design, and the performance benefits expected are elements of the work. Concepts to be examined include relaxation of inherent static stability, ride quality control, flutter margin control, and maneuver load control. (Author)

A71-12684 # **Pilot and aircraft augmentation on the C-5.** Leo J. Mueller (Honeywell, Inc., Minneapolis, Minn.). *Journal of Aircraft,* vol. 7, Nov.-Dec. 1970, p. 553-556.

Description of some approaches, both simulation and actual, used in testing the C-5 military transport. The gross weight, large pitch, yaw inertia, and low landing speed of this aircraft presented new problems. These problem areas have been alleviated by an augmentation system designed to improve the handling qualities of the C-5. The aircraft's pilots were able to log more than 500 hr on a simulator before the first flight. This simulator was a valuable assist in the analysis and design of the augmentation system. M.M.

A71-12687 # **A system analysis view of aerodynamic coupling.** Peter Hamel (Braunschweig, Technische Universität, Braunschweig, West Germany). *Journal of Aircraft,* vol. 7, Nov.-Dec. 1970, p. 567-569. 7 refs.

Application of system analysis methods to stability investigations of coupled flight vehicle motions. An effort is made to give the stability and control analyst some feel of and a simple procedure for determining aerodynamic coupling effects due to steady sideslip. On the basis of the feedback analogy, it is shown that the root locus technique is a powerful tool for inspecting and predicting the single contributions of the aerodynamic coupling derivatives on the characteristic roots for a wide variety of aircraft classes. M.M.

A71-12688 # **Pitot inlet additive drag.** E. L. Crosthwait (General Dynamics Corp., Fort Worth, Tex.). *Journal of Aircraft,* vol. 7, Nov.-Dec. 1970, p. 569, 570. 6 refs.

Description of a unique Pitot inlet additive drag approximation defined in simple terms of capture area ratio, together with static pressure coefficient and total pressure coefficient ahead of the inlet. The values obtained for the approximate expression for additive drag coefficient for a specific Pitot inlet are compared with analytical levels presented by Sibulkin (1954) and others (Gibbings, 1961; Seddon, 1954). The agreement is well within plus or minus 0.003. M.M.

A71-12690 # **Upwash interference on a jet flap in slotted tunnels.** Ching-Fang Lo (ARO, Inc., Propulsion Wind Tunnel Facility, Arnold Air Force Station, Tenn.). *Journal of Aircraft,* vol. 7, Nov.-Dec. 1970, p. 572-574. 8 refs.

Description of the upwash interference on a two-dimensional jet-flap wing in a slotted-wall tunnel. The formulation is based on the small disturbance theory and the linearized model of the jet-flap wing as derived by Spence (1956, 1957). An analytical solution is developed for the upwash interference, and some numerical results are shown graphically. M.M.

A71-12691 # **Spanwise distribution of induced drag in subsonic flow by the vortex lattice method.** T. P. Kálmán, J. P. Giesing (McDonnell Douglas Corp., Long Beach, Calif.), and W. P. Rodden. *Journal of Aircraft,* vol. 7, Nov.-Dec. 1970, p. 574-576. 15 refs. Research sponsored by the McDonnell Douglas Independent Research and Development Program.

Review of the calculation of the spanwise distribution of induced drag by the Vortex Lattice Method (VLM). The scaled spanwise distribution of induced drag is shown and is compared to the best results obtained by Garner, Hewitt, and Labrujere (1968). The comparison is excellent. Further comparisons with results of other methods are made. The VLM can also be used for estimating certain quasi-steady rotary derivatives required in stability and control analyses. M.M.

A71-12719 # **Nonlinear conical gas flows (Nelineinye konicheskie techeniia gaza).** B. M. Bulakh. Moscow, Izdatel'stvo Nauka, 1970. 344 p. 234 refs. In Russian.

An attempt is made to consider all the essential problems arising in the theory of nonlinear conical gas flows. The general properties of conical gas flows and certain particular forms of such flows are reviewed. Among the particular forms considered are axisymmetric flow past a circular cone, axisymmetric conical flows, flow past pyramidal bodies, and simple conical waves. In considering supersonic conical gas flows, a study is made of flow past conical bodies entirely contained in the Mach cones of the unperturbed flow. Flow past a circular cone at an angle of attack, flow past conical bodies with flow separation, flow past conical bodies located outside the Mach cones of the unperturbed flow, and flow past conical bodies partly projecting from the Mach cones of the unperturbed flow are also investigated. In considering hypersonic conical gas flows, a study is made of flow past conical bodies in cases where the head shock waves are attached only to the tips of the bodies and of flow past conical wings in cases where the head shock waves are attached to the leading edges of the wings. A.B.K.

A71-12722 Aircraft power plants: Systems and devices (Aviatsionnye silovye ustanovki: Sistemy i ustroistva). N. T. Domotenko, A. S. Kravets, A. I. Pugachev, and T. I. Sivashenko. Moscow, Izdatel'stvo Transport, 1970. 352 p. 62 refs. In Russian.

General problems of the design and operation of aircraft power plant equipment are considered. A method of designing aircraft power plant systems and devices is presented. The assumptions made for teaching purposes have little effect on the accuracy of the results and make it possible to obtain comparatively simple formulas and graphs which are convenient for monitoring the operation of the systems and devices and for designing them. Data concerning the layout of power plants, the attachment of engines and gondolas, the characteristics of propellers, and the control of power plants are presented. Fuel systems, oil systems, cooling systems, deicing systems, fire-fighting systems, suction systems, and exhaust systems are considered. Problems in monitoring and operating power plant equipment are discussed. A.B.K.

A71-12723 Threads used in the aircraft industry: Handbook (Rez'by, primeniaemye v aviatsionnom proizvodstve: Spravochnik). A. E. Vaisman, P. S. Denisov, O. V. Morozenko, T. V. Beglova, and Z. V. Barabasheva. Moscow, Izdatel'stvo Mashinostroenie, 1970. 368 p. 18 refs. In Russian.

Standardized definitions are given for the basic parameters of threads used on aircraft bolting and coupling elements, and criteria are listed for quality control and reliability requirements. Numerous practical recommendations are included for selecting thread profiles and configurations as a function of the materials employed and the conditions of operation. The text consists of very detailed tables of specifications for various applications as prescribed by the Soviet GOST standards. Practical reference data are given for thread cutting instruments and tools, and cutting processes are explained for inner and outer threads with emphasis on special demands posed by aircraft materials and high-tolerance requirements. Special quality control and diagnostic methods are recommended, and assembly operations for threaded components are discussed. T.M.

A71-12740 **The Mirage 'Milan' (Le Mirage 'Milan').** Jacques Morisset. *Air et Cosmos,* vol. 8, Nov. 21, 1970, p. 21-28. In French.

Description of the Mirage 'Milan' ground attack fighter, which is the latest addition to the Mirage 3 and Mirage 5 families. It can assure air superiority up to Mach 2. It embodies improvements which consist of a forward mounted retractable 'moustache,' which aids in increasing lift, a more powerful engine, and modern electronic navigation and attack equipment. Low speed handling and operation from short airstrips with steep approaches are superior, and the maintenance rate is very low. F.R.L.

A71-12746 **Concorde and the air travel market.** E. H. Burgess (British Aircraft Corp., Ltd., Filton, Bristol, England). *Esso Air World,* vol. 23, no. 2, 1970, p. 49-51.

Discussion of the economical and operational prospects of the Concorde. Studies and experience indicate that the high speed of travel on Concordes would appeal to passengers notwithstanding a 35% increase in fares. It is expected that a profitable operation of the Concorde will prove realizable. It is maintained that a mixed fleet of Concordes and subsonic airliners, tailored to the operator's route and traffic characteristics, will achieve a higher return on capital investment than an all-subsonic fleet of equivalent capacity. V.Z.

A71-12840 # **Meteorological conditions of supersonic aircraft flights (Meteorologicheskie usloviia poletov sverkhzvukovykh samoletov).** I. G. Pchelko, N. V. Petrenko, and G. S. Buldovskii. Leningrad, Gidrometeorologicheskoe Izdatel'stvo, 1970. 164 p. 147 refs. In Russian.

The structure of the atmosphere is analyzed, with emphasis on the general characteristics of meteorological conditions in the troposphere and stratosphere. Seasonal regularities of atmospheric circulation in the stratosphere are outlined, and the relationship between stratospheric and tropospheric processes is examined. Stratospheric cyclones, anticyclones, jet streams, and warmings are described, together with typical vertical wind and temperature distributions. The main features of supersonic flight are explained in terms of relationships between the atmospheric parameters and the aircraft speed, altitude, fuel consumption, and sonic boom formation. Current knowledge about turbulence in the stratosphere is surveyed, and data are given for turbulence zone characteristics, meteorological sources of turbulence, and prediction of aircraft buffeting in turbulence. The effects of convective activity, icing, ozone, and solar flare radiation are examined. T.M.

A71-12852 **A preliminary investigation of gas turbine combustor modelling.** Dean C. Hammond, Jr. and Arthur M. Mellor (Purdue University, Lafayette, Ind.). *Combustion Science and Technology,* vol. 2, Nov. 1970, p. 67-80. 27 refs. Grant No. DA-AE-07-69-0756.

An analytical model for the design of tubular gas turbine combustors is developed by combining the desirable portions of several models from the literature. A literature survey covering the three major theories of combustor analysis, turbulent flame speed, microvolume burning, and stirred reactors is briefly summarized. Based on the results of the literature survey a combustor model composed of stirred reactors is proposed. A kinetic formulation for the combustion of propane in a single-staged stirred reactor is developed, and limited results are presented. (Author)

A71-12885 • **Hot-salt stress-corrosion of a titanium alloy in a dynamic air environment.** Hugh R. Gray and James R. Johnston (NASA, Lewis Research Center, Cleveland, Ohio). *Metallurgical Transactions,* vol. 1, Nov. 1970, p. 3101-3105. 16 refs.

Hot-salt stress-corrosion threshold data were determined for the Ti-8Al-1Mo-1V alloys under simulated turbine-engine compressor environmental conditions. Threshold data determined by residual tensile ductility were demonstrated to be a more sensitive indication of hot-salt stress-corrosion than threshold data determined from crack observations. Specimens that had been stress-relieved by chemically milling exhibited drastically lower threshold stresses than did specimens in the as-machined condition. A Mach 0.7 airflow with a dewpoint of -120 F did not significantly reduce stress-corrosion when compared to static air conditions. (Author)

A71-12892 **The impact of helicopter operations on air traffic control in the 1970's.** James G. McFadden (U.S. Army, Office of the Director of Defense Research and Engineering, Washington, D.C.). (Institute of Navigation, National Air Meeting on Air Traffic Control in the 1970's, St. Louis, Mo., April 14-16, 1970, Proceedings, p. 27-39.) *Navigation,* vol. 17, Fall 1970, p. 246-252.

The integration of helicopter operations into the civil air traffic system has been initiated. The quantitative impact in the next decade is difficult to forecast but it appears that in total numbers, helicopters will not create particularly great problems in air traffic control. They will, however, require special systems and procedures, particularly in terminal areas. Their slow operating speeds make them generally incompatible with fixed wing operations. Further, from the standpoint of operational efficiency, their VTOL capabilities and high maneuverability must be exploited in air traffic management. Military experience in Viet Nam provides valuable insight into operation of helicopters in mixed fixed and rotary wing terminal environments. (Author)

A71-12893 **Analysis of a capacity concept for runway and final-approach path airspace.** A. J. Goldman (National Bureau of Standards, Operations Research Section, Washington, D.C.). (Institute of Navigation, National Air Meeting on Air Traffic Control in the 1970's, St. Louis, Mo., April 14-16, 1970, Proceedings, p. 119-131.) *Navigation,* vol. 17, Fall 1970, p. 253-259. 8 refs.

This paper describes some highlights of a short-term analytical study leading: (a) to a 'maximum throughput-rate' capacity concept in the context of a service facility handling a stream of customers of various types, and (b) to the specialization of this concept to a stream of IFR landings at a runway. The specialization is shown to be representable by a simple mathematical formula, of potential value (for example) in connection with cost-effectiveness analyses of proposed changes in ATC equipment or procedures. Directions for further research are identified, and the paper concludes with some general remarks on conceptual difficulties associated with the notion of 'capacity. (Author)

A71-12894 **Time-synchronized approach control.** Ralph L. Erwin, Jr. (Boeing Co., Renton, Wash.). (Institute of Navigation, National Air Meeting on Air Traffic Control in the 1970's, St. Louis, Mo., April 14-16, 1970, Proceedings, p. 163-173.) *Navigation,* vol. 17, Fall 1970, p. 260-266.

Time-synchronized approach control is a concept that takes advantage of available aircraft precision navigation and guidance capabilities. It combines these with advanced ATC equipment to provide an improved method of air traffic control. The basic concept is for ATC to assign each aircraft a three-dimensional approach path and schedule that the aircraft must then maintain with an error that is small compared to the allowable longitudinal spacing between approaches. The advantages of reduced control workload and increased control precision are used as a basis for computing potential benefits in terms of increasing peak-hour operations without increasing delay. This paper describes the concept, the airborne and ground-based equipment capabilities, the expected performance, and the potential benefits. (Author)

A71-12895 **Avoiding collisions in a timely manner.**.Robert E. Perkinson (McDonnell Douglas Astronautics Co., St. Louis, Mo.). (Institute of Navigation, National Air Meeting on Air Traffic Control in the 1970's, St. Louis, Mo., April 14-16, 1970, Proceedings, p. 185-198.) *Navigation,* vol. 17, Fall 1970, p. 267-276. 7 refs.

The Air Transport Association Collision Avoidance System is in its final stages, and a number of programs have been conducted over the last year to verify and confirm assumptions made in the system. The results of these programs are discussed in this paper, and the verification of system concepts and times is discussed based on: (1) a computer simulation program to verify the system parameters, accuracies, and maneuver times; (2) a program to verify pilot capability to observe and react to the CAS displays under instrument flight load conditions in airline cockpit simulators; (3) the work done by NAFEC in analyzing probability of alarm under real-life conditions; and (4) the final proof-of-the-pudding flight test that was conducted last fall on the CAS systems supplied by three electronics companies. (Author)

A71-12896 **Results of the ATA CAS flight test program.** Martin J. Borrok and David C. Rider (McDonnell Douglas Corp., St. Louis, Mo.). (Institute of Navigation, National Air Meeting on Air Traffic Control in the 1970's, St. Louis, Mo., April 14-16, 1970, Proceedings, p. 199-213.) *Navigation,* vol. 17, Fall 1970, p. 278-289.

The Collision Avoidance System Flight Test and Evaluation Program was conducted by the Martin Marietta, Baltimore Division, under contract with the Air Transport Association of America. The purpose of the test program was to evaluate the compatibility and effectiveness of the Collision Avoidance System as set forth in the airline industry CAS specification, ANTC Report No. 117. CAS equipments designed and built by three companies, Bendix Avionics, McDonnell Douglas and joint team of Sierra Research Corporation and Wilcox Electric Company, were furnished for this test and evaluation program. A total of 124 CAS test flights (greater than 300 flight hours) were flown from 6 June 1969 to 19 November 1969. From the total 124 flights, 75 flights (210 flight hours) yielded sufficient quantitative data for adequate analysis of the CAS. Approximately 260 intercepts, the majority involving two aircraft encounters, were flown. Test results from this program show that CAS operating normally in the synchronized mode, per ANTC 117 specification, provide the proper pilot command in adequate time to perform the evasive action to prevent a potential midair collision. (Author)

A71-12909 # **Inlet flow field simulation techniques for engine/compressor testing.** J. L. Younghans, M. T. Moore, T. P. Collins, and J. G. Direnzi (General Electric Co., Evendale, Ohio). *Aircraft Engineering,* vol. 42, Nov. 1970, p. 12-17.

Development of an inlet flow field simulator design for engine/compressor tests to ensure inlet/engine compatibility for a stable operation under all flight conditions. The available distortion testing devices (distortion screens, a discrete frequency generator, a pulse jet, a turbulator) are reviewed briefly, showing their limited efficiency. Ramp angle effects, screen location effects, and diffuser length effects are considered. The good simulating performance of the proposed simulator is demonstrated. V.Z.

A71-12910 # **Preliminary design of structural components in carbon fibre reinforced plastics and metals.** A. S. Henney (Ministry of Technology, London, England). *Aircraft Engineering,* vol. 42, Nov. 1970, p. 18-24. 30 refs.

The importance of the utilization of carbon fibers in commercially useful as well as experimental structures is discussed. This may be achieved by using the fibers in conjunction with conventional sheet metal components, as a preliminary step toward the 100 per cent reinforced plastic structure. A few such applications are described, together with a brief summary of the fiber processing and properties as an aid to preliminary design studies. (Author)

A71-12911 # **A reliable high temperature transducer for engine vibration measurement.** R. Hatschek (Vibro-Meter, S.A., Fribourg, Switzerland) and G. Schofield (Vibro-Meter, Ltd., Manchester, England). *Aircraft Engineering,* vol. 42, Nov. 1970, p. 25-27.

Discussion of the design and fabrication of reliable high temperature transducers for engine vibration monitoring in the difficult environment of modern jet engines. Design considerations are given for overcoming the difficulties of fabrication due to the temperature, acoustic noise, pressure, humidity and other factors of a jet engine environment. The properties of the piezoelectric materials used are analyzed. V.Z.

A71-12912 # **Development testing of the RB.211 turbofan engine.** *Aircraft Engineering,* vol. 42, Nov. 1970, p. 28, 30, 31.

Account of a test program for the development of the advanced RB.211 turbofan for the Lockheed L-1011 airliner. Test equipment of the Aerodynamic Test Facility at Hucknall, including open air test beds, an RB.211 flying test bed and a pilot's engine, is described. The instrumentation techniques used in tests are outlined. V.Z.

A71-12924 **Goniometry by laser gyro (Goniométrie par gyromètre laser).** J. M. Lamarre and J. J. Roland (CNRS, Service d'Aéronomie, Verrières-le-Buisson, Essonne, France). *L'Onde Electrique,* vol. 50, Nov. 1970, p. 869-871. In French. Research supported by the Direction de Recherches et Moyens d'Essais.

Description of laser gyro test manipulations, and assessment of the results of measurements of fluctuations and angular measurements at low rotational velocities. The principal characteristics of a goniometry device improved within the framework of inertial detection are considered, noting, in particular, a countup/countdown detection system developed for this purpose. A.B.K.

A71-12935 **Utilization of a niobium alloy in the fabrication of a hypersonic vehicle (Utilisation d'un alliage de niobium dans la réalisation d'un véhicule hypersonique).** Perez, Syre (Tréfimétaux GP, Argenteuil, Val-d'Oise, France), Billon (Société Nationale Industrielle Aérospatiale, Paris, France), Pichoir, and Guyot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Délégation Générale à la Recherche Scientifique et Technique and Direction des Recherches et Moyens d'Essais, Colloque sur les Journées Niobium, Paris, France, Oct. 20, 21, 1969.) Revue de Physique Appliquée,* vol. 5, June 1970, p. 455-465. In French.

Review of the various studies performed by some of the contributors to the VERAS project, an experimental structure for a hypersonic glider model involving the use of a niobium-based alloy. The Péchiney group perfected the formulation and processing of the alloy, and determined its general characteristics (mechanical properties, resistance to oxidation, etc.), which are presented in tabular form. The Nord-Aviation Company worked out the described full-scale technology of sandwich panel fabrication and protection by appropriate coatings. The ONERA group performed a comprehensive oxidation prevention study - i.e., selection of the protective coating and perfecting of the coating application method - whose specific application results are presented in detail, following an outline of the general features of this study. It is noteworthy that some of the techniques developed in the course of these studies have been earmarked for use in the space shuttle project. M.V.E.

A71-12939 **Problems involved in the application of niobium alloys to turbine blades (Problèmes posés pour l'application des alliages de niobium aux aubes de turbine).** G. Gauje and R. Brunetaud (SNECMA, Paris, France). *(Délégation Générale à la Recherche Scientifique et Technique and Direction des Recherches et Moyens d'Essais, Colloque sur les Journées Niobium, Paris, France, Oct. 20, 21, 1969.) Revue de Physique Appliquée,* vol. 5, June 1970, p. 513-518. In French.

Review of advantages gained from the use of niobium alloys for the hottest and mobile parts of a gas turbine. Using these alloys, it is expected that the working temperatures can be up to 150 C higher than those possible with currently used Ni-Cr alloys. The critical problem in the development of niobium alloys is shown to be the development of suitable protective coatings. The relatively high brittle-ductile transition temperature of these alloys is shown to cause some concern. Improvements which have to be made to reach the phase of engine development are reviewed. Z.W.

STAR ENTRIES

N71-10021*# Mechanical Technology, Inc., Latham, N.Y.
FLEXIBLE ROTOR BALANCING BY THE EXACT POINT-SPEED INFLUENCE COEFFICIENT METHOD Final Report
Juergen M. Tessarzik [1970] 115 p refs
(Contract NAS3-13473)
(NASA-CR-72774; MTI-70TR59) Avail: NTIS CSCL 13I

A test program was conducted to confirm experimentally the validity of the exact point-speed influence coefficient method for balancing rotating machinery, and to assess the practical aspects of applying the method to flexible rotors. Testing was performed with a machine having a 41-inch long, 126-pound rotor. The rotor was operated over a speed range encompassing three rotor-bearing system critical speeds: two rigid body criticals and one flexural critical. Rotor damping at the flexural critical was very low due to the journal bearings being located at the nodal points of the shaft. The balancing method was evaluated for three different conditions of initial rotor unbalance. The method was found to be effective and practical. Safe (and slow) passage through all the critical speeds was obtained after a reasonable number of balancing runs. Success of the balancing method was, in large part, due to the accuracy of the instrumentation system used to obtain phase angle measurements during the balancing procedure. Author

N71-10052*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED WIND-TUNNEL INVESTIGATION OF A SERIES OF TWIN-KEEL ALL-FLEXIBLE PARAWINGS
Rodger L. Naeseth Washington Oct. 1970 103 p refs
(NASA-TN-D-5936; L-7096) Avail: NTIS CSCL 01C

Low-speed wind-tunnel studies were made to obtain the static aerodynamic characteristics of a series of 10 twin-keel all-flexible parawings. The parawings, in flat planform, had a leading-edge sweep angle of 45 deg and generally a 20-percent keel length cut off of the apex of the basically triangular shape. The nose of each parawing model was contoured in such a manner that the airfoil sections in the center panel of the model had rounded leading edges. Twin-keel parawings were found to have improved performance characteristics as compared with single-keel parawings. The maximum lift-drag ratios of the models ranged from 2.6 to 3.2. Results of a limited flight-test program indicated that the twin-keel parawings would glide when the rigging, except for control-line length, was set as determined in the small-scale wind-tunnel tests. Author

N71-10094# Hydrospace Research Corp., Rockville, Md.
PENETRATION OF SONIC BOOM ENERGY INTO THE OCEAN: AN EXPERIMENTAL SIMULATION Final Report
John F. Waters and Ray E. Glass Jun. 1970 55 p refs
(Contract N00014-70-C-0374; FA-70-WAI-185)
(AD-711963; HRC-TR-288) Avail: NTIS CSCL 1/1

Penetration of sound into a body of water from a simulated airborne sonic boom was measured in an acoustically scaled experiment. Dynamite caps were used to produce spherically spreading N-waves which impinged upon the water. Microphones at the water surface and hydrophones at various shallow depths were used to measure the exponentially attenuating penetration of the airborne pressure field into the water, under total reflection conditions. Agreement between the scaled experimental measurements and predictions based on existing theory was generally good. Application of the theory to the case of actual sonic booms impinging upon the ocean, and comparisons with measurements of typical deep-ocean ambient noise, indicate that underwater sonic boom noise will be discernible only at very low frequencies and at shallow depths. Pressure fluctuation spectrum levels due to surface waves will be higher than levels due to sonic booms. Author

N71-10110*# Air Force Flight Test Center, Edwards AFB, Calif.
IFR EXPERIENCE WITH UNPOWERED, LOW-LIFT-DRAG-RATIO LANDING APPROACHES
Peter C. Hoag and B. Lyle Schofield *In* NASA. Flight Res. Center Flight Test Results Pertaining to the Space Shuttlecraft Oct. 1970 p 109–125 refs
Avail: NTIS CSCL 17G

The results of IFR flight studies are discussed and two terminal area guidance schemes are presented specifically designed for terminal area energy management and guidance of unpowered, low L/D ratio vehicles. The studies involved the F-111A, F-104, and NB-52B aircraft. The approaches considered include ILS, IFR, and ground controlled. It was found that IFR approaches made in the NB-52B airplane were no more difficult to fly than similar approaches with the smaller aircraft. In addition, ILS approaches were found easier to perform than ground controlled approaches under the same conditions. D.L.G.

N71-10114# Federal Aviation Administration, Washington, D.C. Systems Maintenance Service.
REPORT ON SYSTEMS MAINTENANCE PROGRAM EVALUATION CONDUCTED IN THE EASTERN REGION, 22 JULY–15 AUGUST 1969
Oct. 1969 42 p ref
Avail: NTIS

Significant strengths and weaknesses identified in the SMS evaluation of the Eastern Region maintenance program are summarized. Findings are based on visits to sectors and Airway Facilities Branches (AFB) in the Region's four areas (Washington, Cleveland, Boston and New York), to the Airway Facilities Division (AFD) and other regional headquarters elements, and on study of pertinent documents. It is concluded that budgetary limitations and other factors have affected SM program management and execution. Author

N71-10115# National Transportation Safety Board, Washington, D.C.
SYSTEMS APPROACH TO ACCIDENT INVESTIGATION
C. O. Miller [1969] 22 p refs Presented at Flight Safety Found. Ann. Seminar, Montreux, Switz., 28 Oct. 1969
Avail: NTIS

The complex aerospace world has generated a systems management methodology to efficiently and effectively achieve stated objectives in accident investigation. The systems approach to accident investigation is discussed, wherein the resultant process is referred to as accident inquiry management. Author

N71-10116# Department of Transportation, Washington, D.C.
TRAVELER SERVICE STUDY
Jul. 1970 334 p Prepared by Golightly and Co. Intern., Inc.
(PB-193300) Avail: NTIS CSCL 05B

The principal traveler service problems in domestic intercity air, bus and rail transportation were studied. The specific experiences and problems of the young, the elderly, the poor, the ill, and the handicapped traveler received particular attention. Over 200 passengers were interviewed during June and July, 1970 in terminals located at New York, Chicago and Houston. Interviews were conducted at Pennsylvania Station, Port of New York Authority Bus Terminal, East Side Airlines Terminal and LaGuardia Airport in New York; O'Hare International Airport in Chicago; and the international airport and private bus terminals in Houston. Travelers aid, law enforcement officials, and carrier personnel at these terminals were also interviewed. The approximate distribution by mode of the passenger interviews was: air - 57 percent; bus - 28 percent; and rail - 15 percent. Copies of the questionnaires used for passenger interviews are appended. Author

N71-10118# France. Direction de la Meteorologie Nationale, Paris.
OBSERVATION AND MEASUREMENT OF GROUND VISIBILITY. AUTOMATIC CALCULATION OF THE VISUAL RANGE OF AIRPORT RUNWAYS [OBSERVATION ET MESURE DES VISIBILITES AU SOL. CALCUL AUTOMATIQUE DE LA PORTEE VISUELLE DE PISTE SUR LES AERODROMES]
C. Perrin de Brichambaut and A. Bettan Aug. 1970 57 p refs In FRENCH *Its* Monographie No. 76
Avail: NTIS

CONTENTS:
1. OBSERVATION AND MEASUREMENT OF GROUND VISIBILITY C. P. de Brichambaut p 1-29

2. AUTOMATIC CALCULATION OF THE VISUAL RANGE OF AIRPORT RUNWAYS A. Bettan p 31-51 refs

N71-10120# France. Direction de la Meteorologie Nationale, Paris.
AUTOMATIC CALCULATION OF THE VISUAL RANGE OF AIRPORT RUNWAYS [CALCUL AUTOMATIQUE DE LA PORTEE VISUELLE DE PISTE SUR AERODROME]
A. Bettan *In its* Observation and Meas. of Ground Visibility Aug. 1970 p 31-51 refs In FRENCH
Avail: NTIS

An operational system to measure, compute, and supply runway visual range data automatically is discussed. Data are taken for luminance, atmospheric transmission and diffusion, and visibility range of the running track. The stability and performance of the system are also discussed. Transl. by E.H.W.

N71-10122# Naval Postgraduate School, Monterey, Calif.
COMPUTERIZED AERODYNAMIC OPTIMIZATION OF AIRCRAFT PROPELLERS
Robert Linford Shaw (M.S Thesis) Jun 1970 102 p refs
(AD-710356) Avail: NTIS CSCL 1/3

The objective of the thesis was to develop a practical computer system for use of empirical data in the aerodynamic optimization of aircraft propellers. The system was designed for use with the IBM 2741 on-line computer terminal. This program provides instructions to the operator during execution, and allows interaction by the operator for input and alteration of data, and for program instructions. The Lockheed P-3C aircraft was chosen as the subject for test and evaluation of the program. The currently operational propeller of this aircraft was tested to compare the programs prediction of aircraft performance against flight test information. An attempt was then made to select a propeller which could provide better performance under the same constraints as those imposed in design of the operational propeller. Author (TAB)

N71-10126# Royal Radar Establishment, Malvern (England).
RRE NEWSLETTER AND RESEARCH REVIEW, NO. 8
1969 151 p refs
Copyright. Avail: NTIS

Newsletters are presented on research in electronics, solid state devices, microwave equipment, electro-optics, magnetic fields, semiconductors, integrated circuits, and their applications.

N71-10163# Royal Radar Establishment, Malvern (England).
A TRAFFIC SAMPLE FOR AIR TRAFFIC CONTROL MODEL EVALUATION
R. W. Gregory *In its* RRE Newsletter and Res. Rev., No. 8 1969 4 p
Copyright. Avail: NTIS

Computer models are becoming increasingly important as a means of testing new ATC techniques. This traffic sample was generated as an input to such models; for the traffic situation in the London terminal area during the peak summer periods of the 1980s. The sample relates only to movements at Heathrow, Gatwick, and a third London Airport. It takes no account of minor airport traffic, but it does include traffic overflying London. It is based on the following assumptions: (1) All three airports are omni-directional. (2) Heathrow and the third London Airport each have a maximum sustainable movement rate of 70 per hour, while Gatwick's maximum sustainable rate is 45 per hour. (3) All three airports are subject to noise restrictions and, as a result, these rates can only be maintained between the hours 0700 to 2300. (4) SSTs operating in the London area have a performance similar to subsonic jets. Author

N71-10164# Royal Radar Establishment, Malvern (England).
A PROPOSAL FOR PRIMARY RADAR AUTOMATIC TRACKING IN TERMINAL AREAS
T. Buckley *In its* RRE Newsletter and Res. Rev., No. 8 1969 3 p refs
Copyright. Avail: NTIS

With the ever-increasing density of civil air traffic in terminal areas such as that of London, there is a case to be made, on grounds of both the safety and capacity of the air traffic control system, for a three-dimensional radar system. Such a system must be capable of automatically and accurately tracking all the aircraft in a terminal area. One proposal for such a system is outlined and the more obvious advantages are highlighted. Author

N71-10167# Federal Aviation Administration, Washington, D.C.
DATA FILE EDITING AND PRELIMINARY ANALYSIS. CLEVELAND-HOPKINS AIRPORT ACCESS STUDY
May 1970 179 p
Avail: NTIS

A survey is presented on types of transportation used to reach the Cleveland Hopkins Airport before and after the construction of direct rapid rail transit service. The factors influencing the demand for rapid rail transit to airports were determined. J.A.M.

N71-10170# Federal Aviation Administration, Washington, D.C.
THE DEMAND FOR USE OF WASHINGTON NATIONAL AIRPORT
Joseph V. Yance Jan. 1970 82 p refs
Avail: NTIS

The air carrier demand for use of Washington National Airport (DCA) is studied (based on a CAB survey of flights) at the Washington-Baltimore area airports to determine the feasibility of a pricing system for landing and takeoff slots to reduce the congestion at DCA. The two components of passenger traffic: enplanements (and deplanements) at area airports, and through traffic are analyzed. It is concluded that a pricing policy would result in economic benefits to the airport, community, and the passengers. F.O.S.

N71-10171# Department of Transportation, Washington, D.C.
FIRST FEDERAL AIRCRAFT NOISE ABATEMENT PLAN, FY 1969 – 1970
Nov. 1969 79 p refs
Avail: NTIS

The reduction of aircraft noise is studied for achieving compatibility between airports and the adjacent metropolitan environs. The sonic boom phenomenon and the effects of meteorological conditions on the magnitude are described. The government and nongovernment research and development programs are presented with the emphasis of the noise reduction studies on airplane and engine design, flight procedures, and reducing the impact of the noise on communities. F.O.S.

N71-10183# Air Force Academy, Colo. Frank J. Seiler Research Lab.
DETERMINATION OF REALISTIC PERFORMANCE TRADE-OFFS IN THE AIR-TO-AIR ROLE Final Report
Roger W. Gallington and David Finkleman Jul. 1970 15 p refs Presented at AIAA 2nd Aircraft Design and Operations Meeting, Los Angeles, 20 – 22 Jul. 1970 *Its* AIAA Paper No. 70-930
(AD-710497; SRL-69-0007) Avail: NTIS CSCL 15/7

Recent air superiority fighter studies have failed to include systematically the trade-offs between ordnance and aircraft capabilities. Compromises among performance demands must be studied along with the capabilities of current technology in order to arrive at the most effective weapons system within the state-of-the-art. The investigation described has led to the formulation of a realistic design philosophy which allows analysis of the interrelated demands upon armament, detection capability, thrust, speed, and load factor. Author (TAB)

N71-10184# Naval Postgraduate School, Monterey, Calif.
A PILOT EVALUATION OF MOVABLE AND RIGID AIRCRAFT CONTROLS
James Daniel Cole (M.S. Thesis) Jun. 1970 82 p refs
(AD-709934) Avail: NTIS CSCL 1/3

A simulator facility employing a two-axis compensatory tracking task with a random-appearing signal was used to evaluate the performance of fifty-five pilot and non-pilot test subjects using four separate control sticks--two movable and two rigid. Pilot acceptance of the rigid cockpit controllers was determined by comparing individual pilot ratings of the sticks. Author (TAB)

N71-10240*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ON THE RELATIONSHIP BETWEEN SMALL-SCALE WIND SHEARS AND WIND PROFILE POWER SPECTRA
George H. Fichtl 27 Oct. 1970 32 p refs
(NASA-TM-X-64562) Avail: NTIS CSCL 04B

Rawinsonde wind profile data provide accurate wind shear information for intervals Delta z > or = to 1 km. To specify wind shears for Delta z < 1 km for space vehicle design, detailed wind profile information like that provided by the FPS-16 radar/Jimsphere system or an extrapolation procedure is required. It is assumed that any realization from an ensemble of wind profiles can be represented in terms of a Fourier integral. This permits the calculation of the ensemble standard deviation and mean of the corresponding shear ensemble for any altitude and shear interval Delta z in terms of the power spectrum of the ensemble of wind profiles. To calculate how the mean and standard deviations depend on Delta z, it is assumed that (1) the wind profile power spectrum behaves like k to the minus 2.4 power at sufficiently large values of the vertical wave number k, (2) the vertical variation of the power spectrum can be neglected locally in the calculations of the ensemble mean and standard deviations of the wind shear, and (3) the probability distribution function of the standardized shear variate is invariant with Delta z. The results of these calculations show that the mean and standard deviations of the shear ensemble, as well as the shear for any percentile, asymptotically behave like (delta z) to the 0.7th power. This result is in excellent agreement with shear data from Cape Kennedy, Florida. Author

N71-10247# Colorado State Univ., Fort Collins.
TRANSPORTATION RESEARCH NEEDS RELATED TO CIVIL ENGINEERING
Robert F. Baker Jun. 1970 288 p refs Prepared in cooperation with Am. Soc. of Civil Engr.
(PB-193388; CER69-70C WT41) Avail: NTIS CSCL 15E

The civil engineering research needs in the field of transportation are reported. A program is drawn looking to the future needs of the profession for the type of engineering information, data, and findings best developed through purposeful research. The present and immediate future needs for research in the civil engineering aspects of transportation are discussed. Needed research in associated fields is indicated but not detailed. Transportation is considered as a system made up of a grouping of parts, or sub-systems, of social and economic programs. The role of transportation in society, and the interest that the civil engineer has in transportation are established. A program of research is presented in considerable detail with estimates of the level of funding considered to be necessary if the profession is to improve and enlarge its capabilities to meet the future needs for transportation of the society. Many subjects, such as, soil mechanics and foundations, structures, and environmental considerations, which are vital to overall development of a transportation system were treated lightly. Author

N71-10249# Technion-Israel Inst. of Tech., Haifa.
INVESTIGATION OF HEAT TRANSFER IN BASE TYPE SUPERSONIC LAMINAR AND TRANSITIONAL SEPARATED FLOWS
Josef Rom, Arnan Seginer, and Michael Green Apr. 1970 48 p refs
(Contract F61052-70-C-0005)
(AD-710347; TAE-111; ARL-70-0142; SR-1) CSCL 20/4

Heat transfer rate distributions were measured in the separated regions of a two-dimensional backward facing step, an axially symmetric backward facing step, a blunt two-dimensional base, a sharp protruding two-dimensional leading edge and in the leading edge bubble over the surface of a flat nosed two-dimensional model. The results of these measurements are compared with measurements of heat transfer rates in various base type separated flows obtained in various wind tunnels and to a calculation of heat transfer behind a backward facing step based on the integral method. In most of these investigations a high peak in the heat

transfer rate is found to occur in the reattachment zone. Maximum heat transfer rate values of up to 10 times the flat plate heat transfer rate are reported in various investigations. An inverse relation between the value of the peak heat transfer rate and the distance between the separation point to the position of the maximum heating in the reattachment zone is shown to exist. Author (TAB)

N71-10273# Royal Aircraft Establishment, Farnborough (England).
CUMULATIVE FREQUENCY DISTRIBUTIONS OF AIRCRAFT LANDING GEAR LOADS [ZUR AUFSTELLUNG VON LASTKOLLEKTIVEN FUER FLUGZEUGFAHRWERKE]
O. Buxbaum et al Jun. 1970 27 p refs Transl. into ENGLISH from Luftfahrttech.-Raumfahrttech. (West Germany), v. 15, no. 11, 1969 p 269 - 274
(RAE-LIB-Trans-1462) Avail: NTIS CSCL 20K

The increased damage to modern aircraft landing gears caused by frequently repeated loading necessitates detailed analyses of the fatigue strength of landing gears similar to those carried out on aircraft wings. A provisional working foundation is presented for the collection of all available load spectra whether based on theoretical or experimental information. The proposals offered combine the present state of knowledge with some recent measurements and extend the ground covered by current theories. Load cases which are critical from the fatigue viewpoint are summarized and emphasis is placed on defining those data which determine the cumulative frequency distributions of undercarriage loads. D.L.G.

N71-10276*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF NOZZLE LATERAL SPACING ON AFTERBODY DRAG AND PERFORMANCE OF TWIN-JET AFTERBODY MODELS WITH CONVERGENT NOZZLES AT MACH NUMBERS UP TO 2.2
Donald L. Maiden and Jack F. Runckel Washington Oct. 1970 142 p refs
(NASA-TM-X-2099; L-7192) Avail: NTIS CSCL 21H

Twin-jet afterbody models were investigated by using two balances to separately measure the thrust minus afterbody drag and the afterbody drag at static conditions and at Mach numbers up to 2.2 for a constant angle of attack of 0 deg. Hinged-flap convergent nozzles were tested at dry- and afterburner-power settings with a high-pressure air system used to simulate jet-total-pressure ratios up to 21.0. Equal nondimensional area distributions were maintained as the nozzle lateral spacing was varied. In addition to the lateral-spacing study, afterbodies with recessed blunt bases were investigated, and the effects of exposing primary nozzle flaps to free-stream flow were examined. The results indicate an increase in afterbody axial-force (drag) coefficient with increased lateral spacing for the shrouded and unshrouded configurations for subsonic and supersonic Mach numbers, with the exception of the shrouded dry-power nozzle configurations at subsonic Mach numbers (for which the trend was opposite). Author

N71-10279# Aerospace Corp., El Segundo, Calif. Air Transportation Program.
WESTERN REGION SHORT HAUL AIR TRANSPORTATION PROGRAM. VOLUME 1: DEMONSTRATION PROGRAM PLAN Definition Phase Report, Jul. 1970
E. R. Hinz Jul. 1970 132 p Sponsored in part by the Western Conf. of the Council of State Govt
(ATR-71-(7190)-1-Vol-1) Avail: NTIS

The representative demonstration opportunities and requirements in the Western Region are described. Funding and management requirements to implement the program, study requirements associated with the implementation of specific demonstration activities, and the regulatory issues associated with the conduct of air transportation demonstrations are discussed. The technology bases and systems analyses are also included. Author

N71-10280# Aerospace Corp., El Segundo, Calif. Air Transportation Program.
WESTERN REGION SHORT HAUL AIR TRANSPORTATION PROGRAM. VOLUME 2: TECHNICAL REPORT Definition Phase Report, Jul. 1970
Jul. 1970 296 p refs Sponsored in part by the Western Conf. of the Council of State Govt.
(ATR-71-(7190)-1-Vol-2) Avail: NTIS

The technical and analytical base studies are discussed. The current state of the art and anticipated advances in aircraft, avionics, and ground systems are assessed, primarily from the standpoint of identifying available hardware appropriate for near-term demonstration applications. Advanced hardware concepts for the late 1970-1980 period and periodic addition of improved hardware are considered. Tradeoff analyses, competitive travel modes, equipment choices, and system operating economics are discussed. New analytical techniques were developed to assist in determining the potential viability of demonstration programs; notable is the transportation modal split program for determining traveler choice among competing modes of transport. Author

N71-10283*# Bell Aerospace Co., Buffalo, N.Y.
FINAL FLIGHT CONTROL SOFTWARE PACKAGE FOR DIGITAL FLIGHT CONTROL AND LANDING SYSTEM
May 1970 36 p
(Contract NAS12-2074)
(NASA-CR-110905; Rept-6200-933011) Avail: NTIS CSCL 09B

The software required to mechanize the flight control system on an airborne computer is described. The majority of the description is presented in the form of detailed engineering equations and functional block diagrams and only those functions that are peculiar to the digital nature of the system are presented in the form of digital flow diagrams and logic equations. Author

N71-10284*# Bell Aerospace Co., Buffalo, N.Y.
FINAL GUIDANCE SOFTWARE PACKAGE FOR DIGITAL FLIGHT CONTROL AND LANDING SYSTEM
May 1970 32 p
(Contract NAS12-2074)
(NASA-CR-111025; Rept-6200-933012) Avail: NTIS CSCL 09B

The software required to mechanize the guidance system on an airborne digital computer is described. The majority of the description is presented in the form of detailed engineering equations and functional block diagrams and only those functions that are peculiar to the digital nature of the system are presented in the form of digital flow diagrams and logic equations. Author

N71-10287# General Accounting Office, Washington, D.C.
IMPROVEMENTS NEEDED IN THE MANAGEMENT OF AIRCRAFT MODIFICATIONS. DEPARTMENT OF THE ARMY (B-157373) Comptroller General's Report to the Congress
Elmer B. Staats 14 Jan. 1970 26 p ref
Avail: Issuing Activity

The procedures used in the aircraft modification program, and pertinent maintenance and aircraft log records were reviewed.

It was found that modifications in many cases are not applied promptly, the volume of modification results in work loads beyond the capacity of maintenance activities, modification kits are apparently lost by local using units, and kits in some instances are not received in time for economical installation during overhaul of aircraft. It is recommended that delays be specifically justified, adequate controls be established to ensure proper approval procedures, management of aircraft modification be given immediate attention by the Army, and management controls be improved. N.E.N.

N71-10294# Bell Aerospace Co., Buffalo, N.Y.
SYSTEMS PERFORMANCE/DESIGN REQUIREMENTS SPECIFICATION FOR THE CH-46C HELICOPTER DIGITAL FLIGHT CONTROL AND LANDING SYSTEM
Apr. 1970 96 p refs
(Contract NAS12-2074)
(NASA-CR-110889; Rept-6200-933033) Avail: NTIS CSCL 01C

The performance, design, development, and test requirements for an experimental digital flight control and landing system (DFCLS) for the CH-46C helicopter were established. The DFCLS was used to demonstrate and evaluate flight control concepts under closely monitored flight test conditions and was not intended to be an operational system. Author

N71-10297*# Bell Aerospace Co., Buffalo, N.Y.
DIGITAL FLIGHT CONTROL AND LANDING SYSTEM FOR THE CH-46C HELICOPTER Final Report
William Cockayne, Walter Rusnak, and Lionel Shub May 1970 135 p
(Contract NAS 12-2074)
(NASA-CR-111024; Rept-6200-933013) Avail: NTIS CSCL 01C

A set of control laws were defined for a digital approach and landing flight control subsystem. The flight control subsystem includes six manual modes with varying degrees of pilot assistance and a fully automatic mode. Guidance laws suitable for flight demonstration of the flight control system in an approach and landing under minimal visibility conditions were formulated. A real time simulation using a piloted cockpit was developed. The flight control and guidance laws were mechanized on an IBM 7090 computer in a manner similar to that in which they could be mechanized on an airborne computer. Performance criteria were established and automatic and pilot runs were made. A guidance and control configuration was established. Subsystem requirements and interfaces were defined to the device level. A system signal flow diagram was developed. Author

N71-10299# Peat, Marwick, Livingston and Co., Washington, D.C.
NATIONAL INTERCITY TRAVEL: DEVELOPMENT AND IMPLEMENT OF A DEMAND FOR FORECASTING FRAMEWORK Final Report
Raymond H. Ellis and Paul R. Rassam Mar. 1970 149 p
Sponsored by Dept. of Transportation
(PB-192455) Avail: NTIS

The development and application of a prototype methodolgy for predicting national passenger travel demands are described. It specifically takes account of competition among four modes: air, rail, bus, and auto. Forecasts are prepared for the years 1975, 1980, and 1990. Author

N71-10328# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
APPLICATION OF DIFFERENTIAL GAME THEORY TO PURSUIT-EVASION PROBLEMS OF TWO AIRCRAFT
William L. Othling, Jr. (Ph.D. Thesis) Jun. 1970 118 p refs
(AD-711055; DS/MC/67-1) Avail: NTIS CSCL 12/2

The pursuit-evasion aspect of the two aircraft combat problem is introduced as a fixed time, zero sum, perfect information differential game. A realistic aircraft model is presented for which a solution of this combat problem is desired. Because of the non-linear dynamics associated with this model, an optimal closed-loop solution cannot be obtained. Three additional simplified aircraft models are introduced as approximations to the realistic model. Optimal solutions and closed-loop control laws are obtained for each of these models. Analysis of these solutions and control laws enables the formulation of an approximate closed-loop control law for use with the original realistic model. Author (TAB)

N71-10339# Advisory Group for Aerospace Research and Development, Paris (France).
BIBLIOGRAPHY OF DOCUMENTS CONTAINING NUMERICAL DATA ON PLANAR LIFTING SURFACES
R. Dat Aug. 1970 63 p refs
(AGARD-R-574-70) Avail: NTIS

The material presented covers the years 1951 to 1968, in chronological order, and lists documents that are unsuited to systematic classification but which nevertheless make a considerable contribution to the literature on unsteady aerodynamic forces. Emphasis is placed on experimental results and on comparisons between theory and experiment. Program descriptions, which may be useful as guides, are presented and abstracts include the nature of the results and their importance. Captions indicate the speed range, whether the results are theoretical or experimental, whether control surfaces are considered, and whether pressure distributions are given. Consideration is limited to planar surfaces and to calculations resulting from the general formulation of the problem. Author

N71-10347# Federal Aviation Administration, Washington, D.C.
THE THEORY OF AIR CARRIER DEMAND FOR SLOTS
Joseph V. Yance Jan. 1970 35 p refs
(PB-193350) Avail: NTIS

A study directed at exploring the possible use of airport pricing in achieving optimal utilization of airports, particularly those in the Washington-Baltimore area, is presented. Author

N71-10349# Washington Univ., Seattle.
EVALUATING THE NOISES OF TRANSPORTATION: PROCEEDINGS OF A SYMPOSIUM ON ACCEPTABILITY CRITERIA FOR TRANSPORTATION NOISE
James D. Chalupnik, ed. Apr. 1970 406 p refs Conf. held at Seattle, 26-28 Mar. 1969
(Contract DOT-OS-A9-036)
(PB-191-117; OST-ONA-70-2) Avail: NTIS

Conference papers are presented on noise sources and measurement, and individual and community responses. The major topics covered are aircraft, automobile, and truck noise; noise level measurement, effects, and evaluation; psychophysical studies, hearing damage, background noise effects, factors affecting judgement experiments, and effect of pop group music on hearing; measuring community responses to noise, noise complaints, and community action; predicting community responses, criteria for design and legislation, subjective response to community noise, origin and spread of public reaction to noise, and traffic noise investigation. N.E.N.

N71-10355# Federal Aviation Administration, Washington, D.C. Aviation Policy Div.
SPECIAL STUDY: FAA PROGRAM EFFECTIVENESS AND FACILITY CRITERIA INSTRUMENT LANDING SYSTEMS
Aug. 1970 95 p refs
Avail: NTIS

The problem of determining the extent to which a decision model should be pursued for the purpose of making ILS investment decisions is examined. Alternatives are presented from this viewpoint. The methodology presented for making ILS investment decisions represents the highest degree of sophistication which it is believed feasible to consider. Topics include: a recommendation that individual cost/benefits studies be required to support requests for ILS facilities; a definition of the recommended method for comparing costs and benefits; a definition of the parameters to be used and the methodology for estimating them (safety, time, cancellation/diversions, and all other benefits); and an examination of the analytical bases used in selecting parameters and methods. Author

N71-10356# National Aviation Facilities Experimental Center, Atlantic City, N.J.
A HISTORY OF THE NATIONAL AVIATION FACILITIES CENTER, 1958 1970
Aug. 1970 102 p ref
Avail: NTIS

A narative account is given of the center's organization and reorganizations, resources, employee/management cooperation, and technology. The latter includes air traffic control, all weather radar, communication, aircraft safety, bird hazards, fire fighting, and human factors engineering. Activities of individual divisions are also considered. N.E.N.

N71-10360# Federal Aviation Administration, Washington, D.C.
AIR PASSENGER SURVEY, SELECTED TABULATIONS. CLEVELAND-HOPKINS AIRPORT ACCESS STUDY
Jun. 1970 263 p ref
Avail: NTIS

Results are presented from a survey of airport users at the Cleveland Hopkins Airport before and after the opening of the Cleveland Transit System (CTS) rail transit service to the airport. Three origin and destination surveys were conducted to obtain information on both the trip to and from the airport and the trip maker for four groups of airport users. The user groups included air travelers originating or terminating trips at Hopkins, air traveler related visitors (meeting or sending off passengers), casual visitors (sightseeing, on business, buying tickets, or restaurant patrons), and employees. The number and percent of trips by mode and passenger residence, travel purpose, or land use at the local origin or destination of the trip are tabulated at district, cordon area, and census tract levels. The age, sex, income, purpose, duration of trip, land use at the origin or destination, and the means of access to or from the rapid transit system are shown by CTS station, passenger residence, and direction of travel. Maps of the CTS stations, districts, and census tracts are appended. J.M.

N71-10366# Federal Aviation Administration, Washington, D.C. Air Traffic Service
TERMINAL AREA AIRLINES DELAY DATA, 1964 1969
Augusta Galbreath and Richard M. Warfield Sep. 1970 64 p refs
Avail: NTIS

Data are compiled on delays and cost of delays in terminal areas served by three airlines. The statistical data provide an indication of system effectiveness in the terminal environment. Basic data consist of the number of delays, minutes of delay, and cost of delay attributed to ATC, airport, and other causes during departure and arrival operations in terminal area. Delay costs are calculated by the reporting airlines and primarily represent direct operating costs. Author

N71-10370# Regional Planning Commission, Cleveland, Ohio.
SURVEY RESULTS: CLEVELAND HOPKINS AIRPORT ACCESS STUDY
Jun. 1970 187 p Sponsored by the Dept. of Transportation
Avail: NTIS

A statistical analysis was made of the mode of transportation to and from the airport before and after a direct rail rapid transit service was provided from the central business district to the airport. Among the findings are the following: 57.6% of the rapid transit riders are air passengers; 14.5% of the air passengers ride the rapid transit, including more than 25% of passengers with origin or destination in the transit service area; the use of private cars, taxis, and limousines decreased and the use of rented cars and courtesy vehicles increased; 4% of passenger-related visitors use the rapid transit; 8.4% of the airport employees rode a public bus to work prior to the transit opening and 11.2% rode the transit afterwards; and 17% of the riders are casual visitors. N.E.N.

N71-10371# Regional Planning Commission, Cleveland, Ohio.
DATA FILE FORMATS AND CODE DESCRIPTIONS: CLEVELAND HOPKINS AIRPORT ACCESS STUDY
Jun. 1970 94 p Sponsored by Dept. of Transportation
Avail: NTIS

The file formats and code descriptions are presented for the analysis of transportation to and from the airport before and after a direct rail rapid transit was provided from the central business district. Air passenger, airport employee, and casual visitor survey forms, and parking lot and rapid transit interview sheets are included. N.E.N.

N71-10372# Federal Aviation Administration, Washington, D.C.
FAA STATISTICAL HANDBOOK OF AVIATION
1969 287 p
Avail: SOD $2.75; NTIS

Data are presented on major civil aviation activities for the 11-year period ending 31 December 1969. The FAA, National Airspace System, civil and general aviation, airmen, aeronautical production, and accidents are covered. N.E.N.

N71-10386# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE RESPONSE OF, AND THE ACOUSTIC RADIATION FROM PANELS EXCITED BY TURBULENT BOUNDARY LAYERS Technical Report, 1 Dec. 1966 30 Nov. 1968
Edmond Szechenyi Wright-Patterson AFB, Ohio AFFDL Jun. 1970 186 p refs
(Contract F61052-67-C-0009)
(AD-710696; AFFDL-TR-70-94) Avail: NTIS CSCL 1/3

The principal aim of the work is to develop approximate solutions for both the response of skin-stringer panels to turbulent boundary layer excitation and the subsequently acoustic radiation from these structures. As a first step, the solution for the response of single simply supported panels is extended to include panels with clamped edges. Using this as the basic theory, solutions for the response of rows and arrays of skin-stringer panels are found by applying a method of effective or pseudo wavelengths. Equations for the radiation characteristics of single panels both with fixed and with simply supported edges are established from basic principles.

These solutions are then used to find the radiation from arrays of bays by introducing a qualitatively derived system of relative bay phases. The combination of the radiation characteristics and of the response gives acoustic power radiation due to turbulent boundary layer excitation. This shows an interesting result which is probably particular to this form of excitation, that is, that for most practical configurations the acoustic power radiated by an array of bays does not exceed the arithmetic sum of the powers radiated separately by each bay. Author (TAB)

N71-10390# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin, 1 Jan. - 31 Mar. 1970
31 Mar. 1970 85 p refs
(AD-710638; DME/NAE-1970(1)) Avail: NTIS CSCL 6/18

Contents: Assessment of the radiation hazards of supersonic transport; Comprehensive tidal study of the St. Lawrence River; Current projects of the Division of Mechanical Engineering and the National Aeronautical Establishment. TAB

N71-10391*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENT AND ANALYSIS OF LIGHTNING INDUCED VOLTAGES IN AIRCRAFT ELECTRICAL SYSTEMS
Paul T. Hacker and J. A. Plumer (GE, Pittsfield, Mass.) [1970] 28 p refs to be presented at the 1970 Lightning and Static Electricity Conf., San Diego, 9-11 Dec. 1970
(NASA-TM-X-52906) Avail: NTIS CSCL 01C

A series of measurements were made of voltages induced in electrical circuits within a metallic aircraft wing by full-scale simulated lightning currents flowing through its skin and structure. The measured data were mathematically analyzed to enable determination of voltages across load impedances to which the circuits might be connected elsewhere in the aircraft. Relationships between induced voltages and lightning current, wing structural, and circuit parameters were determined. Induced voltages of magnitudes likely to cause damage or interference with avionics were measured. Author

N71-10394# National Aviation Facilities Experimental Center, Atlantic City, N.J.
STUDY OF THE PERFORMANCE CHARACTERISTICS OF THE BENDIX TYPE DRA-12 AIRBORNE DOPPLER RADAR SYSTEM Final Report, Feb. - Oct. 1970
Robert H. Mayer Nov. 1970 20 p refs
(FAA-NA-70-50; FAA-RD-70-73) Avail: NTIS

A study of the performance characteristics of the Bendix Radio type DRA-12 Doppler navigation system and the General Electric miniature heading and attitude system type A/A24G-26, for the purpose of determining the expected navigation error when flying straight and level, and the expected error as a result of making a standard rate turn at a speed of 200 knots, is reported. A profile of the error, while in straight and level flight, is presented to which each 180 deg turn error of 184 feet should be added in quadrature to obtain the expected error at any discrete distance from the Doppler reference point. The results of this study are considered useful in determining the extent to which Doppler navigation can be applied to the Sabreliner aircraft flight inspection mission. Author

N71-10407# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
HOLOGRAPHIC INTERFEROMETRY FOR THE STUDY OF TRANSPARENT MEDIA [INTERFEROMETRIE HOLOGRAPHIQUE POUR L'ETUDE DES MILIEUX TRANSPARENTS]
Jean Surget 1970 5 p refs In FRENCH Presented at the Intern. Symp. on Appl. of Holography, Besancon, France, 6 - 11 Jul. 1970
(TP-851) Avail: NTIS

A quantitative study of aerodynamic phenomena by holographic interferometry is presented. A comparison of obtained results to the one proven by employment of conventional interferometry reveals perfect agreement in the dispersion boundary measurements of the same order of size for the two methods. Transl. by E.H.W.

N71-10411*# National Aeronautics and Space Administration.
FORTRAN PROGRAM FOR COMPUTING COORDINATES OF CIRCULAR ARC SINGLE AND TANDEM TURBOMACHINERY BLADE SECTIONS ON A PLANE
William D. McNally and James E. Crouse Washington Nov. 1970 48 p refs
(NASA-TN-D-6020) Avail: NTIS CSCL 21E

A FORTRAN 4 program is presented which computes and plots coordinates for circular arc blade sections on a plane. Either single blade sections or tandem blade sections with up to 5 segments can be designed. Surfaces of blade segments consist of single circular arcs. The arrangement of segments on the plane is a function of the input parameters. These parameters are overall blade section quantities such as chord, camber, and solidity, as well as individual blade segment parameters such as chord, camber, gap between blade segments, overlap of segments, maximum thickness, and leading- and trailing-edge radii. Author

N71-10417# TRW Systems Group, Redondo Beach, Calif.
HIGH-SPEED JETPORT ACCESS: FEASIBILITY STUDY OF A DEMONSTRATION PROJECT IN SOUTHERN FLORIDA Final Report
Dec. 1969 576 p refs
(Contract C-353-66(Neg))
(PB-192842; FRA-RT-70-38; TRW-06818-6044-R0-00) Avail: NTIS HC $10.00/MF $0.65

The feasibility of a high speed access system as a transportation demonstration project to a new Southern Florida Jetport was determined. Several candidate systems were considered and included vertical-takeoff (VTOL) and short-takeoff (STOL) airborne vehicles, in addition to high speed rail (HSR), monorail systems (MRS), and tracked air cushion vehicles (TACV) ground vehicles. The evaluation of the perspective alternatives was made using technical performance and cost considerations over similar routes connecting a jetport to the main population centers in Southern Florida. Several jetport locations were postulated and considered in the evaluation of the routes and terminal requirements. A Tracked Air Cushion Vehicle (TACV) system capable of a cruise speed of approximately 150 mph is recommended as the initial jetport high speed access system. This system provides economic transportation for the projected airport access demands and for growth to the high speeds desired for future interurban service. A performance description, preliminary implementation plan, and cost estimates are provided for the recommended system from a jetport to Miami. A general description of the expanded network is also presented with data for long-range planning and the development of programs for financing. Author

N71-10434# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
STRESSES AND DEFORMATIONS IN MULTI-PLY AIRCRAFT TIRES SUBJECT TO INFLATION PRESSURE LOADING Technical Report, Aug. 1968 - Dec. 1969
Howell K. Brewer Jun. 1970 209 p refs

(AD-711073; AFFDL-TR-70-62) Avail: NTIS CSCL 1/3

The pneumatic tire casing is treated as a laminated, anisotropic, toroidal shell of revolution possessing bending rigidity. The plies are considered to be homogeneous orthotropic laminae on a macroscopic scale, which are constructed of elastic textile cords embedded in an elastic rubber matrix. Modern micro-mechanics theory, which is based on the self-consistent model of composite materials, is used to calculate the four basic elastic moduli of a single lamina. The tire shell is considered to deform according to the classical Love hypothesis. The equilibrium, strain-displacement, and laminate constitutive equations governing the tire shell are reduced to a system of six first order ordinary differential equations with variable coefficients. A multi-segment, forward integration technique is used which first transforms the two point boundary value problem into an equivalent set of initial value problems which can then be integrated numerically with a fourth order Runge-Kutta routine. The finite displacements are taken into account by an incrementing process which builds up the total solution as sequence of linearized solutions. The theory and solution technique is illustrated by means of a numerical example. The tire chosen for this purpose is a 32 x 8.8 Type VII aircraft tire. A complete set of numerical data is presented. The calculations were verified experimentally by measuring tire strains and the inflated tire meridian profile. The agreement between theory and experiment is good.
Author (TAB)

N71-10440# Regional Planning Commission, Cleveland, Ohio.
SURVEY PROCEDURES: CLEVELAND HOPKINS AIRPORT ACCESS STUDY
May 1970 123 p Sponsored by Dept. of Transportation
Avail: NTIS

The impact of the rapid rail extension from the central business district of Cleveland to the Hopkins airport was studied. The survey of the airport users was conducted in the following phases: (1) Data collection and processing prior to the opening of the rapid rail transit link to the airport. (2) Data collection and processing after the opening of the rapid rail transit link to the airport. Questionnaire design, and survey procedures are given. The results of the study are to be used to develop a model that can help assess the feasibility of rapid transit rail service to airports in other cities.
F.O.S.

N71-10461# *University of Southern Calif., Los Angeles. Dept.* of Aerospace Engineering.
MEASUREMENTS OF THE HYPERSONIC, RAREFIED FLOW FIELD OF A DISK
Stewart Berlin Jan. 1970 36 p refs
(Grant AF-AFOSR-0697-67)
(AD-710641; USCAE-115; AFOSR-70-0194TR) Avail: NTIS CSCL 20/4

The flow density and temperature about a disk normal to a hypersonic, rarefied stream were measured. The tests were conducted in nozzle-produced flow fields of dry nitrogen. The electron beam fluorescence technique (EBT) was utilized to determine local fluid density and rotational temperature. In addition, impact pressure surveys were made in the wake and photographs of the flow field were obtained by traversing the electron beam with the camera shutter held open. Two higher Mach number centerline density and temperature profiles show qualitative agreement with free-molecular and first collision theoretical estimates. In general, the axial and lateral extents of the disk flow field are much greater than in continuum flow over the same geometry. The rotational temperature data indicates that essentially full temperature recovery is achieved near the forward stagnation point. The maximum shock layer densities, however, are somewhat below the Rankine-Hugoniot values for the given free stream Mach numbers due to the finite width of the electron beam and the thickening effect on the shock of the degree of gas rarefaction.
Author (TAB)

N71-10467*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN PROGRAM FOR CALCULATING AERODYNAMIC FORCES FROM PRESSURE OR VELOCITY DISTRIBUTIONS ON BLADE SECTIONS
William D. McNally Washington Nov. 1970 38 p refs
(NASA-TM-X-2123; E-5652) Avail: NTIS CSCL 01A

A FORTRAN 4 program is presented which calculates aerodynamic forces on turbomachinery blade sections from distributions of pressure or velocity along the surfaces. Blade sections for which forces are calculated may have either one blade segment or two segments (tandem blades). Input includes blade surface coordinates, surface distributions of pressure or velocity, and several overall flow parameters. Surface angles may also be given as input, or may be computed by the program from spline curves. The program integrates pressure or velocity distributions to obtain components of force on the blade surfaces. Meridional and tangential forces and lift and drag forces are then computed. For tandem blade sections, ratios of forces on rear blade segments to forces on front blade segments are also given. The program is particularly useful in conjunction with existing ideal flow programs which allow the analytical study of blading.
Author

N71-10470# Air Vehicle Corp., San Diego, Calif.
A METHOD FOR CALCULATING HELICOPTER VORTEX PATHS AND WAKE VELOCITIES Final Report, Nov. 1968 Dec. 1969
E. S. Levinsky and T. Strand Jul. 1970 72 p refs
(Contract F33615-69-C-1101)
(AD-710694; AFFDL-TR-69-113) Avail: NTIS CSCL 1/3

A simple method is developed for calculating the time averaged velocity field induced at large distances from the rotor by a helicopter in steady horizontal motion. The influence of the ground plane and of horizontal winds on the rotor wake and velocity field is included.
Author (TAB)

N71-10478# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
DESIGN OF AN INTERMITTENT, SINGLE JACK FLEXIBLE NOZZLE SUPERSONIC WIND-TUNNEL FOR MACH NUMBERS 1.5 TO 4.0
I. Kadushin and J. Rom [1970] 39 p refs
(TAE-86) Avail: NTIS

This report describes the design of a single jack flexible nozzle wind-tunnel having a 400 mm × 500 mm test section and capable of operation between Mach numbers of 1.5 to 4.0. Description of the wind tunnel installation, the pressure air supply and other auxiliary systems of this wind-tunnel are presented. The main design features were tested in one-fifth scale model wind-tunnel. The results of the model tests are in good agreement with the design requirements.
Author

N71-10495*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF A JET TRANSPORT AIRPLANE CONFIGURATION WITH HIGH THRUST-WEIGHT RATIO AND AN EXTERNAL-FLOW JET FLAP
Lysle P. Parlett, Delma C. Freeman, Jr., and Charles C. Smith, Jr. Washington Nov. 1970 75 p refs
(NASA-TN-D-6058, L-7166) Avail: NTIS CSCL 01A

An investigation was conducted in a full-scale tunnel to determine the aerodynamic, stability, and control characteristics of

a jet transport configuration that has a high thrust-weight ratio and is equipped with an external-flow jet flap. The model is powered by four high-bypass-ratio turbofan engines. Maximum lift coefficients of about 8 were measured for test conditions which simulated a jet transport configuration having a thrust-weight ratio of about 0.5. Longitudinal instability was encountered at high thrust coefficients because of adverse downwash variations in the vicinity of the tail. This problem was solved by raising the tail and moving it forward to a more favorable downwash field. The model was laterally and directionally stable under all power conditions. The moments associated with an engine failure were too large to be trimmed out by conventional aileron and rudder control; spoilers alone provided enough control to offset the engine-out rolling moments but the lift loss associated with the use of spoilers was severe. Author

N71-10496# Royal Australian Air Force Academy, Melbourne.
THERMAL COATING OF GONDOLA PAYLOADS
J. A. Thomas [1970] 8 p
(NYO-3747-12) Avail: NTIS

To help maintain equipment temperature in high altitudes to that of the laboratory, the radiative properties of the coatings of gondola payloads are investigated. Flight tests were carried out to determine the actual equilibrium temperatures. Aluminum cans with a variety of coatings were used. The recorded temperatures are in good agreement with the values obtained from radiosonde data. E.H.W.

N71-10531# National Transportation Safety Board, Washington, D.C.
AIR FRANCE BOEING 747-128, F-BPVD SAINT JEAN PQ, CANADA, AUGUST 17, 1970: AIRCRAFT INCIDENT REPORT
7 Oct. 1970 14 p
(NTSB-AAR-70-26) Avail: NTIS

The flight from Chicago to Montreal was normal in every respect. The takeoff from Montreal at 2226 was routine; however, approximately 9 minutes after takoff, at 2235 at an altitude of 5,600 feet m.s.l., a separation of the second-stage turbine disk rim of the No. 3 engine occurred, and pieces penetrated and ruptured the high-pressure turbine case and associated engine cowling. The separation of the turbine disk rim resulted in a localized fire in the upper forward portions of No. 3 engine. A fire warning, which came on simultaneously with the turbine failure, terminated after both containers of fire extinguishing agent were discharged. The No. 3 engine was shut down and the flight diverted to John F. Kennedy International Airport, New York, where it landed safely at 0004 (August 18). There were no injuries to passengers, crew, or persons on the ground. The Board determined that the probable cause of this incident was the in-flight separation of the second-stage turbine disk rim of the No. 3 engine. The separation of the disk rim was the result of incorrect assembly of the high-pressure turbine module. Author

N71-10537*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SIMULATED DOWNSTREAM FLOW BLOCKAGE DOORS ON THE PERFORMANCE OF AN AXIAL-FLOW FAN ROTOR
Walter M. Osborn and Jack M. Wagner Washington Nov. 1970 26 p refs
(NASA-TN-D-6071; E-5215) Avail: NTIS CSCL 21E

Two downstream flow blockages simulating door positions of 20 deg and 45 deg in the bypass air duct of a turbofan engine were tested with an axial flow fan rotor. The rotor performance was stable and repeatable, and both configurations suppressed rotating stall. At the minimum flow points, an increase in inlet temperature in the tip region indicates the existence of an eddy flow. Temperatures remained within operational limits. Reductions in torque and flow rate with the 45 deg blockage ring indicate that a flow blockage device might ease engine starting requirements and might be used to reduce engine thrust while maintaining high engine speed. Author

N71-10546# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
EXPERIMENTAL INVESTIGATION OF THE TRAJECTORIES AND VELOCITIES OF SOLID PARTICLES ENTRAINED BY FLUID FLOWS IN CASCADE NOZZLES
W. Tabakoff and M. Hussein Aug. 1970 31 p refs
(Contract DAHC04-69-C-0016; Proj. Themis)
(AD-711121; THEMIS-AE-70-12; AROD-T-4.18-E) Avail: NTIS CSCL 10/1

The study of the trajectories and velocities of solid particles suspended in a fluid flowing through a cascade nozzle is of importance to the investigation of erosion damage sustained by the blades. In general, the trajectories and velocities of the particles depend upon the slope of the cascade nozzle, particle and flow inlet conditions, particle material density, mean diameter, angle of attack and initial place of collision. The particles are more likely to follow the fluid streamlines when their material density is of the same order of magnitude as that of the fluid and when their mean diameter is small. In the investigation, a cascade row of turbine blades was mounted in a cascade tunnel to produce the desired gas-particle flow. A high speed camera was used to photograph the flow, and the subsequent film analysis provided the data for the particle velocities and the particle paths through the cascade nozzle. The particles used are of mean diameter of 1000 microns. Author (TAB)

N71-10562# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Mechanical Engineering.
RESEARCH ON THE FLUTTER OF AXIAL-TURBOMACHINE BLADING Semiannual Status Report
Fernando Sisto and Ron Ho Ni Jun. 1970 39 p
(Contract N00014-67-A-0202-0016)
(AD-710794; ME-RT-70004; SASR-2) Avail: NTIS CSCL 10/1

Theoretical and experimental phases of a program to study flutter in turbomachinery blading are summarized. The analytical model serves mainly to describe the unstalled, linearized baseline from which the large amplitude, possibly stalled data may be compared. The effect of significant parameters on quasistatic aerodynamic moment is displayed and generalized conclusions are drawn. Author (TAB)

N71-10563# Naval Postgraduate School, Monterey, Calif.
EVALUATION OF THE LONGITUDINAL STATIC STABILITY OF THE US-2A AIRCRAFT
Paul William Cooper, Jr. (M.S. Thesis) Apr. 1970 63 p refs
(AD-710722) Avail: NTIS CSCL 1/3

The aircraft was equipped with a data acquisition system capable of sensing and recording aerodynamic data other than that given by the standard cockpit instruments. Recorded data were displayed graphically and the neutral points for stick-free stability and stick-fixed stability were determined. Stick-free static margin and stick-fixed static margin were determined and evaluated. Author (TAB)

N71-10564# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.

A METHOD FOR DETERMINING A CONCEPTUAL SOLUTION TO ENSURE 301

R. Joseph Milelli, John F. O'Connor Jun. 1970 25 p

(AD-710948; ECOM-3302) Avail: NTIS CSCL 1/3

A requirement (ENSURE 301) exists for a system which will enable a pilot to hover in the CH-54 with reasonable precision (undefined) over a predetermined point for 10 minutes or less in IFR conditions while personnel on the ground attach or remove cargo from a sling load. Several schemes have been proposed by airframe and electronics contractors, including different control systems, displays, and sensors. The Government is required to evaluate the various proposals and the purpose of the paper is to illustrate how using a simulation in the evaluation can suggest a conceptual solution. Author (TAB)

N71-10581# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.

SUBCRITICAL FLOWS OVER TWO DIMENSIONAL AIRFOILS BY A MULTISTRIP METHOD OF INTEGRAL RELATIONS

R. E. Melnik and D. C. Ives Oct. 1970 10 p refs Presented at the 2d Intern. Conf. on Numerical Methods and Fluid Dyn., Berkeley, Calif., 14 Sep. 1970

(RE-393J) Avail: NTIS

The possibility of using Dorodnitsyn's method of integral relations (MIR) to treat this classical nonlinear potential flow problem is considered. The scheme 1 version of the method is employed, in which the strip boundaries are taken more or less parallel to the airfoil surface. This scheme is considered to be best suited for airfoil type problems in which the rapid variations are along the airfoil surface. The chief advantage of MIR is that, because a relatively coarse mesh can be taken across the flow field, useful solutions can be obtained with less computer time than might be required by other methods. This approach offers the possibility of developing an economical calculation scheme for practical airfoil design. Author

N71-10674# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

STUDY OF AIR TAXI ACCIDENTS: A STATISTICAL SUMMARY AND ANALYSIS OF A SPECIAL SEGMENT OF US GENERAL AVIATION, 1964-1968

May 1970 190 p refs

(NTSB-AAS-70-1) Avail: NTIS

This study was compiled from the records of 995 accidents occurring in Air Taxi flying during the 5-year period 1964-68. Collisions between aircraft are treated as one accident. A complete analysis and coding is done on each aircraft involved in collisions. This produces two aircraft accident records, one for each aircraft involved in the collision. Consequently, when compiling information on accidents including collisions between aircraft, the number of accident records will exceed the number of accidents. All analytic tables show both records and accidents. Author

N71-10679# Ballistic Research Labs., Aberdeen Proving Ground, Md. Exterior Ballistics Lab.

COOLING WATER SYSTEM, COMPRESSOR PLANT NO. 1

Ernest P. Reklis Jun. 1970 29 p

(AD-710971; BRL-TN-1735) Avail: NTIS CSCL 14/2

In the operation of the BRL Supersonic Wind Tunnels it is necessary to hold the air temperature at the entrance to the tunnels to a constant given level. This report describes the cooling system used to accomplish this and a few of the problems involved in its operation. Author (TAB)

N71-10681# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

RESTORATION OF LANDING MAT-SURFACED SUBGRADES BY GROUTING METHODS Final Report

Cecil D. Burns and Victor C. Barber Jun. 1970 81 p *Its* Misc. Paper S-70-19

(AD-710962) Avail: NTIS CSCL 13/3

Engineering tests were conducted in order to evaluate the use of portland cement and asphaltic materials as grout for the repair of pumped subgrades under heavy-duty airfield landing mats and to develop equipment and criteria for their application. Author (TAB)

N71-10682# Ohio River Div. Labs., Cincinnati.

DEVELOPMENT STUDY FOR A VFR HELIPORT STANDARD LIGHTING SYSTEM Final Report

T. H. Morrow, Jr. Aug. 1970 136 p refs Sponsored in part by FAA

(AD-710982; CERL-TR-M-3) Avail: NTIS CSCL 1/5

The report describes a four part study directed toward a standard lighting system for heliport under visual flight rule (VFR) conditions. The investigation includes a laboratory model study, a preliminary field layout and two helipad installation tests using actual helicopter flight operations. Results were analyzed by pilot questionnaires and interims. Tentative recommendations for further testing are presented including all particulars of a heliport lighting system. Author (TAB)

N71-10705# School of Aerospace Medicine, Brooks AFB, Tex.

AIRSPEED INFLUENCE ON NOISE WITHIN FIXED- AND ROTARY-WING AIRCRAFT Research Report, Jan. 1966 - Oct. 1969

Donald C. Gasaway Jun. 1970 22 p refs

(AD-711359; SAM-TR-70-27) Avail: NTIS CSCL 20/1

The influence of increased motive power and airspeed on noise levels within 163 fixed- and rotary-wing aircraft is depicted in 9 noise-exposure envelopes. Increased power and airspeed resulted in increments in cockpit noise in all of these aircraft groups. Changes in acoustic spectra and speech interference are illustrated and described. Author (TAB)

N71-10720# National Severe Storms Lab., Norman, Okla.

SEVERE THUNDERSTORM RADAR ECHO MOTION AND RELATED WEATHER EVENTS HAZARDOUS TO AVIATION OPERATIONS

Peter A. Barclay and Kenneth E. Wilk Jun. 1970 68 p refs

(ESSA-TM-ERLTM-NSSL-46) Avail: NTIS

Objective techniques for identifying and tracking individual storms by radar are described, using digital weather radar data with space resolution of approximately 1 n.mi. The minimum time interval between observations required for deriving storm controid velocity is 2 to 3 minutes. The optimum signal threshold for defining storm cores for tracking is 1000 to 10,000 mm(6)m(-3) for

isolated storms and 100 to 1000 mm(6)m(-3) for squall lines. A technique is suggested for the extrapolation of arrival of a thunderstorm core into a control zone of an airport. The degree of confidence in the extrapolated path is measured in terms of timing and distance errors resulting from the variance in storm velocity. Analyses of the wind fields associated with several severe squall lines show narrow zones of high winds that veer sharply with increased speed and contain strong gusts that also increase with mean wind speed. Author

N71-10734# Dayton Univ., Ohio. Research Inst.
PARAMETRIC STUDY OF NATURAL FREQUENCIES OF SKIN-STRINGER STRUCTURE
T. J. McDaniel Wright-Patterson AFB, Ohio AFML Jul. 1970 90 p refs
(Contract F33615-67-C-1187)
(AD-711383; AFML-70-145) Avail: NTIS CSCL 1/3

The results of a parametric study of the natural frequencies of a row of skin-stringer structures are contained in this report. Typical aircraft structures with hat-section, Z-section, or milled stringers were considered. The effect on the natural frequencies of parametric variation of stringer spacing, distance between frames, thickness of the covering skin, and material properties of the structure are tabulated. These results were obtained from a delta-matrix procedure which is developed from a transfer matrix analysis of the skin-stringer structure. Improvements in the transfer matrix analysis of the structure are also developed. Author (TAB)

N71-10735# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ICING OCCURRENCE, CONTROL AND PREVENTION. AN ANNOTATED BIBLIOGRAPHY
Kevin L. Carey Jul. 1970 61 p refs
(AD-711534; CRREL-SR-151) Avail: NTIS CSCL 8/12

Icings present severe problems for highways, railroads, airfields, and structures. Details of icing processes, and past and present practices of icing prevention and control, are given in annotations for 93 of 94 bibliographic entries. The entries were selected from over 200 references examined through March 1968. Of the 94 entries, 51 are from the Soviet Union, 37 from the United States, and 6 from Canada. Fourteen recent Russian papers were translated specifically for this study. Author (TAB)

N71-10737# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIR TRAFFIC CONTROL Quarterly Technical Summary Report, 1 May – 31 Jul. 1970
Herbert G. Weiss 15 Aug. 1970 18 p refs
(Contract AF 19(628)-5167)
(AD-711662; ESD-TR-70-235) Avail: NTIS CSCL 17/7

Efforts were made to evaluate quantitatively the capabilities and limitations of the systems, procedures, and instrumentation utilized for ATC. A new activity is directed toward defining and evaluating the impact that a data-linked cockpit display of Automated Radar Terminal System (ARTS) information could have upon terminal area capacity. Also under study is the application of a laser beam alerting system at Logan International Airport to increase the usefulness of Runway 4R. Author (TAB)

N71-10812# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: THE PITTSON COMPANY AERO COMMANDER 1121, N236JP, RURAL RETREAT, VIRGINIA, 31 OCTOBER 1969
9 Sep. 1970 20 p *Its* File No. 3-4110
(NTSB-AAR-70-22) Avail: NTIS

The Aero Commander 1121 crashed while descending on a radar vector to the final approach course at Tri-City. The crew of two and the one passenger aboard the aircraft were fatally injured. The aircraft made contact with the ground 2,450 feet above sea level while in approximately 60 deg nosedown wings-level attitude. The impact site was about 2 miles northeast of Mountain Empire Airport, Rural Retreat, Virginia. The probable cause of this accident was that, following a malfunction or failure in the 115-volt alternating current electrical system, the crew did not take proper action, resulting in the loss of the pilot's flight instruments in instrument flight conditions and subsequent loss of control. Author

N71-10813# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: MACK TRUCK, INCORPORATED LEAR JET 23A, N1021B, HORLICK-RACINE AIRPORT, RACINE, WISCONSIN, 6 NOVEMBER 1969
9 Sep. 1970 17 p *Its* File No. 3-3766
(NTSB-AAR-70-21) Avail: NTIS

Lear Jet N1021B, crashed into Lake Michigan while executing an instrument approach to Runway 22 at the Horlock-Racine Airport, Racine, Wisconsin. There were seven people aboard the aircraft; the pilot, copilot, and five passengers, none of whom have been found to date. Radar contact was lost shortly after the flight was advised that it was passing a radar fix 3.6 nautical miles northeast of the radio beacon which is located on the southern boundary of the airport. It is determined that the probable cause of this accident was the continued descent below the prescribed approach path profile, for reasons unknown. Author

N71-10814# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT INCIDENT REPORT: BOEING 747, N732PA, RENTON AIRPORT, RENTON, WASHINGTON, 13 DECEMBER 1969
26 Aug. 1970 30 p *Its* File No. 5-0046
(NTSB-AAR-70-19) Avail: NTIS

The probable cause of this incident was the premature touchdown of the aircraft during a visual approach to a relatively short runway, induced by the pilot's not establishing a glidepath which would assure runway threshold passage with an adequate safety margin, under somewhat unusual environmental and psychological conditions. During an approach to a landing at Renton, the Boeing 747 aircraft struck an embankment approximately 20 feet short of the threshold of Runway 15. The ground contact point was approximately 30 inches below the top of the bank and the runway level. The aircraft came to a stop on the centerline of Runway 15, approximately 3,500 feet beyond the threshold. Small fires broke out in the No. 3 engine wing strut and the No. 4 engine forward of the tail cone. These were immediately extinguished. Structural damage was confined to the right wing landing gear, right flap assemblies, and the Nos. 3 and 4 engines and their cowlings. Author

N71-10815# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: OZARK AIR LINES, INCORPORATED DOUGLAS DC-9-15, N974Z, SIOUX CITY AIRPORT, SIOUX CITY, IOWA, 27 DECEMBER 1968
2 Sep. 1970 42 p *Its* File No. 1-0039
(NTSB-AAR-70-20) Avail: NTIS

A Douglas DC-9 crashed while taking off from the Sioux City Airport, Sioux City, Iowa. There were no fatalities. The probable cause of this accident was a stall near the upper limits of ground effect, with subsequent loss of control as a result of the aerodynamic and weight penalties of airfoil icing. The flightcrew failed to have the airfoil ice removed prior to the attempted takeoff and selected an improper takeoff thrust for the existing gross weight conditions of the aircraft. Author

N71-10816# Congress. House. Committee on Interstate and Foreign Commerce.
CIVIL AERONAUTICS BOARD AIR MAIL RATE AUTHORITY
Washington GPO 1970 71 p refs Hearings on H.R. 16879 before Comm. on Interstate and Foreign Com., 91st Congr., 2d Sess., 14 15 Apr. 1970 *Its* Serial No. 91-52
Avail: Subcomm. on Transportation and Aeron.

Discussed is a provision authorizing the postal authorities to contract with certified air carriers for the carriage of airmail by the filing of tariffs, and the resulting changes to the Civil Aeronautics Board air mail rate authority. G.G.

N71-10832# ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATION OF THE RECIRCULATION REGION OF A FLOW FIELD CAUSED BY A JET IN GROUND EFFECT WITH CROSSFLOW Final Report, 19 Mar. -30 Apr. 1970
T. W. Binion, Jr. AEDC Sep. Spe. 1970 31 p refs
(Contract F40600-71-C-0002)
(AD-711665; AEDC-TR-70-192) Avail: NTIS CSCL 20/4

A wind tunnel investigation was conducted in the Low Speed Wind Tunnel (V/STOL) to determine the velocities in the recirculation region of the flow field produced by the interaction of a jet impinging on a ground plane with crossflow. Axial and vertical velocity component measurements were obtained with a forward-scattering laser Doppler velocimeter. Test results provide two-component velocity fields and indicate that the jet-to-free-stream velocity ratio is much more important in determining the flow field than the magnitude of the individual velocities. Author (TAB)

N71-10853# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AVIATION GAS TURBINE ENGINES. CONSTRUCTION AND DESIGN OF PARTS
G. S. Skubachevskii 19 Jun. 1970 851 p refs Transl. into ENGLISH of the book "Avyatsionnye Gazoturbinnye Dvigatelei. Konstruktsi ya i Raschet Detalei" Mosciw, Mashinostroyeniye, 1969 p 1 - 543
(AD-711757; FTD-MT-24-65-70) Avail: NTIS CSCL 21/5

In the textbook design fundamentals of aviation gas turbine engines are expounded. There is an examination of operating conditions of individual subassemblies of engines and their parts and the demands imposed on them, construction of parts, strength and vibration calculations; requirements are presented for materials from which parts are prepared, and certain technological indications are outlined. Examples of strength and vibration calculations of basic parts of gas turbine engines are provided. The third edition includes up-dated examples of engine structures and their parts, new methods for calculating strength and vibration and examples of calculations are given. The textbook is intended for students of aviation technical institutes. TAB

N71-10866*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF A SUPERSONIC KERNEL-FUNCTION PROCEDURE TO FLUTTER ANALYSIS OF THIN LIFTING SURFACES
Herbert J. Cunningham Washington Nov. 1970 39 p refs
(NASA-TN-D-6012; L-6808) Avail: NTIS CSCL 20K

A description is presented of a systematic procedure for obtaining generalized aerodynamic forces from the lifting-surface theory by the supersonic kernel-function method and for using those forces thus obtained in a Galerkin modal flutter analysis. The method is applicable to planforms with subsonic leading and supersonic trailing edges. Analytical flutter results were obtained and compared with experimental values from three flutter models. Author

N71-10867*# General Electric Co., Schenectady, N.Y. Research and Development Center.
HEAT TRANSFER ON A FLAT PLATE IN CONTINUUM TO RAREFIED HYPERSONIC FLOWS AT MACH NUMBERS OF 19.2 AND 25.4
H. T. Nagamatsu, W. T. Pettit, and R. E. Sheer, Jr. Washington NASA Nov. 1970 53 p refs
(Contract NASw-1785)
(NASA-CR-1692) Avail: NTIS CSCL 13M

Surface heat transfer rates were measured on a sharp flat plate at zero angle of attack in a hypersonic shock tunnel at flow Mach numbers of 19.2 and 25.4. The density and Knudsen number were altered to span the continuum to near free molecule flow regimes. For both Mach numbers, the heat transfer data agree reasonably well with the strong interaction predictions of Li and Nagamatsu for Reynolds number per inch greater than 10,000 and leading edge Knudsen numbers less than 4. Below a unit Reynolds number of 10,000 a systematic reduction in the heat transfer rate close to the leading edge was observed for both Mach numbers. Furthermore, the Stanton number remained relatively constant independent of Mach number and unit Reynolds number. Author

N71-10914# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: UNITED AIR LINES, INCORPORATED, BOEING 727-22C, N7434U NEAR LOS ANGELES, CALIFORNIA, 18 JANUARY 1969
18 Mar. 1970 44 p
(PB-190812; NTSA-AAR-70-6) Avail: NTIS CSCL 01B

The report contains the analysis, findings and recommendations made by the National Transportation Safety Board and applicable to a Boeing 727's crash while the crew attempted to abort a take-off. USGRDR

N71-10932# National Transportation Safety Board, Washington, D.C.
BRIEFS OF ACCIDENTS, 1969, NO. 2: US CIVIL AVIATION
Feb. 1970 456 p
(PB-190792; NTSB-BA-70-2) Avail: NTIS CSCL 01B

The publication contains reports of U. S. civil aircraft accidents. The reports are reproduced directly from the coded record on magnetic tape. The cause factor, accident types, operational phases, and kinds of flying are tabulated. Author (USGRDR)

N71-10933# National Transportation Safety Board, Washington, D.C.
BRIEFS OF ACCIDENTS, 1968, NO. 7: US CIVIL AVIATION
Feb. 1970 197 p
(PB-190811; NTSA-BA-70-1) Avail: NTIS CSCL 01B

The publication contains reports of U. S. Civil aircraft accidents. The reports are reproduced directly from the coded record on magnetic tape. The cause factor, accident types, operational phases, and kinds of flying are tabulated. Author (USGRDR)

N71-10948# Weather Squadron (24th), Detachment 11, Reese AFB, Tex.
TERMINAL FORECAST REFERENCE FILE, REESE AFB, TEXAS Final Report
Jul. 1970 47 p refs
(AD-711390) Avail: NTIS CSCL 4/2

The reference file discusses factors affecting the weather at Reese AFB, TX. Included are location and topography, weather controls, climatic aids, and special synoptic studies. Author (TAB)

N71-10949# Weather Squadron (24th), Detachment 15, Vance AFB, Okla.
TERMINAL FORECAST REFERENCE FILE, VANCE AFB, OKLAHOMA Final Report
15 Jul. 1970 83 p refs
(AD-711381) Avail: NTIS CSCL 4/2

The reference file discusses factors affecting the weather at Vance AFB, Ok. Included are location and topography, weather controls, climatic aids, and special synoptic study. Author (TAB)

N71-10982*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDY OF TURBOJET COMBUSTOR DYNAMICS USING SWEEP-FREQUENCY DATA
John R. Szuch, Francis J. Paulovich, and William M. Bruton Washington Nov. 1970 42 p refs
(NASA-TN-D-6084; E-5595) Avail: NTIS CSCL 21H

The analysis of data obtained from sweep-frequency testing of the J85 turbojet combustor is discussed. Bode plots of the response of combustor pressure to sinusoidal disturbances in fuel-spray-nozzle pressure are presented for a range of fuel flows. An analog simulation was developed and used to match the experimental data and to identify the combustion dynamics. The effects of primary or burning-zone fuel-to-air ratio on the system response were also investigated. The experimental data were fit by linear transfer function forms to be used in overall system studies. Author

N71-11001# Weapons Research Establishment, Salisbury (Australia).
THE USE OF RATE GYROSCOPES IN THE FREE FLIGHT MEASUREMENT OF AERODYNAMIC LATERAL FORCE AND MOMENT COEFFICIENTS
N. E. Gilbert Mar. 1970 43 p refs
(HSA-TN-164) Avail: NTIS

Suitable flight data regions are selected for the free flight measurement of aerodynamic force and moment coefficients on two bombs, each with four fins. The bombs carried an incidence meter, three rate gyroscopes, and four linear accelerometers. The flight data are fitted to a mathematical model of the force and moment system. Pitch and yaw rates and pitch and yaw accelerations derived using rate gyroscope measurements are compared with those derived using other sources and the agreement was found to be very good. Static coefficients are found to be equally well obtained using any of the various combinations of rate gyroscope and linear accelerometer measurements. Results are given at a Mach number of 0.6, and very good agreement is obtained between free flight and wind tunnel measurements of the static forces and moments. Author

N71-11002# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
CIRCULATION CONTROL BY SLOT SUCTION ON A CIRCULAR CYLINDER: PRELIMINARY MEASURED FORCE DATA
R. A. Tyler and R. G. Williamson Feb. 1970 49 p refs
(LR-530) Avail: NTIS

Suction coefficients from zero to unity were applied to a single-slotted commercial steel circular cylinder at low free-stream Mach numbers. Balance measured force data for a full range of slot position in the upper surface are presented and discussed. The results indicate slot position and suction coefficient to be powerful means of controlling cylinder lift. Measurements at zero slot flow demonstrated that the presence of the sharp-edged slot (s/d = 0.05) could give rise to sizeable crosswind forces that reversed direction as cylinder Reynolds number was changed through the critical value. Author

N71-11003# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamics Section.
DYNAMIC VISCOUS PRESSURE INTERACTION IN HYPERSONIC FLOW
Kazimierz J. Orlik-Rueckemann Jul. 1970 86 p refs
(LR-535; NRC-11598) Avail: NTIS

A method is presented for the determination of boundary layer effect on the unsteady pressure distributions on an oscillating body in continuum hypersonic flow. The method is based on the concept of dynamic viscous pressure interaction, which takes into account the relative motion between the body surface and the boundary-layer displacement surface. The method can be applied to arbitrary bodies and flow conditions, provided the relevant inviscid unsteady pressure distributions and the dependence of the boundary-layer displacement on the steady flow variables are known. In its present version, the method is limited to low-frequency and small-amplitude oscillations. Calculated examples of oscillatory pressure distributions, phase angles, and stability derivatives are given for a few typical flow conditions over slender wedges and slender right circular cones performing oscillation-in-pitch about zero mean incidence and completely submerged in the weak interaction region of a laminar boundary layer. Author

N71-11004*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
JET-WAKE EFFECT OF A HIGH-BYPASS ENGINE ON WING-NACELLE INTERFERENCE DRAG OF A SUBSONIC TRANSPORT AIRPLANE
James C. Patterson, Jr. and Stuart G. Flechner Washington Nov. 1970 47 p refs
(NASA-TN-D-6067; L-7310) Avail: NTIS CSCL 01A

An experimental wind-tunnel investigation has been conducted recently to determine the aerodynamic interference associated with the wing, pylon, and high-bypass fan-jet engines installed on a typical highwing logistics transport airplane configuration and the interference due to the jet wake produced by powered model fan-jet engines. These tests were conducted over a Mach number range from 0.700 to 0.825 at angles of attack from 0 deg to 4 deg. Author

N71-11005# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
AN EXPERIMENTAL STUDY ON THE UNSTEADY BEHAVIOR OF A SHORT BUBBLE ON AN AIRFOIL DURING DYNAMIC STALL WITH SPECIAL REFERENCE TO THE MECHANISM OF THE STALL OVERSHOOT EFFECT
Koji Isogai Jun. 1970 27 p refs
(Contract DA-31-124-ARO(D)-247)
(AD-711540; ASRL-TR-130-2; AROD-4846-12) Avail: NTIS CSCL 1/3

Unsteady behavior of the reattachment point of a short bubble on a two-dimensional wing of NACA 0012 airfoil section during rapid change of angle of attack was studied by the use of miniature pressure transducers installed in the model for the purpose of detecting the sudden pressure rise at the reattachment

point. Tests were made for the range of non-dimensional pitch rate from 0 to 0.25 and Reynolds number from 64,000 to 125,000. The results obtained suggest that the delay of the initiation of the leading edge vortex shedding is, at most, the same order of magnitude as the delay of the movement of the reattachment point. Author (TAB)

N71-11006# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

A TWO-DIMENSIONAL REPRESENTATION OF THE CROSSWIND FOR THE JET INTERFERENCE PROBLEM

Mary Anne Wright (Ph.D. Thesis) May 1970 156 p refs Sponsored in part by NSF

(Contract DAHC04-68-C-0004; Proj. Themis)

(AD-711578; GIT-AER-70-4; AROD-T-2-16) Avail: NTIS CSCL 20/4

The problem of a jet exhausting normally from an infinite flat plate into a crosswind is studied analytically, primarily in terms of the resulting interference pressures on the plate. Three jet exit shapes are considered: a circle; an ellipse with the major axis aligned with the crosswind (streamwise exit); and an ellipse with the major axis perpendicular to the crosswind (blunt exit). It is shown that a two-dimensional steady potential flow model for the crosswind in planes parallel to the plate may be used, provided the jet-to-crosswind speed ratio is sufficiently large and the wake region is excluded. A blockage-sink model is developed wherein the blockage elements represent blockage due to the jet plume and due to the presence of the wake and a single sink represents entrainment. The model parameters are presented as functions of speed ratio and jet exit thickness ratio. The blockage and entrainment parameters are varied over a range of values to determine the effects of each on the interference pressure, and it is found that the entrainment factor is quite significant. The streamwise and circular jet exits are more useful for lifting-jet applications than the blunt exit because of their favorable coupling of the blockage and entrainment effects and their relatively small wake production. Author (TAB)

N71-11007# ARA, Inc., West Covina, Calif.

INVESTIGATION OF THE EFFECT OF LEADING EDGE ON THE AERODYNAMIC CHARACTERISTICS OF A 70 DEG SWEPT DELTA WING Final Scientific Report, Nov. 1969 Jul. 1970

Bernard Mazelsky and Richard B. Lohman Jul. 1970 36 p refs

(Contract F44620-68-C-0027)

(AD-712087; ARA-110; AFOSR-70-1989TR) Avail: NTIS CSCL 1/3

Measurements were taken to determine the effects of varying the gap width of two parallel leading edge slots on the aerodynamic characteristics of a 70 deg swept delta wing. The two major changes over previous model tests were the use of flush slots and study under turbulent boundary layer conditions. The slots were aligned parallel to the leading edges to simulate leading-edge flaps. The report analyzes preliminary computer data and develops a comparative thesis of three delta wing tests. Author (TAB)

N71-11008# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

EFFECT OF UNSYMMETRICAL NOSE-BLUNTNESS ON THE STABILITY DERIVATIVES OF A 10 DEG CONE AT MACH 14 Final Report

Otto Walchner, Frank M. Sawyer, and Kevin E. Yelmgren Jul. 1970 27 p refs

(AD-711921; ARL-70-0119) Avail: NTIS CSCL 20/4

In the analysis of the free flight motion of bodies of revolution, the tricyclic theory assumes that a small configurational asymmetry does not violate the rotational symmetry of the stability derivatives in pitch and yaw but does produce a non-zero trim angle. Tests at Mach 14 show that a small unsymmetric nose bluntness destroys the rotational symmetry of the stability derivatives of a slender cone at hypersonic Mach numbers and therefore severely violates the assumptions of the tricyclic theory. Restoring and damping derivatives in pitch and yaw are reported for a 10 deg cone with symmetric and unsymmetrically blunted noses. The effect of non-equal stability derivatives on the motion are shown for a simplified case. Author (TAB)

N71-11009# National Aerospace Lab., Tokyo (Japan).

DYNAMIC STABILITY TEST IN A TRANSONIC WIND TUNNEL WITH A ROTARY SYSTEM

Yasujiro Kobashi, Nagamasa Kono, Takenori Nishi, and Masafumi Miyazawa May 1970 15 p refs In JAPANESE; ENGLISH summary

(NAL-TR-196) Avail: NTIS

A method is explored for extracting various kinds of aerodynamics derivatives from forces measured in a wind tunnel by rotating a model through a bent rotary sting and a straight rotary sting with attack angles. The experiments are conducted with [illegible] models, and the dynamic damping and stiffness derivatives of each longitudinal and lateral direction are obtained. The results of the experiments revealed that this technique is very suitable for dynamic tests in a wind tunnel because of small inertia effect, simple model drive and easy measurement of steady dynamic derivatives which are important at steady turning flight. The measured derivatives are not obtained from pure modes of movement such as pitching or plunging, therefore it is necessary to check whether the assumption of linearity is satisfied. Comparison between the present results and those obtained from the conventional methods showed fairly good agreement. The number of measurements is limited at present, but the obtained values agreed well with theoretical predictions. Author

N71-11010*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD-AIR INVESTIGATION OF A TURBINE WITH TRANSPIRATION-COOLED STATOR BLADES. 2: STAGE PERFORMANCE WITH DISCRETE HOLE STATOR BLADES

Edward M. Szanca, Harold J. Schum, and Frank P. Behning Washington Nov. 1970 25 p refs

(NASA-TM-X-2123; E-5812) Avail: NTIS CSCL 01A

Turbine performance characteristics were obtained for a single-stage axial-flow turbine equipped with stator blades employing transpiration coolant ejection through discrete holes. The turbine was tested over a range of speed and pressure ratio, and with a coolant fraction of 0.03. Additional tests were made at the design speed in which the coolant flow was varied from zero to 0.07 of the primary flow. The results were compared to similar results obtained with a turbine using stator trailing-edge coolant ejection. A base turbine with no cooling provision was used as a standard for comparisons. Author

N71-11011# Naval Postgraduate School, Monterey, Calif.

THE UNSTEADY NORMAL FORCE ON AN AIRFOIL IN OSCILLATING FLOW

Maurice R. Banning (M.S. Thesis) Dec. 1969 174 p refs

(AD-711830) Avail: NTIS CSCL 20/4

The effects of oscillating flow on the pressure force normal to the chord of a symmetrical airfoil were investigated experimentally employing a remote pressure transducer to measure the instantaneous pressure distribution. An open circuit wind tunnel having a set of rotating shutter blades located down stream of the test section was used to produce the oscillating flow. Electrical signals analogous to the free stream velocity and surface pressure were recorded simultaneously on separate tracks of a magnetic tape. The recorded data were converted to digital representation, and

numerical techniques utilized to evaluate the spectral composition of the measured pressure distribution, from which the normal force was calculated. It was found that the magnitude of the total normal force at high angles of attack is significantly greater in oscillating flow than in steady flow and is frequency dependent; while at low angles of attack no significant differences were observed. Moreover it was found that higher order harmonics of the fundamental free-stream frequency constitute a significant fraction of the normal force, and these fractions are also frequency dependent. The observed results are not adequately predicted by quasi-steady aerodynamic analysis. Author (TAB)

N71-11012# Oxford Univ. (England). Dept. of Engineering Science.

[AN EXPERIMENTAL INVESTIGATION OF THE LAMINAR NEAR WAKE BEHIND A CIRCULAR CYLINDER IN A MACH 6, RAREFIED AIR STREAM]

G. P. D. Rajasooria and C. L. Brundin Jun. 1970 103 p refs
(Rept-1108/70) Avail: NTIS

A method is presented whereby the hot wire end loss correction can be directly and accurately determined. The more important results are as follows: The surface pressure measurements indicate that the magnitude of the pressure recovery at the base region of the cylinder decreases with decreasing Reynolds numbers. Owing to the relatively small amount of pressure recovery at the base region, there are no separation shocks emanating from the body. The wake shock is a broad, weak recompression area, the strength of which decays rapidly in the downstream axial direction. An expansion region, similar to that found behind slender bodies, is present in the region between the base of the cylinder and the rear stagnation point. Furthermore, an entropy wake is found to exist. This entropy wake is caused by the curved bow shock producing large lateral entropy gradients. Author (ESRO)

N71-11013# National Physical Lab., Teddington (England). Aerodynamics Div.

THE THEORETICAL TREATMENT OF SLOWLY OSCILLATING PART-SPAN CONTROL SURFACES IN SUBSONIC FLOW

H. C. Garner and Doris E. Lehrian Oct. 1969 130 p refs
(NPL-AERO-1303; ARC-31490) Copyright. Avail: NTIS

To first order in frequency, subsonic lifting-surface theory is applied to arbitrary configurations of a thin wing and a trailing-edge control. The discontinuities in flow direction at the hinge line and part-span boundaries are surmounted by independent consideration of smooth equivalent slopes in the chordwise and spanwise directions; the combined equivalent incidences depend on the aerodynamic quantities to be evaluated. The method yields satisfactory values for lift, pitching, and rolling moments, hinge moment and the associated spanwise distributions, but does not determine the complete load distribution due to an oscillating control. Illustrative examples cover four planforms, namely, rectangular and cropped delta wings for which there are experimental data on hinge moment, an untapered swept wing that has been studied by electrical analogue, and a tapered swept wing to be the subject of future experiment. The solutions for each planform are tabulated and plotted as functions of control chord, control span or Mach number and are examined from the standpoint of numerical convergence with respect to the number of chordwise collocation points. Consideration is given to the transformed aerodynamic problem on the reversed wing by application of the reverse-flow theorem, and these alternative numerical results strengthen confidence in the present method and give some indication of the likely accuracy. The optimum central rounding of swept edges is discussed together with many other refinements of numerical technique. It is concluded that significant wing forces can be calculated to at least two-figure accuracy. Author (ESRO)

N71-11014# National Physical Lab., Teddington (England). Aerodynamics Div.

OBSERVATIONS OF THREE-DIMENSIONAL FLOW PATTERNS OBTAINED DURING STALL DEVELOPMENT ON AEROFOILS, AND ON THE PROBLEM OF MEASURING TWO-DIMENSIONAL CHARACTERISTICS Progress Report

N. Gregory, V. G. Quincey, C. L. O'Reilly, and D. J. Hall Jan. 1970 35 p refs
(NPL-AERO-1309; ARC-31702) Copyright. Avail: NTIS

Surface oil-flow patterns were used at low speeds on both thick and thin airfoils to show the onset of three-dimensionality in either separation or re-attachment when there is an appreciable extent of the separated flow that accompanies the development of the stall. Observations on a thick airfoil in compressible flow showed a similar trend in the re-attachment behind a shock-induced separation. A form of boundary-layer control applied at the corners at the ends of the airfoil was able to prevent separation of the corner flow but not to inhibit the development of three-dimensionality. Author (ESRO)

N71-11015# National Aerospace Lab., Amsterdam (Netherlands).

COMPARISON OF CALCULATED PRESSURE DISTRIBUTIONS ON SOME SWEPT WINGS WITH WARREN 12 PLANFORM AT SUBSONIC SPEEDS

A. F. Jones, (RAE, Farnborough), P. V. Grey-Wilson (RAE, Farnborough), and J. W. Slooff 10 Oct. 1969 36 p refs
Sponsored by Direc. of Materiel Air, RNLAF
(NLR-TN-T-189) Avail: NTIS

Data are presented from calculations for the surface pressure distribution on some particular swept wings with Warren 12 planform. Comparisons are given between results obtained from an RAE computer program and a similar program developed at NLR. It is shown that small differences exist as a consequence of different numerical procedures and slight changes in formulation of the basic method. Additional comparisons with a numerical solution of the exact equation for incompressible potential flow suggest that thickness effects are reasonably well represented for the configurations considered. Author (ESRO)

N71-11016# National Physical Lab., Teddington (England). Aerodynamics Div.

LOW-SPEED AERODYNAMIC CHARACTERISTICS OF NACA 0012 AEROFOIL SECTION, INCLUDING THE EFFECTS OF UPPER-SURFACE ROUGHNESS SIMULATING HOAR FROST

N. Gregory and C. L. O'Reilly Jan. 1970 41 p refs
(NPL-AERO-1308; ARC-31719) Copyright. Avail: NTIS

Results are presented for the aerodynamic characteristics of NACA 0012 airfoil section at Reynolds numbers of 2.88 million and 1.44 million with some indications of scale effect at other Reynolds numbers. The measurement of the maximum lift coefficient at a Reynolds number of 2.88 million was uncertain because a laminar separation bubble disappears intermittently for reasons that are not fully understood and it was found that the flow broke down into a three-dimensional pattern when an appreciable extent of separation was present. Boundary-layer control by suction in the vicinity of the wing/wall junction was shown to improve the two-dimensionality in the early stages of separation, but did not inhibit the appearance of three-dimensional flow at and beyond the stall. Distributed roughness was progressively applied from the trailing edge forwards over the upper surface of the airfoil. Both sparse and dense distributions were used and they were intended to simulate the hoar frost deposit remaining after partial cleaning of the forward part of the airfoil. Subject to the above qualifications the maximum lift coefficient was not greatly reduced until the front edge of the roughness extends forward of 0.1 chord, at which stage the drag increment due to the roughness rapidly became much larger. Author (ESRO)

N71-11017# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

A PARAMETRIC STUDY OF ADIABATIC LAMINAR BOUNDARY LAYER SHOCK WAVE INTERACTIONS BY THE METHOD OF LEES-REEVES-KLINEBERG

M. L. Riethmuller and J. J. Ginoux Jun. 1970 90 p refs
(VKI-TN-60) Avail: NTIS

The problem of the interactions between a shock wave and a laminar boundary layer with emphasis on the adiabatic case is briefly discussed. A computer program is described which has been used for a parametric study, the results of which are presented graphically. Ranges of Mach number from 1.5 to 6.0, and of Reynolds number per meter from 0.8 million to 0.1 x 10 to the 8th power are considered. A study of incipient separation shows good agreement with the theoretical results with the correlation established from experimental data by Needham and Stollery. The listing of the computer program used for this study is also given. Author (ESRO)

N71-11018# National Aviation Facilities Experimental Center, Atlantic City, N.J.

FIRE PROTECTION TESTS IN A SMALL FUSELAGE-MOUNTED TURBOJET ENGINE AND NACELLE INSTALLATION Final Report, 1965 - 1970

Daniel E. Sommers Nov. 1970 61 p refs
(FAA-NA-70-41; FAA-RD-70-57) Avail: NTIS

Tests under simulated flight conditions were conducted to investigate the potential explosion and fire hazards and detection and fire control methods. Hot surface ignition of flammables did not occur during simulated flight operating conditions until a change to the normal nacelle configuration reduced cooling airflow to the hot section of the engine (Zone 1) below 0.15 pound per second. The installed detection system did not provide for prompt detection of all fires originated in the lower forward portion of the compressor compartment (Zone 2). Both the Zone 2 fire detection and the Zone 1 overheat detection system, were sensitive to fires originating in the inboard portion of Zone 2. The installed extinguishing system provided rapid extinguishment of all Zone 2 fires until extensive accumulative damage from fires destroyed the integrity of the zone. Fireproof protection incorporated in the nacelle was very effective in performing its intended function. Most susceptible to damage by fire was the aluminum portion of the nacelle, especially aluminum receptacles for camlock type fasteners, an aluminum ventilation louver panel in the top aft portion of Zone 2, and aluminum ribs, formers, and baffles inside the nacelle in the path of fire. The fire damage to the engine and accessories was insignificant in regard to engine operation. Author

N71-11019# National Aviation Facilities Experimental Center, Atlantic City, N.J.

INVESTIGATION OF TWO METHODS FOR IMPROVING THE CRASHWORTHINESS OF INTEGRAL FUEL TANKS Final Report, 1967 - 1970

Robert H. Ahlers Nov. 1970 19 p ref
(FAA-NA-70-46; FAA-RD-70-56) Avail: NTIS

F-86 droppable fuel tanks, fitted with reticulated polyurethane foam and filled to capacity with JP-4 fuel, were drop tested and catapulted to test the effectiveness of the foam in reducing fuel spray and leakage at impact. Also, structurally reinforced DC-7 integral wing tanks were impacted against an upright beam restrained by a steel shear pin to limit the loads. The forward spar caps were strengthened with aluminum alloy doublers and chordwise stiffeners to determine the effect of structural modifications on the crashworthiness of the structure. It was determined that the 10 pores per inch and the 60 pores per inch polyurethane foam have little effect on the attenuation of fuel misting and spilling. The addition of a 0.040 inch thick doubler strip to the upper and lower DC-7 wing skins did not appreciably decrease the vulnerability of the integral tank to leakage, but the front spar rails when reinforced by chordwise structural shapes did increase impact resistance. Author

N71-11020# Federal Aviation Administration, Washington, D.C. Flight Standards Service.

MODERN SURVEILLANCE OF AIRCRAFT INTEGRITY

James E. Dougherty [1969] 32 p refs Presented at the 5th Ann. Aviation Maintenance Symp. Advances in Aviation Maintenance Technol., Oklahoma City, 9 - 11 Dec. 1969

Avail: Issuing Activity

Terminology such as overhaul at fixed times, progressive maintenance, sampling techniques, on condition, reliability, and condition monitoring is noted. The relationship between industry and government in the formulation, evaluation, and approval of maintenance programs is discussed, as is the need for realistic and scientific appraisal of modern day aircraft maintenance programs. The paper's prime purpose is to help speed up recognition and acceptance of condition monitoring as applied to the forthcoming family of large transport jets, as well as the supersonic transports still in the embryonic stage. Conjecture is devoted to the possibility of condition monitoring serving as the basis for future development of maintenance programs for many of the complex high speed executive jet powered aircraft now in use and now being developed for entry in the general aviation field. Author

N71-11021# Young (Arthur) and Co., Bethesda, Md.

PASSENGER DEMAND AND MODAL SPLIT MODELS: CALIBRATION AND PRELIMINARY ANALYSIS

J. M. McLynn and T. Woronka Dec. 1969 172 p refs Supported in part by Dept. of Transportation
(Contract NBS CST-468)
(PB-190946; NECTP-230) Avail: NTIS CSCL 13B

The report develops demand and modal split models for passenger transportation in the Northeast Corridor of the United States. These models are to be used for estimating the patronage on intercity transportation systems in the time period up to 20 years in the future. The uniqueness of these models is that they can be used to estimate patronage on many existing and new modes simultaneously and consistently, ensuring the compatibility of the several estimates. Author (USGRDR)

N71-11022# Naval Academy, Annapolis, Md.

FLYAWAY SEAT

Samuel R. Swah 15 May 1970 128 p
(AD-711642; USNA-TSPR-3) Avail: NTIS CSCL 1/3

An investigation was made to test the feasibility of the use of the flexible rotor blades for a new type of ejection system to be used by pilots in military service to maneuver to safety rather than remain on the mercy of the wind in a parachute. Among designs being considered is an ejection system which works on the autogyro principle. Since prior research has already been done on flexible blades, the primary problem was to adapt them to an ejection system. Different blade configurations were tested in order to find one which would be stable through all ranges of RPM, within the structural limits of the blade and which would satisfactorily autorotate. Results indicate that the use of flexible blades on an escape system is feasible and very advantageous due to their light weight and ease of storage within the limited confines of a cockpit. The construction of a model was also undertaken which will be used to test the autorotative qualities of the blades. Author (TAB)

N71-11023# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

OPTIMIZATION TECHNIQUES IN AIRCRAFT CONFIGURATION DESIGN

Brent Silver and Holt Ashley Jun. 1970 59 p refs
(Contract F44620-68-C-0036)
(AD-711410; SUDAAR-406; AFOSR-70-2361TR) Avail: NTIS CSCL 1/3

The application of optimization techniques to aircraft configuration design is discussed. Advantages and disadvantages of automated search methods are compared with those of parametric

analysis methods. The formulation of the design problem for direct search methods using a normalization procedure is developed. Various direct methods are briefly described. Operational results using several of these methods are reported for aircraft configuration design problems. Gradient methods are found to give disappointing results when compared with certain non-gradient methods. Reasons are suggested for this behavior. The future promise of man-computer interactive design is briefly described. Author (TAB)

N71-11024# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AVIATION, ISSUE NO. 4, 1969 ACCIDENTS
Aug. 1970 501 p *Its* File No. 1-0047-0057; 0059;3-2701-2999,3001-3600
(NSTB-BA-70-4) Avail: NTIS

Sixty-four accidents including foreign registered aircraft involved in accidents in the U.S. are presented. The types of aircraft, pilot certificates, accidents, aircraft damage, and human injuries are listed in tabular form. J.A.M.

N71-11025*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF VARIOUS SMALL-SCALE ROTOR/WING CONFIGURATIONS FOR VTOL COMPOSITE AIRCRAFT IN THE CRUISE MODE
James P. Shivers Washington Oct. 1970 227 p refs
(NASA-TN-D-5945; L-7133) Avail: NTIS CSCL 01C

A subsonic wind-tunnel investigation of a small-scale rotor/wing VTOL airplane has been conducted in a low-speed tunnel with a 12-foot octagonal test section at the Langley Research Center to determine the aerodynamic characteristics of the model in the cruise mode. Five three-blade and three four-bland rotor/wing planforms were tested on a model with a conventional fuselage and tails. The investigation consisted of tests in the cruise configuration to determine lift, drag, static stability and control characteristics, and the dynamic rolling-stability derivatives. Studies with the rotor/wing fixed at various azimuth angles were made to determine the rolling and pitching moments due to variation of the azimuth angle and the effectiveness of the controls for countering these moments. Author

N71-11026# National Aeronautics and Space Council, Washington, D.C.
THE STATUS OF FEDERAL INVOLVEMENT IN SHORT HAUL AIR TRANSPORTATION
Richard D. FitzSimmons and William E. Thurman [1970] 3 p
Avail: Issuing Activity

Interagency cooperation is discussed that could lead to a short haul air transportation program taking into account the realities of fiscal restraints and the somewhat overlapping agency responsibilities. Some of the aspects of federal involvement are discussed. Some thoughts on the interaction of civilian and military agencies and the private industry and municipalities are described. Finally, the impact of this new involvement of the government is developed in view of the many benefits which should accrue to the nation. Author

N71-11027# Mitre Corp., Baileys Crossroads, Va.
V/STOL MODE DESCRIPTIONS
Donald Goldman and Michael J. Roberts Dec. 1969 68 p refs
(Contract DOT-7-35248)
(PB-190940; MTR-4113; NECTP-220) Avail: NTIS CSCL 01B

The report documents the various vertical takeoff and landing (VTOL) and short takeoff and landing (STOL) modal configurations used in the generation of the 1969 NECTP (Northeast Corridor Transportation Project) record run series. A modal configuration can be described by its network and by the vehicles which traverse that network. The report presents the physical and economic characteristics of the VTOL and STOL vehicles and the terminals and links which comprise their service networks. Author (USGRDR)

N71-11028# Rhode Island Statewide Comprehensive Transportation and Land Use Planning Program, Providence.
STATE AIRPORT SYSTEM INVENTORY: AN INVENTORY OF THE EXISTING AIRPORT SYSTEM IN RHODE ISLAND
Kent L. A. Zimmerman, William M. Davies, and Richard J. Shapiro Oct. 1969 163 p refs Supported by HUD and Dept. of Transportation *Its* Tech. Paper No. 14
(PB-189332) Avail: NTIS CSCL 01E

Contents: Rhode Island aviation history, State operated airports and heliport, Private airports, Military airports and heliports, and Data summary. USGRDR

N71-11029# Mitre Corp., Baileys Crossroads, Va.
AIR MODE SERVICE ANALYSIS IN THE NORTHEAST CORRIDOR
Michael J. Roberts and Donald Goldman Dec. 1969 209 p refs
(Contract DOT-7-35248)
(PB-190935; MTR-4112; NECTP-215) Avail: NTIS CSCL 01B

The innovative air modes analyzed for the NECTP (Northeast Corridor Transportation Project) were vertical takeoff and landing (VTOL) and short takeoff and landing (STOL). The report describes the air mode operator supply models and the procedures which generate the VTOL and STOL modal service characteristics within the NECTP model system. The results of all of the model system runs containing VTOL or STOL are analyzed and presented in summary form. Author (USGRDR)

N71-11030# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
EFFECT OF ROOT CUTOUT ON HOVER PERFORMANCE Final Report, Jun. 1969 – Apr. 1970
Sebastian J. Cassarino Wright-Patterson AFB, Ohio AFFDL Jun. 1970 63 p refs
(Contract F33615-69-C-1176)
(AD-711396; SER-50661; AFFDL-TR-70-70) Avail: NTIS CSCL 1/3

Tests were conducted to determine the effect of blade root cutout on the hovering performance of a helicopter rotor. Rotor thrust and torque characteristics were measured on model rotors with root cutouts of 10, 25, 40, and 50 percent radius. In addition, smoke was ejected from various spanwise locations along the trailing edge of blades with cutouts of 10 and 50 percent. The wake patterns developed below the hovering rotor were photographed and examined for several rotor speed/collective pitch combinations to determine how these parameters affect the wake structure. The test data revealed a loss in hovering efficiency of 5 to 7 percent for the 50 percent cutout rotor at a typical design thrust coefficient. This result is in agreement with previous calculations made using blade element-momentum theory. The loss in hovering efficiency was highly nonlinear with increasing root cutout. This behavior was not predicted by blade element-momentum theory or a prescribed wake hover performance analysis using a standard wake pattern. The flow visualization phase of the investigation showed that the increase in root cutout decreases the radial contraction of the tip vortex. When this result was included in the prescribed wake analysis, the correlation accuracy was improved. Author (TAB)

N71-11031# Air Force Cambridge Research Labs., Bedford, Mass.
POINT AND ROUTE TEMPERATURES FOR SUPERSONIC AIRCRAFT
Irving I. Gringorten and Paul Tattelman 28 Jul. 1970 200 p refs *Its* AFCRL-AFSIG-223
(AD-712017; AFCRL-70-04) Avail: NTIS CSCL 4/2

The atlas of the Northern Hemisphere temperature field at SST altitudes consists of 84 plates showing the isotherms at each of the constant-pressure levels, 100, 50, and 30 mb, standard altitudes of 53,000, 67,500, and 78,500 ft, respectively. For each level and season there are seven maps giving the 2-, 10-, 25-, 50-, 75-, 90-, and 98-percentile temperatures. The charts were prepared from twice-daily grid-point data obtained from charts covering the area from the North Pole to approximately 15 deg N for the period 1959 to 1968. Charts were computer analyzed. Since fuel consumption of supersonic aircraft is quite dependent upon temperature, each of the 84 plates is accompanied by a graph giving the probability that the temperatures on any route plotted on the map will equal or exceed the temperatures shown on the map. While the 84 maps are intended for straightforward informational use in SST flight-planning, there are many noteworthy features that are revealed by the percentile-type presentation. Author (TAB)

N71-11032*# Tracor, Inc., Austin, Tex. Sociometric Research Div.
COMMUNITY REACTION TO AIRPORT NOISE, VOLUME 2 Final Report
4 Sep. 1970 245 p refs
(Contract NASw-1549)
(NASA-CR-111316; T-70-AU-7454-U-Vol-2) Avail: NTIS CSCL 01E

A study of the relationships of large numbers of variables (physical, psychological, and social) with community reaction to the noise of aircraft around international airports in large U.S. cities is described. The seven major airports involved were Logan International-Boston, O'Hare International-Chicago, Dallas International-Dallas, Stapleton International-Denver, Los Angeles International-Los Angeles, Miami International-Miami, and Kennedy International-New York. Author

N71-11033# TRW Systems Group, Washington, D.C.
HSGT SYSTEMS ENGINEERING STUDY, TRACKED AIR CUSHION VEHICLES Final Report, 1967 - 1969
Dec. 1969 606 p refs
(Contract DOT-C-353-66)
(PB-190939, NECTP-219) Avail: NTIS CSCL 13F

Based on requirements and constraints chosen for an operational system, subsystem alternatives are evaluated and the selected subsystems are synthesized into a TACV system. Cost and performance are estimated over a range of parameters such as design cruise speed (150 to 350mph) and vehicle capacity (50 to 150 passengers per vehicle). The configuration defined consists of trainable, electrically powered TACV's which collect power from trackside power rails mounted on the side of a channel guideway. Propulsion is by linear induction motors with variable frequency speed control. Control of the vehicles, singly or in trains, is automated and centralized. The vehicles are supported on and guided by peripheral jet air cushions with high pressure air provided by electrically driven axial flow compressors. Author (USGRDR)

N71-11034# Committee on Government Operations (U.S. Senate).
TFX CONTRACT INVESTIGATION, SECOND SERIES, PART 2
Washington GPO 1970 220 p refs Hearings before Comm. on Govt. Operations, 91st Congr., 2d Sess., 25 26 Mar., 7, 9, and 14 Apr. 1970
Avail: Permanent Subcomm. on Invest.

Congressional testimony is reported on investigation of the TFX aircraft contract. Testimony is given on the primary mission of the aircraft, the contract schedule, proposed changes in the design, and difficulties encountered during development and testing. R.B.

N71-11035# Institut Franco Allemand de Recherches, St. Louis (France).
GROUND AND BUILDING WALL REGISTRATIONS OF BOOMS AND NOISES CAUSED BY STARFIGHTERS AND OTHER SOURCES [KNALLE UND GERAUSCHE VON STARFIGHTERN UND ANDEREN QUELLEN, AN BODENPUNKTEN UND HAUSWANDEN REGISTRIERT]
M. Froboese, G. Mathieu, and D. Seydel 27 Jan. 1970 129 p refs In GERMAN; FRENCH summary
Avail: NTIS

The mechanical effects of sonic booms and detonation waves on buildings were studied during overflights of supersonic Starfighters, as well as in connection with explosive detonations of varying force and density, and through shock waves triggered by ordnances of differing calibers. Pressure loads and shock wave pressure-time propagation were measured and registered at several points on the building's wall and in its vicinity in order to determine qualitative and quantitative modifications in supersonic waves during their propagation along the measuring points. Also measured were noise effects of low flying Bell UH-1D and Sikorsky H 34 helicopters and the F 104 on several components of the test building. Transl. by G.G.

N71-11036# Institut Franco-Allemand de Recherches, St. Louis (France).
SONIC BOOM PROPAGATION DURING SUPERSONIC FLIGHT IN UNPERTURBED ATMOSPHERE. PART 1: HORIZONTAL STRAIGHT FLIGHT [PROPAGATION DU BRUIT BALISTIQUE D'UN AVION DANS L'ATMOSPHERE NON PERTURBEE. 1ERE PARTIE: AVION EN VOL RECTILIGNE HORIZONTAL]
F. Reggiani 25 Feb. 1969 36 p refs In FRENCH; GERMAN summary
(Contract DRME-69/415)
Avail: NTIS

Numerous formulas are presented that are applicable to the analysis of sonic aircraft boom propagation during supersonic flight in an unperturbed atmosphere. Sound wave characteristics are used to form the equations for determining the caustic, its intersecting ground points, as well as expressions for the radii of curvatures at some important points. The two cases considered are: (1) a homogeneous atmosphere; and (2) an atmosphere with constant temperature gradients. Example calculation results for real situations are included; the flight path is always considered rectilinear and horizontal and the atmosphere unperturbed. Transl. by G.G.

N71-11037* National Aeronautics and Space Administration. Langley Research Center, Langley Sation, Va.
HOT AIR BALLOON DECELERATION AND RECOVERY SYSTEM Patent
Stanley H. Scher and James C. Dunavant, inventors (to NASA) Issued 28 Apr. 1970 (Filed 14 Nov. 1968) 5 p Cl. 244-31; Int. Cl. B64b; Int. Cl. B64g Continuation-in-part of US Patent Appl. SN-665682, Filed 31 Aug. 1967
(NASA-Case-XLA-06824-2; US-Patent-3,508,724; US-Patent-Appl-SN-775966) Avail: US Patent Office CSCL 01C

A hot air balloon deceleration and recovery system is described. The balloon is equipped with ram air openings which permit inflation by admitting aerodynamically heated air. The balloon inflates during the descent trajectory and acts as a decelerating device. Materials used in the construction of the balloon and methods of fabrication are discussed. Author

N71-11038* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONTROL FOR FLEXIBLE PARAWING Patent
Francis M. Rogallo and William C. Sleeman, Jr., inventors (to NASA) Issued 21 Mar. 1967 (Filed 9 Feb. 1966) 6 p Cl. 244-44 Continuation-in-part of US Patent Appl. SN 338535, Filed 17 Jan. 1964
(NASA-Case-XLA-06958; US-Patent-3,310,261;
US-Patent-Appl-SN-551815) Avail: US Patent Office CSCL 01C

A method for controlling a flexible wing is described. Boltropes from the trailing edge of the flexible wing to a control unit in the payload provide the control system. Control is accomplished by shortening or lengthening the boltrope. By changing the wing configuration symmetrically, pitch control is provided, while asymmetrical variation of the wing planform will provide roll control. Response of the vehicle is dependent upon the rate at which the boltrope is shortened and lengthened, this speed being determined by a conventional servo mechanism. P.N.F.

N71-11039* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GRAVITY STABILIZED FLYING VEHICLE Patent
Harold I. Johnson, inventor (to NASA) Issued 20 Jan. 1970 (Filed 14 Nov. 1968) 6 p Cl. 244-23; Int. Cl. B64c
(NASA-Case-MSC-12111-1; US-Patent-3,490,721;
US-Patent-Appl-SN-775877) Avail: US Patent Office CSCL 01C

A hovering-type flying vehicle for manned or unmanned use is described in which the lift vector is normally aligned with the direction of the prevailing gravity vector without the need for ancillary stabilizing systems such as gyroscopes or manned guidance. The vehicle consists of an upper body section for containing the payload, a lower body section for housing the lifting engine and its related components, as essentially frictionless universal-type joint affixing the upper body to the lower body, and a biasing means between the bodies at the joint which is set to retain the centers of gravity of the bodies along a common axis. Illustrations of the vehicle embodying the principle concepts and basic mechanisms in a static stable condition and subsequent to a destabilizing condition are included. J.M.

N71-11040# Royal Aircraft Establishment, Farnborough (England).
SOFT-GROUND ARRESTING OF CIVIL AIRCRAFT: INFLUENCE OF GRAVEL DEPTH AND TYRE INFLATION PRESSURE
E. Bade Jan. 1969 17 p refs
(RAE-TR-69001) Copyright. Avail: NTIS

The arresting trials carried out with a Lightning aircraft to examine the influences of gravel depth and tire inflation pressure on deceleration are described. The mean decelerations achieved at normal main wheel tire pressures of 260 lb/sq in in a 30 inch depth of 3/4 inch - 1/4 inch rough irregular gravel have compared with previous results in depths of 12 inches and 18 inches. They show that mean deceleration can be increased by an increase in gravel depth but not in direct proportion and that the effectiveness of increased depth is greatest at lower aircraft speeds. Mean decelerations achieved at main wheel tire pressures of 190 lb/sq in were lower than those at 260 lb/sq in but the difference was only slight. Compaction of the gravel occurred due to increased depth and to the fact that the gravel had laid undisturbed for a long period. It is recommended that harrowing a gravel arrester to the full depth would be worthwhile about every 6 months. Author

N71-11041* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
VARIABLE SWEEP AIRCRAFT Patent
Edward C. Polhamus and Alexander D. Hammond, inventors (to NASA) Issued 6 Sep. 1966 (Filed 30 Mar. 1965) 7 p Cl. 244-46
(NASA-Case-XLA-03659; US-Patent-3,270,989;
US-Patent-Appl-SN-444087) Avail: US Patent Office CSCL 01C

A variable sweep wing employing provisions to compensate for undesirable longitudinal stability problems encountered by variable sweep aircraft is described. A double-pivot segmented variable sweep wing eliminates longitudinal pitch-up without the necessity of a low horizontal tail position and compensates for a portion of the aerodynamic center shift during changes in wing sweep angle. The configuration incorporates an auxiliary movable surface at the junction of the leading edge with the fuselage. Movement of the auxiliary surface during wing sweep operations provides increased longitudinal stability. P.N.F.

N71-11042# Royal Aircraft Establishment, Farnborough (England).
REQUIREMENTS FOR EJECTION SEAT SYSTEMS [ANFORDERUNGEN AN SCHLEUDERSITZSYSTEME]
U. Schmidt Jun. 1970 25 p refs Transl. into ENGLISH from Deutsche Luft- und Raumfahrt. (West Ger.), Mitt 69-11 p 372–393
(RAE-LIB-Trans-1471) Avail: NTIS

The requirements for ejection seat systems are expounded and discussed in terms of some extreme flight conditions, specified by the parameters: airstream velocity, altitude, attitude and rate of descent. The physiological and functional limiting conditions are indicated, and some possible means of extending the performance range of rescue systems are presented. Author

N71-11043* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSLATING HORIZONTAL TAIL Patent
Morris L. Spearman, inventor (to NASA) Issued 3 Feb. 1970 (Filed 5 Mar. 1968) 5 p Cl. 244-43; Int. Cl. B64c
(NASA-Case-XLA-08801-1; US-Patent-3,493,197;
US-Patent-Appl-SN-710533) Avail: US Patent Office CSCL 01C

A method for improving aircraft stability through translational motion of the horizontal tail surface is described. The horizontal tail surface is located at the aft of the fuselage during low speed flight and is moved forward toward the fixed wing trailing edge as airspeed increases. Variations in the positions of the tail surfaces provide lift, control, and stability in varying amounts depending on the airspeed of the aircraft. P.N.F.

N71-11061*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SERVOSYSTEM DESIGN OF A HIGH-RESPONSE SLOTTED-PLATE OVERBOARD BYPASS VALVE FOR A SUPERSONIC INLET
George H. Neiner Washington Nov. 1970 22 p refs
(NASA-TN-D-6081; E-5529) Avail: NTIS CSCL 10A

The valve utilizes a multislotted plate to achieve flow area change with minimum stroke and mass of moving parts. The servosystem utilizes a hydraulic piston-in-cylinder actuator close-coupled to a two-stage electrohydraulic servovalve. Using

electronic compensation, the small-amplitude response of the system, modulating 14 percent of its full flow area, is flat within 0 to -3 db to 110Hz. Full valve flow area was 25 sq in. (161 sq cm). A mathematical model of the system is presented and analytical responses are compared with experimental data. Author

N71-11129# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

SYMPOSIUM ON AIRCRAFT WAKE TURBULENCE

Sep. 1970 72 p refs Conf. held at Seattle, 1-3 Sep. 1970

(AD-712080; D1-82-0993) Avail: NTIS CSCL 20/4

Session topics: Fundamental problems; Experimental methods; Flow visualization presentations and results; Wake formation and character; Stability and decay of trailing vortices; Aircraft response to wake turbulence; and Control and use of trailing vortices. TAB

N71-11139# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.

A STUDY OF FLOW FROM TWO PLANAR NOZZLES

Jerzy A. Owczarek, Donald O. Rockwell, and Y.-S. Cha Jun. 1970 43 p refs

(Contract N00014-69-A-0417; Proj. Themis)

(AD-711313; THEMIS-LU-TR-1) *Avail:* NTIS CSCL 20/4

The report describes an experimental investigation of the characteristics of low-Mach number flow of air from each of two planar nozzles having an aspect ratio of 3 at the exit. The nozzles had rectangular inlets with rounded leading edges to channel the flow from round stagnation tanks. The nozzle which produced nonuniform flow at the exit was tested with and without a flow straightener inside. Most experiments were performed at the Reynolds number, based on the width of the nozzle at the exit and on the average flow speed at the nozzle exit, of 12,400. The tests showed that the planar convergent nozzle having a concave-convex inner wall profile, without a flow straightener in it, produced a very nonuniform total pressure distribution at the exit. The flow visualization study showed that the regions of low total pressure are associated with vortices whose axes have the general direction of the main flow. The planar convergent nozzle having a concave-straight inner wall profile, tested without a flow straightener in it, produced uniform total pressure distribution at the exit outside of the boundary-layer region. Small concentrated vortices were observed to exist inside both nozzles. Author (TAB)

N71-11160*# Geological Survey, Tacoma, Wash.

SNOW AND ICE SENSING WITH PASSIVE MICROWAVE AND GROUND TRUTH INSTRUMENTATION: RECENT RESULTS, SOUTH CASCADE GLACIER

M. Meier and A. T. Edgerton *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 15 p refs Prepared in cooperation with Aerojet-Gen. Corp., El Monte, Calif. (See N71-11151 02-13)

Avail: NTIS CSCL 08L

Field experiments utilizing a multifrequency microwave radiometry field laboratory were conducted in the Pacific Northwest to assess the effects of melting, layering surface roughness, density variations, etc. on microwave emission and to determine effective penetration as a function of sensor wavelength. Laboratory studies involved measurement of the dielectric properties of snowpacks at microwave frequencies. Analytical modeling consisted of formulation of models to describe vertically structured media in which both the dielectric properties and physical temperature are permitted to vary with depth. During field studies, the investigators experienced difficulty in obtaining reliable ground truth measurements of snow moisture. To improve confidence in this measurement, a series of tests were conducted on the South Cascade Glacier where several techniques for determining snow moisture were compared. The investigators are also analyzing 1:55-cm imagery of Mount Rainier where effects of terrain slopes parallel and perpendicular to the flight line are encountered. These data correspond to a variety of snow and ice conditions. Author

N71-11422*# General Applied Science Labs., Inc., Westbury, N.Y.

DESCRIPTION AND CAPABILITIES OF A TRAVELING WAVE SONIC BOOM SIMULATOR

Roger Tomboulian and William Peschke Washington NASA Nov. 1970 68 p refs

(Contract NAS1-8940)

(NASA-CR-1696; TR 734) Avail: NTIS CSCL 14B

Studies were made to obtain a more complete understanding of performance range and capability of a traveling wave type sonic boom simulator. Specifically, the studies were concerned with methods and techniques to reduce unwanted jet noise, improved definition of the simulator's operating range, development of non-idealized wave shapes in the simulator and the use of shock wave absorber techniques in the simulator. The simulator was investigated in both a valve operated mode and a diaphram operated mode with the valve mode showing advantages for longer duration and higher overpressure N-waves and the diaphram mode showing advantages for obtaining minimum rise times. Means for substantially reducing the jet noise and for additional attenuation of unwanted high frequencies were indicated. Author

N71-11426*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EVALUATION OF NiCrAl AND FeCrAlY CLADDINGS ON T D-NiCr: MACH 1 BURNER RIG TESTS AT 2100 F (1149 C)

M. A. Gedwill and S. J. Grisaffe Nov. 1970 13 p refs

(NASA-TM-X-52916; E-6021) Avail: NTIS CSCL 11F

Foils, of several oxidation resistant alloys approximately 5 mils thick, were diffusion bonded to TD-NiCr. The protection potential of these claddings for use on aircraft gas turbine components was examined by conducting Mach 1 burner rig tests at 2100 F for time periods up to 160 hours using 1 hour cycles. The NiCrAl cladding was protective for over 120 hours. All of the FeCrAlY alloys, however, began suffering from oxidation and loss of cladding after 20 to 40 hours of testing. Visual indications of interdiffusion were observed in TD-NiCr for both cladding systems. Author

N71-11466*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.

AN APPLICATION OF PREDICTOR DISPLAYS TO AIR TRAFFIC CONTROL PROBLEMS

William Bradford Rouse (M.S. Thesis) Sep. 1970 115 p refs

(Grant NGL-22-009-002)

(NASA-111372; DSR-70283-15) Avail: NTIS CSCL 17G

The feasibility of using a predictor display system to help solve terminal area air traffic control problems is investigated. A computer-based predictor display is proposed as an aid for the air traffic controller to use in guiding aircraft to the glidepath. It was determined that learning, in most cases, was faster with the predictor display. However, the difference in performance with and without the predictor display decreased as learning proceeded. The predictor display helped to reduce errors, but not task completion time. A prediction which was too long and displayed more than the necessary amount of information increased task completion time. The prediction display significantly improved performance for the easier tasks while it did not significantly improve performance for the more difficult tasks. Author

N71-11470# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

THE AEROTHERMODYNAMIC TEST CENTRE OF MODANE-AVRIEUX [LE CENTRE D'ESSAIS AEROTHERMODYNAMIQUES DE MODANE-AVRIEUX]

Marcel Pierre and Guy Fasso 1970 47 p refs In FRENCH; ENGLISH summary

(ONERA-NT-166) Avail: NTIS

The Modane Center supplied directly by water under 800 m pressure and giving up to 88,000 kW includes four wind tunnels and various smaller facilities. The wind tunnels are the S1 continuous 8 m diameter sonic wind tunnel, the S2 continuous 1.80 m square sub-, trans- and supersonic (up to Mach 3) wind tunnel, the S3 0.80 m square blowdown trans- and supersonic (up to Mach 4.5) tunnel and the S4 0.60 to 0.90 m diameter blowdown hypersonic (from 6 to 12 Mach) tunnel. The smaller facilities include vacuum tank exhaust flow simulation and balance calibration benches. Both these and the tunnels as well as tests performed at the Center are described. ESRO

N71-11474# National Aviation Facilities Experimental Center, Atlantic City, N.J.

VISUAL AIDS FOR SECONDARY AIRPORTS Final Report, Sep. 1968 - May 1970

Thomas H. Paprocki Sep. 1970 35 p

(FAA-NA-70-51; FAA-RD-70-59) Avail: NTIS

A new type lighting and marking system for use at small general aviation type airports under VFR weather conditions was installed at the municipal airport, Ocean City, New Jersey, for evaluation. The system consisted of fluorescent runway edge and approach lighting systems; an incandescent sequenced flashing light system; a Simplified Abbreviated Visual Approach Slope Indicator (SAVASI) system; painted aiming-point runway markings; and retro-reflective centerline and threshold markers. All of these visual aids were evaluated individually, and in addition the fluorescent runway edge lighting fixtures were evaluated in comparison with standard incandescent edge lighting units. It was determined that all of the above mentioned visual systems provided satisfactory guidance under VFR conditions and that the fluorescent type of runway edge light fixture can provide excellent VFR lighting with fewer maintenance problems and lower operating costs than the present standard medium intensity runway edge light fixture. Author

N71-11510# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

HOLOGRAPHIC INTERFEROMETRY BY RETRO-DIFFUSION [INTERFEROMETRIE HOLOGRAPHIQUE PAR RETRO-DIFFUSION]

Jean-Marie Caussignac 1970 5 p refs In FRENCH Presented at the Intern. Symp. on Holography, Besancon, France, 6 - 11 Jul. 1970 Submitted for publication

(ONERA-TP-852) Avail: NTIS

Interferential holography permits the visualization of fluid flows inside aerodynamic wind tunnels. In case of turbomachinery, only a retro-diffusion setup can be considered. The material connexion of the diffuser to the wind tunnel entails new constraints. The paper deals with the problems related to the diffuser: displacements and deformations. ESRO

N71-11519# Virginia Polytechnic Inst., Blacksburg. Dept. of Engineering Mechanics.

INCOMPRESSIBLE LAMINAR BOUNDARY LAYERS ON A PARABOLA AT ANGLE OF ATTACK: A STUDY OF THE SEPARATION POINT

M. J. Werle and R. T. Davis Aug. 1970 29 p refs

(Contract N00014-70-C-0024)

(AD-712084, VPI-E-70-17) Avail: NTIS CSCL 20/4

The laminar boundary-layer equations were solved for incompressible flow past a parabola at angle of attack. Such flow experiences a region of adverse pressure gradient and thus can be employed to study the boundary-layer separation process. The present solutions were obtained numerically using both implicit and Crank Nicholson type difference schemes. It was found that in all cases the point of vanishing shear stress (the separation point) displayed a Goldstein type singularity. Based on this evidence, it is concluded that a singularity is always present at separation independent of the mildness of the pressure gradient at that point. Author (TAB)

N71-11520*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BOUNDARY-LAYER TRANSITION STUDY OF SEVERAL POINTED BODIES OF REVOLUTION AT SUPERSONIC SPEEDS

William A. Cassels and James F. Campbell Washington Nov. 1970 69 p refs

(NASA-TN-D-6063; L-7159) Avail: NTIS CSCL 20D

Boundary-layer transition by the sublimation and impact-pressure techniques and force tests were performed on three Haack--Adams bodies of revolution of fineness ratios 7, 10, and 13 at zero angle of attack for free-stream Mach numbers of 2.00, 2.75, and 4.63 and a range of Reynolds numbers based on model length of 6 to 15,000,000 with and without a roughness strip. The grit method of inducing turbulence was found to provide for a nearly complete turbulent flow over the models at the lower Mach numbers and higher Reynolds numbers considered, while the amount of trip drag was less than 8 percent of the model drag with transition fixed. A method of interpreting sublimation data is discussed and used and the results compare well with the impact-pressure results. Author

N71-11579*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN STUDY OF SHAFT FACE SEAL WITH SELF-ACTING LIFT AUGMENTATION. 2: SEALING DAM

John Zuk, Lawrence P. Ludwig, and Robert L. Johnson Washington Nov. 1970 29 p refs

(NASA-TN-D-7006; E-5796) Avail: NTIS CSCL 11A

Analytical studies made on a 6.50-inch nominal dam diameter seal with sealed pressure to 315 psia revealed that a shaft face seal with self-acting lift pads can be designed to yield low leakage and positive sealing face separation. The study showed that the leakage flow through the sealing faces can become choked at pressure ratios as low as 4 to 1 for typical seal operating film thicknesses. Slight angular deformations of the sealing faces had a significant effect on the pressure gradient within the sealing faces; thus, seal force balance was correspondingly affected. For sealing faces having angular deformation, the radial width of the sealing dam was found to markedly affect the seal force balance. Author

N71-11626# Advisory Group for Aerospace Research and Development, Paris (France).

ADVANCED TECHNOLOGY FOR PRODUCTION OF AEROSPACE ENGINES

Sep. 1970 318 p refs Presented at the 35th Meeting of the AGARD Propulsion and Energetics Panel, London, 6 - 10 Apr. 1970

(AGARD-CP-64) Avail: NTIS

Conference papers are presented on the following areas of research: engine manufacturing technology and design, materials, test techniques, new manufacturing techniques, and influence of advanced technology on engine accessories.

N71-11627# Rolls-Royce, Ltd., Bristol (England). Manufacturing Development Dept.

ADVANCED MANUFACTURING TECHNOLOGY IN MODERN JET ENGINES

A. H. Meleka *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 5 p

Avail: NTIS

Improved manufacturing technology in aerospace industry encompasses a wide array of methods and processes from value engineering analyses to applied metal working techniques. Special emphasis is placed on metal forming, part joining, electrochemical machining, and electron beam welding methods. Also stressed are the nondestructive tests that find application during the production process. D.G.

N71-11635# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

TECHNOLOGY OF MANUFACTURING AND ADVANCEMENT OF TECHNOLOGY FOR TURBINE ENGINE COATINGS

John R. Williamson *In* AGARD Advanced Technology for Production of Aerospace Eng. Sep. 1970 13 p refs

Avail: NTIS

Advancement in engine coating technology is centered around erosion resistance and coatings to permit increased performance gains for future aircraft engines. Present programs include development of manufacturing techniques for chemical vapor deposition of titanium carbide for erosion protection of titanium blades and vanes in helicopter engines, chrome-aluminum coatings for oxidation resistance of thoria-dispersion strengthened nickel, and various programs for chromium-titanium-silicon coatings for columbium and tungsten/tungsten disilicide coatings for tantalum. Author

N71-11636# Societe Nationale Industrielle Aerospatiale, Paris (France).

APPLICATION OF CORRUGATED CORE SANDWICH STRUCTURES TO POWERPLANT COMPONENTS [L'EMPLOI DES STRUCTURES DU TYPE SANDWICH A AME ONDULEE DANS LES CONSTITUANTS DES UNITES MOTRICES]

A. Gozlan *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 14 p refs

Avail: NTIS

In order to save weight and withstand increasingly stringent operating conditions, great use is currently made, in the construction of airframes and missiles, of new types of basic structure where matter is so distributed as to improve considerably the local stiffness. Such is the case with isotropic materials like honeycomb sandwich or orthotropic materials like corrugated core sandwich. The present paper deals with a material of the latter type made out of stainless or refractory metal sheet and its applicability to some components of power units. It is shown how this material can be used in the design of such selfcooled components as are internal insulating shrouds for combustion chambers of ramjet, turbo-ramjet and turbofan engines. Author

N71-11637# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France). Div. Hispano Suiza.

ELECTROLYTIC RECTIFICATION: APPLICATION IN THE AERONAUTICS INDUSTRY [LA RECTIFICATION ELECTROLYTIQUE: APPLICATIONS DANS L'INDUSTRIE AERONAUTIQUE]

J. Poyau and P. Rame *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 17 p

Avail: NTIS

The removal of metal components by electrolysis shows promise for overcoming some of the problems encountered in using aeronautical parts in electrolytes. In the case of electrolyte rectification, methods and techniques were developed to give descriptions of the components on the basis of this discovery. The industralization procedure is effective on different motor parts, rotating machine blades and shafts. The material is a combination of refractory, steel, and sintered alloys and is free of burns, cracks, and superficial constraints. The action of the electrolyte is localized in the work zone. The state of the surface obtained and the precision of the surface depends on the quality of the work surface of the rotating electrode. Transl. by E.H.W.

N71-11638# Societe Microfusion, Paris (France).

CONTRIBUTION OF FOUNDRY PRECISION IN THE DOMAIN OF AERONAUTICAL TURBINES [APPORT DE LA FONDERIE DE PRECISION DANS LE DOMAINE DES TURBINES AERONAUTIQUES]

R. Cameo *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 12 p ref

Avail: NTIS

The influence of foundry precision in alloys used for the fabrication of aeronautical turbine blades is discussed. A description of the interior forms and cooling points of the turbine blades is given. The results obtained in the models of cylinder wheels for a special duty machine answer the need of motors in the aeronautical domain. Transl. by E.H.W.

N71-11639# TRW, Inc., Cleveland, Ohio.

A COMPARISON OF HIGH ENERGY RADIOGRAPHIC TECHNIQUES FOR LARGE DIAMETER TITANIUM BILLETS

F. J. Sattler *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 15 p refs

Avail: NTIS

Radiographic techniques for billets up to 17 inches in diameter were established in the programs since some engine disks will be forged from the larger diameter billets. Two high energy radiographic units were investigated for this application. A commercial linear accelerator and a betatron were used to analyze the effects of various lead screen, film, and geometry combinations on image sensitivity. Standard radiographic penetrameters were employed for evaluating the radiographic procedures. The inspection method resolved a 40 thousandths inch diameter by 40 thousandths inch deep hole through 17 inches (432 millimeters) of titanium. Various data are illustrated which reveal the effects of front and back lead screen thickness on exposure and resolution. The utility of each unit is discussed in view of the achievable resolution and the economics of the radiographic procedures. Author

N71-11641# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

X-RAY FLUORESCENCE ANALYSIS AS AN AID TO PRODUCTION AND REPAIR OF AIRCRAFT ENGINES

Harald Simon *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 14 p

Avail: NTIS

X-ray fluorescence is a relatively new analytical technique which is reliable, versatile and economic, and is therefore findig increasing use in industry. The technique uses X-ray radiation of the specimen to cause excitation and produce fluorescence which is scanned by a monochromator, measured by detectors, amplified and recorded. The technique identifies and estimates the elements which are sought. Examples of the applications of this versatile analytical tool are: (1) Analysis of raw materials, fuels, chemical processing solutions and metal finishing compounds; (2) inspection of components at overhaul; and (3) detection and correction of manufacturing defects. Author

N71-11644# Motoren-und Turbinen-Union Muenchen G.m.b.H. (West Germany).

ELECTRON BEAM WELDING OF HIGH-DUTY ROTATING ENGINE PARTS

Wolfgang Hansen *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 12 p

Avail: NTIS

Two examples are used to describe the procedure which can be used to investigate the suitability of electron beam welding on rotating components. After welding of a turbine disc, residual stresses were measured which exceeded half of the ultimate strength. The weld joint between a turbine disc and a shaft could be considerably improved by specific heat treatments. From the experiences accumulated up to now, some rules for the design engineer are derived and illustrated. Author

N71-11647# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Corbeil (France).

INTRODUCTION OF THE ECM IN THE AERONAUTICS INDUSTRY [INTRODUCTION DE L'E.C.M. DANS L'INDUSTRIE AERONAUTIQUE]

G. Foucher *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 8 p In FRENCH

Avail: NTIS

After a rapid presentation of procedure and different types of machines, some technological definitions on the concepts and utilization of cathodes, fixtures, elements, and the different problems encountered in this technique are given. Particular attention is given to the problem of lowering fatigue limits and the average of restoring it in some of the elements. Transl. by E.H.W

N71-11650# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

MODERN JOINING METHODS IN THE AIRCRAFT AND AEROSPACE INDUSTRY

Lutz Dorn *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 20 p refs

Avail: NTIS

The present day demand in aerospace technology is for ultra light structures. However, its realisation for the welding engineer poses at least two problems: the most recently introduced high strength materials have more or less unfavourable welding properties; the strength of the welded joint in optimised structures should be approximate to that of the base metal. These problems were solved by improving conventional welding methods and by introducing new methods. Several different types of welding techniques are described and their advantages and disadvantages discussed. Results show electron beam welding to have the least amount of welding damage, best protection from contamination of weld area, and it can easily be used for integral welding. Applications of welding techniques to aerospace structures are also discussed. Author

N71-11653# Rolls-Royce, Ltd., Bristol (England). Olympus 593 Design Office.

THE INFLUENCE OF THE CONCORDE POWERPLANT OPERATING CONDITIONS ON THE DESIGN OF THE OLYMPUS 593 FUEL AND OIL SYSTEM

R. J. Symon *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 8 p

Avail: NTIS

The nacelle configuration and engine operating conditions have had a major effect on the design of the Olympus 593 Engine for the Concorde aircraft. At the cruise condition there is an airflow of 12 lbs/sec. over the outside of the engine, through the engine bay, varying in temperature from 115 C at the front of the engine to 180 C at the rear. The fuel temperature can vary from −54 C to 160 C and the oil temperature from −54 C to over 200 C. With the economics of the Concorde demanding high aircraft utilization, and the possible hazardous effects of fuel leakage, it was obvious at the start of the project that a high standard of piping and sealing technology was required. It is the purpose of this paper to describe some of the areas to which particular attention is being paid to realize this objective. Author

N71-11654# Pisa Univ. (Italy).

FABRICATION TECHNIQUES OF COMPACT FLUIDIC CONTROL EQUIPMENT FOR AEROSPACE ENGINES

R. Lazzeretti, G. Nardi, and D. Dini *In* AGARD Advanced Technol. for Production of Aerospace Eng. Sep. 1970 25 p refs

Avail: NTIS

First attempts to produce fluidic elements made use of photosensitive plastics. Now, for industrial applications, superior materials and production techniques must be used. Methods using photosensitive ceramics, electroerosion, metal microfusion, etc., are described herein. Block combinations for modular systems and complex logic units, having the distinct advantage of small, compact assemblies, are presented. These include binary counters cascades, comparators, converters, sequential circuits, liquid level sensors and entire logic circuits suitable for control of gas turbines and aerospace engines. Also fluidic carburation and fuel injection control on reciprocating engines are discussed. Very simple, low cost fluidic control systems for industrial applications exhibit many superior qualities. Finally, methods suitable for the economical fabrication of compact and reliable control equipment for aerospace engines are investigated. Author

N71-11670# American Cyanamid Co., Stamford, Conn. Central Research Div. Labs.

PASSIVATION OF METAL AIRCRAFT SURFACES Final Report, 1 Jan. −30 Jun. 1970

Francis C. Rauch and Fred W. Luciw Jul. 1970 29 p refs

(Contract N00019-70-C-0228)

(AD-711950) Avail: NTIS CSCL 11/3

An effort was directed toward the screening of a variety of appropriately modified chelating agents as corrosion resistant and adhesion promoting treatments for mild steel, stainless steel and titanium alloys. The program was essentially an extension of earlier work in which the general validity of the concept had been demonstrated for aluminum substrates. Several types of chelating agents were found to be effective in varying degrees as paint primers on E4130 annealed aircraft steel and 321 stainless steel. The formulation previously found to be the most effective for aluminum proved to be an effective treatment for the ferrous substrates as well. Some indications were obtained that it was superior to state-of-the-art phosphatizing treatments and wash primer as a paint primer for steel. Under application conditions similar to those used for aluminum and steel, titanium was found to be resistant to all of the treatments assayed. A technique involving abrasion of the titanium submerged in a de-oxygenated solution of the chelating agent was found to give a substantial increase in the paint retaining properties of the titanium. Author (TAB)

N71-11681# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

SYNCHRONIZATION OF DISTANT STATIONS BY SIMPLE OVERFLIGHT: OPERATION SYNFRAL [SYNCHRONISATION DE STATIONS ELOIGNEES PAR SIMPLE SURVOL: OPERATION SYNFRAL]

Jean Besson, Joseph Cumer, Roger Gouillou, and Jacques Zakheim
1970 33 p refs In FRENCH; ENGLISH summary
(ONERA-NT-165) Avail: NTIS

The most accurate means of synchronization are briefly recalled. The simple overflight method is then described, and the equipment used is presented. Results of a synchronization performed in June 1969 between the Paris and Brunswick Observatories, are finally presented. Author (ESRO)

N71-11766* National Aeronautics and Space Administration. Langley Research Station, Langley Station, Va.
COOPERATIVE DOPPLER RADAR SYSTEM Patent
James H. Schrader, inventor (to NASA) Issued 27 May 1969 (filed 17 Oct. 1967) 15 p Cl. 343-6.5; Int. Cl. G01s9/56
(NASA-Case-LAR-10403; US-Patent-3,447,154;
US-Patent-Appl-SN-676391) Avail: US Patent Office CSCL 17G

A Doppler radar system for avoiding midair collisions between aircraft is described. A protected aircraft carries a transmitter, a transponder, and a receiver. The intruding aircraft carries a transponder. Comparison of signals transmitted by the protected aircraft with return signals from the transponder of the intruding aircraft provides warning of the proximity of the aircraft and measures the distance separating the aircraft in time to take avoiding action. Author

N71-11768# Centre National d'Etudes Spatiales, Paris (France).
THE PROJECT DIOSCURES: GENERAL INTRODUCTION TO THE SYSTEM [LE PROJET DIOSCURES: INTRODUCTION GENERALE DU SYSTEME]
B. Manuali 1970 18 p refs In FRENCH Presented at the Space Symp., Rennes, France, 16 - 19 Jun. 1970; sponsored jointly by CNES, Centre de Perfectionnement Tech., and Fac. des Sci. de Rennes
Avail: NTIS

The DIOSCURES project aims at meeting the need of both the merchant navy and civil aviation on or over the Atlantic and Pacific Oceans. It provides for telephone and data links between ground stations and aircraft or ships via satellites. It also provides for means of plotting their movements for navigation control purposes. Five geostationary satellites are to be launched by 1973, two over the Pacific Ocean and two over the Atlantic Ocean plus one as a standby. ESRO

N71-11848# Army Foreign Science and Technology Center, Washington, D.C.
MICROBIOLOGIC CORROSION [MIKROBIOLOGICHESKAYA KORROZIYA]
A. Smolin May 1970 11 p Transl. into ENGLISH from Aviat. Kosmonavt. (USSR), no. 12, 1969 p 38-39
(AD-712103; FSTC-HT-23-863-70) Avail: NTIS CSCL 6/13

The article is concerned with the microbiologic corrosion occurring in the fuel tanks of jet aircraft. A series of measures are noted which can be taken for detection of bacteria and fungi in fuels in order to prevent contamination of aircraft fuel tanks. The most important measure for contending with this problem appears to be constant checking on the condition of the fuel from the refinery through the tank farm to the fueling equipment at airports and in aircraft wing tanks. Author (TAB)

N71-11876# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
AN EVALUATION OF THE STATIC CHARGE REDUCER FOR REDUCING ELECTROSTATIC HAZARDS IN THE HANDLING OF HYDROCARBON FUELS Summary Report, Jun. - Nov. 1969
Charles R. Martel Jul. 1970 43 p refs
(AD-712368; AFAPL-TR-70-22) Avail: NTIS CSCL 21/4

The report describes the results of an experimental evaluation of the Static Charge Reducer. The Static Charge Reducer is a device which automatically neutralizes an electrically charged fuel as the fuel flows through it. The tests conducted confirmed the claims that the Static Charge Reducer would reduce the charge density of a flowing hydrocarbon fuel to below 30 microcoulombs per cubic meter. The tests also indicate that two corrosion inhibitor fuel additives significantly affect the electrical conductivity of fuel containing the ASA-3 antistatic additive. Author (TAB)

N71-11882*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACOUSTIC AND AERODYNAMIC PERFORMANCE OF A 6-FOOT-DIAMETER FAN FOR TURBOFAN ENGINES. 2: PERFORMANCE OF QF-1 FAN IN NACELLE WITHOUT ACOUSTIC SUPPRESSION
Arthur W. Goldstein, James G. Lucas, and Joseph R. Balombin Washington Nov. 1970 92 p refs
(NASA-TN-D-6080; E-5757) Avail: NTIS CSCL 21E

This fan, designed for low-noise output, produced significantly less perceived noise at take-off and approach conditions than fans in current use. Measured broadband noise varied with speed but not with aerodynamic blade loading. Multiple pure-tone noise was present at 80 percent of design speed and above and at 90 percent of design speed was strongly dependent on loading. Blade-passing tone noise contributed substantially to noise radiation in front of the fan, but very little rearwards. At 90 percent of design speed, this noise component varied strongly with loading in a manner opposite to the loading variation of the multiple pure tones. Author

N71-11890# Army Mobility Equipment Command, Fort Belvoir, Va.
PROPOSED NUCLEAR MAGNETIC RESONANCE METHOD OF DETERMINING THE AROMATICITY OF HYDROCARBON FUELS
James V. Mengenhauser Jun. 1970 21 p refs
(AD-711892; USAMERDC-1983) Avail: NTIS CSCL 21/4

A new method of determining the aromaticity of hydrocarbon fuels is proposed. This method utilizes nuclear magnetic resonance spectroscopy to measure complexation of acceptor molecules by aromatic hydrocarbon donors in the fuel. Dichloromethane and nitromethane were found to be satisfactory acceptors for this purpose. Equations were developed for the general case of N different aromatic donors, each having a different concentration, equilibrium constant, and complexation shift and with the assumption of rapid chemical exchange of the acceptor among the N competing donors. For any unknown fuel, the acceptor shift is a precise, reproducible quantity which may be converted to volume per cent aromatics by means of a simple equation. The constants in this equation may be determined by standardization with any aromatic hydrocarbon or with any mixture of aromatics. The method is applicalbe to any liquid hydorcarbon fuel and, unlike many existing methods, is unaffected by olefins, dyes, and fluorescent compounds. The precision of the shift measurement is typically 0.4 Hz, which corresponds to 0.2 - 0.5 percent aromatics. Author

N71-11905# National Aviation Facilities Experimental Center, Atlantic City, N.J.
VISUAL APPROACH SLOPE INDICATOR (VASI) SYSTEM FOR LONG-BODIED AIRCRAFT Final Report, Jan. - May 1970

Robert F. Gates Dec. 1970 34 p refs
(FAA-RD-70-76; FAA-NA-70-59) Avail: NTIS

A comparative evaluation was conducted of two methods of modifying the standard VASIS for use for long-bodied aircraft operations. Modification was required due to the greater pilot eye-to-wheel height of the larger aircraft which placed these aircraft in a potential undershoot situation when the on-course signals of standard VASIS were flown. Thirty-four subject pilots flying a variety of aircraft, including the B-747 and C-5A aircraft, participated in the program. The aircraft were tracked with phototheodolite equipment, and the pilots completed questionnaires at the conclusion of each flight. The three-bar system, a modification consisting of an additional component of the standard VASIS, was a significantly better aid than the white-wing system, a modification incorporating the use of white lights only adjacent to the upwind bar of the standard VASIS. Author

N71-11950# National Aerospace Lab., Tokyo (Japan).
RESULTS OF STRAIN AND DEFLECTION MEASUREMENTS CARRIED OUT ON MODEL WINGS AND THEIR COMPARISON WITH CALCULATED RESULTS
1970 31 p refs In JAPANESE; ENGLISH summary
(NAL-TR-195) Avail: NTIS

Six model two-spar wings (three non-swept wings, two thirty degree swept wings, and one forty-five-degree swept wing with ribs perpendicular to the spars) were tested for strain distributions and deflections. Two model wings, jointed to a model center wing by bolts, were subjected to symmetrical loadings. Calculated strain distributions and deflections were obtained by the finite element method. Comparison with test results showed satisfactory agreement for the strain distributions. The comparison showed some difference for the deflections. Experimental error estimations are also described. Author

N71-11968# Texas Univ., Austin. Engineering Mechanics Research Lab.
STRESS AND DEFLECTIONS IN TYPE 2 AND TYPE 4 AIRDROP PLATFORMS Final Report
Wen Shing Chang and E. A. Ripperger Natick, Mass. Army. Airdrop Eng. Lab. Dec. 1969 95 p refs
(Contract DAAG17-67-C-0189)
(AD-711556; TR-70-56-AD) Avail: NTIS CSCL 15/7

Severe stress conditions may develop during the extraction and parachute deployment phases of an airdrop with a stressed platform. The platform stresses and deflections during that dynamic loading period are computed by treating the platform as a planar network of beams rigidly connected at the joints. Stiffness properties of the beams in the network are calculated approximately using standard methods and then refined to more exact values by comparing measured deflections under static loading to computed deflections. These stiffness properties are then used in the analysis of the dynamic load. Equations of motion are written for each degree of freedom using a lumped mass representation for the loads. Deflections at the joints of the network are obtained by solving the equations of motion using the Runge-Kurt-Gill numerical procedure. Stresses are then determined from the deflections. Author (TAB)

N71-12035*# Pratt and Whitney Aircraft, East Hartford, Conn.
DEVELOPMENT OF MAINSHAFT SEALS FOR ADVANCED AIR BREATHING PROPULSION SYSTEMS, PHASE 2 Final Report
V. P. Povinelli and A. H. McKibbin 23 Jun. 1970 122 p refs
(Contract NAS3-7609)
(NASA-CR-72737; PWA-3933) Avail: NTIS CSCL 21E

Two mainshaft face seal configurations for advanced gas-turbine engines were designed, fabricated, and tested. The seal concepts incorporated lift geometries which used the relative motion between the primary seal surfaces to provide positive separation (film lubrication). One design (self-acting) with shrouded Rayleigh step lift pads operated with a gas film separating the sealing faces. The other design (hydrodynamic) with a spiral groove geometry operated with oil-film separation. Tests of the gas-film seal demonstrated the feasibility of operation at gas temperatures to 1200 F, pressure differentials to 250 psi, and sliding speeds to 450 ft/sec. Excellent correlations with analytically predicted performance parameters were obtained. Face wear was less than 0.1 mil after 320 hours at an air temperature of 1000 F, a pressure differential of 200 psi, and a sliding speed of 400 ft/sec. Average air leakage during that test was 14 scfm. These operating conditions exceed the capability of conventional contact seals and the air leakage is 1/10 that of a labyrinth seal. Testing of the oil-film seal revealed an inadequate seal force balance. Author

N71-12036*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS-FILM SEAL, TYPE A, APPENDIX A
L. P. Ludwig *In* Pratt and Whitney Aircraft Develop. of Mainshaft Seals for Advan. Air Breathing Propulsion Systems Phase 2 23 Jun. 1970 p 65–76 refs
Avail: NTIS CSCL 11A

A face seal with self-acting geometry was designed for operation in gas turbine engines. Because of the noncontacting feature the seal has high speed and long life potential. Extensive use was made of molybdenum alloy in the design in order to minimize thermal gradients which cause detrimental seal deformation; in particular the seat, carbon retainer ring, carbon carrier and secondary seal were made from the molybdenum alloy. The seat was structurally isolated from the shaft by a radial spacer in order to mitigate the deformation effects caused by shaft thermal displacement. Further, the seat was clamped through a bellows which provided a predetermined amount of axial clamping and mitigated clamping distortions. Seat axial thermal gradients which induce undesirable deformations were minimized by thermal shielding and oil cooling. Further oil cooling the nosepiece assembly helped reduce the carbon temperature to a level at which oxidation was not a problem. Author

N71-12037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OIL-FILM SEAL, TYPE B, APPENDIX B
L. P. Ludwig *In* Pratt and Whitney Aircraft Develop. of Mainshaft Seals for Advan. Air Breathing Propulsion Systems, Phase 2 23 Jun. 1970 p 77–80
Avail: NTIS CSCL 11A

The design goal was to minimize: (1) thermal gradients; (2) nosepiece (and carrier) mass; and (3) distortion at the seal dam. To obtain this goal, thermal distortion studies were made of all the seal parts and materials selection was based on distortion consideration as well as strength. The seal was designed to fit existing mainshaft seal rigs and consist of a resiliently clamped seat which is thermally isolated by three heat shields. Cooling holes are located near the hot gas side, and effects of shaft expansion are minimized by piloting the seal under the seat centroid. Seal cooling oil is directed to the seal interface from which it is expelled by centrifugal force and by the pumping action of the spiral grooves. This spiral groove and centrifugal force pumping action is sufficient to preclude a static oil pressure increase at the orifice exit. Lubrication film thickness over the spiral groove land areas determines the film thickness at the gas sealing dam. Author

N71-12038*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF SELF-ACTING GEOMETRY (RAYLEIGH STEP LIFT PAD) FOR GAS FILM SEAL, APPENDIX C

J. Zuk *In* Pratt and Whitney Aircraft Develop. of Mainshaft Seals for Advan. Air Breathing Propulsion Systems, Phase 2 23 Jun. 1970 p 81–95 refs

Avail: NTIS CSCL 11A

A parametric study was made on a face seal with a self-acting lift geometry. The analysis yielded the following results: (1) the characteristic steep gradient of lift force against gap height of the self-acting geometry was responsible for maintaining the small sealing gap height necessary for low leakage. Thus, the self-acting geometry provides a high gas film stiffness, which is necessary if the nosepiece is to track dynamically the face runout of the seal seat; (2) the gradient of self-acting lift force against film thickness was affected by the recess pad depth; the shallower recesses produced a steeper gradient; (3) for faces with angular deformation the self-acting lift force was less than that for parallel faces. Calculations for practical values of angular deformation indicated that the self-acting geometry produces a useful load; and (4) the self-acting pad geometry selected was a compromise between wear and load capacity considerations; that is, the recess depth selected was deeper than the optimum, and the recess length-to-land length ratio was smaller than the optimum. Author

N71-12039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SEALING DAM DESIGN ANALYSIS, APPENDIX D

J. Zuk *In* Pratt and Whitney Aircraft Develop. of Mainshaft Seals for Advan. Air Breathing Propulsion Systems, Phase 2 23 Jun. 1970 p 97–110 refs

Avail: NTIS CSCL 11A

The results that are found were obtained by using computer programs. The design of the gas film seal required finding the smallest film thickness so the leakage is a minimum but yet a large enough film thickness such that both the power dissipation and subsequent shear heating is tolerable and potential seal face deformations can be accommodated. A rough calculation showed that the gap must be at least 0.1 mil for parallel surfaces. A larger gap than a 0.1 mil is necessary to accommodate deformation of the sealing faces. The effect of the sealing dam radial width (deltaR) on force balance suggested that radial widths of 20 mil, 50 mil, 80 mil and 100 mil be investigated in detail. Leakage flow rates of less than 25 SCFM were desired for all three design points. Author

N71-12059# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

CALORIMETRIC HEAT FLUX MEASUREMENTS IN WIND-TUNNELS [METHODE CALORIMETRIQUE DE MESURE DES FLUX DE CHALEUR EN SOUFFLERIE]

Jean-Pierre Chevallier, Jean Ponteziere, and Andre Betremieux 1970 27 p refs In FRENCH; ENGLISH summary

(ONERA-NT-159) Avail: NTIS

The study of kinetic heating of bodies with complicated shapes entails more and more accurate measurements. The testing methods have to be adapted to the specific heating conditions of the models and to the facility used. With the method developed for blowdown wind tunnels it is possible to measure even very weak convection fluxes with a remarkable accuracy, thanks to a refinement of the technique for inserting the thermocouples within the model skin, and to a critical study of the calorimeter design and conditions of use. The technological details and the theoretical study described must be considered as a whole in the use of the process and for ascertaining the accuracy of the results. This method might easily be extended to very different measuring conditions, such as those met in flight tests. Author (ESRO)

N71-12069# Centre National d'Etudes Spatiales, Paris (France). Div. 'Politique Industrielle.'

INDUSTRIAL POLICY AT THE CENTRE NATIONAL D'ETUDES SPATIALES [LA POLITIQUE INDUSTRIELLE DU CENTRE NATIONAL D'ETUDES SPATIALES]

A. Simon 1970 12 p In FRENCH Presented at the Space Symp., Rennes, France, 16–19 Jun. 1970; sponsored jointly by CNES, Centre de Perfectionnement Tech., and Fac. des Sci. de Rennes

Avail: NTIS

The Centre National d'Etudes Spatiale (CNES) has adopted the policy of allowing the French aerospace industry to participate in its space program. This paper discusses this policy, the conditions and operations both in the past and in the future. ESRO

N71-12075# Army Foreign Science and Technology Center, Washington, D. C.

EFFECT OF ELECTRIC AND MAGNETIC CROSS FIELDS ON THE AERODYNAMICS AND THERMAL REGIME OF A GAS FLAME CONE

L. P. Yarin 16 Jun. 1970 14 p refs Transl. into ENGLISH from Teoriya i Prakt. Szhiganiya Gaza, Tr. Nauchn. Tekhn. Soveshch. (Moscow), v. 13, 1967 p 128–135

(AD-712336; FSTC-HT-23-086-70) Avail: NTIS CSCL 20/13

In the boundary layer there is a narrow, high temperature zone (a region of active reaction of the original components) within which the gas is a conductor. Outside this region the conductivity of fuel, oxidizer, and the products of combustion in the entire flux field is believed equal to zero. In this connection, the calculations for the field of flux outside the effective zone can be made by the usual gas dynamic methods, and the unknown values of temperature and velocity at the borders of the zone defined are found from the supplementary conditions, taking into account the electrical and magnetic influence. The balance of forces and heat equations are used as supplemental conditions. Author (TAB)

N71-12119# Civil Aeronautics Board, Washington, D.C.

STUDY GROUP ON LEGAL ASPECTS OF INTERMODAL TRANSPORTATION

Whitney Gillilland 1970 8 p refs Conf. held at Washington, D.C., 5 May 1970; Sponsored by NAS-NRC

Avail: Issuing Activity

The interactions between air and surface modes in transporting freight are briefly described with respect to statute, custom, and legal decisions. The regulations for pickup and delivery areas within a 25 mile zone, within a 68 mile zone, and beyond are mentioned, along those regarding a surface carrier's acquisition of an air carrier and vice versa. It is felt that there are many capabilities to facilitate intermodal domestic transportation, and that international agreements will eliminate impediments to international coordination. N.E.N.

N71-12120# Civil Aeronautics Board, Washington, D.C.

REMARKS BY THE HONORABLE WHITNEY GILLILLAND, VICE CHAIRMAN, CIVIL AERONAUTICS BOARD

1969 9 p Presented at Am. Airlines Ann. Meeting of Regional Vice Presidents and City Managers, Washington, D.C., 13 Nov. 1969

Avail: Issuing Activity

The possible benefits of local and trunk air carrier mergers are briefly discussed. It is pointed out that the local carriers have had a higher rate of capacity growth over the past 15 years than the domestic trunks and that the total 1968 transport revenues of the local service carriers was nearly $43 million more than that

of the domestic trunks in 1948. A comparison is made between an actual trunk-trunk merger and a hypothetical merger between average local and trunk carriers with respect to passenger miles, revenue, profit, and investment. It is concluded that if some trunk-local carrier mergers take place, the air carrier system and its members might be financially stronger and the public might be better served and at lower fares. N.E.N.

N71-12139# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.

FFA STRUCTURAL RESEARCH AND TEST FACILITIES

1970 63 p

(FAA-61) Avail: NTIS

The Aeronautical Research Institute of Sweden - Flygtekniska Forsoksanstalten (FFA) is discussed. The primary activity of the FFA consists of contract work for the Swedish Air Force and the aircraft industry, as well as indoor research programmes. The FAA has wind tunnels for the static and dynamic testing of various types of aeronautical models, covering the entire range from low subsonic to hypersonic speeds. A special theoretical group deals with aircraft and missile simulation. In the FFA structural test facilities, full-scale structures, sub-assemblies, component and materials are tested under static or dynamic loads at various temperatures. Author

N71-12190# Civil Aeronautics Board, Washington, D.C.

SUBSIDY FOR UNITED STATES CERTIFICATED AIR CARRIERS

Nov. 1969 24 p

Avail: Issuing Authority

The subsidies for American certificated air carriers are identified in dollar amounts, achievements, and standards. The total subsidy for air carrier services for fiscal 1970 is $40,917,000. Summaries by service carrier groups are presented and include: Alaskan, Hawaiian, helicopter, local, and domestic trunklines. The procedures for the determination of the subsidy are given. Tabulated summaries for all certificated carriers for fiscal years 1954 to 1970 are included. F.O.S

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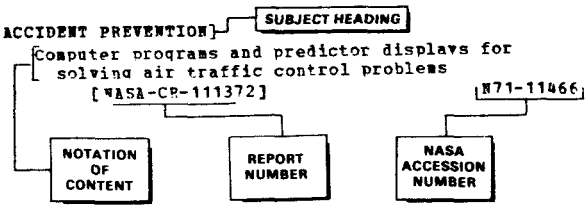

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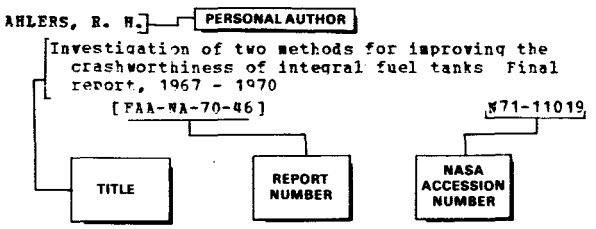

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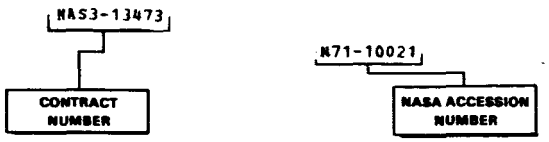

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