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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 16

MARCH 1972

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PREVIOUS BIBLIOGRAPHIES IN THIS SERIES

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NASA SP-7037 (16)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 16

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 February 1972 in

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

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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 426 reports, journal articles, and other documents originally announced in February 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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

Each entry in the bibliography consists of a standard bibliographic citation accompanied by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citations and abstracts are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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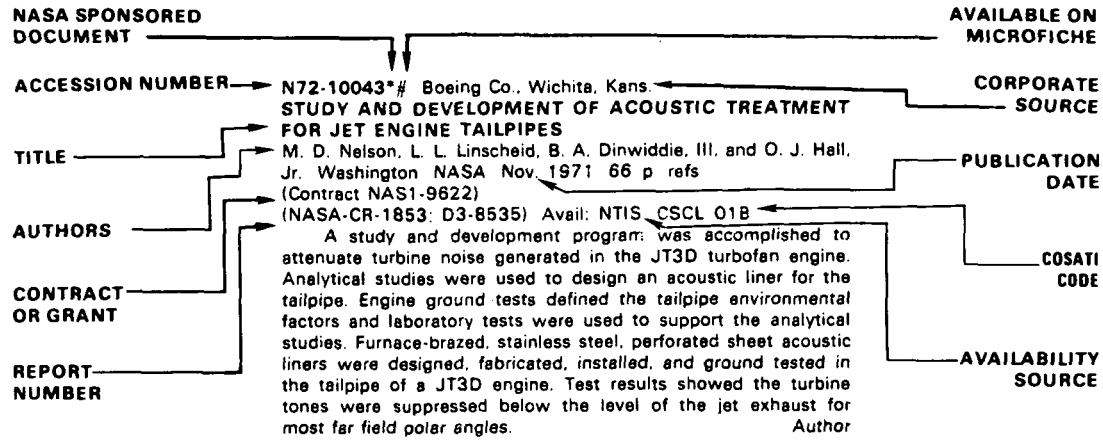

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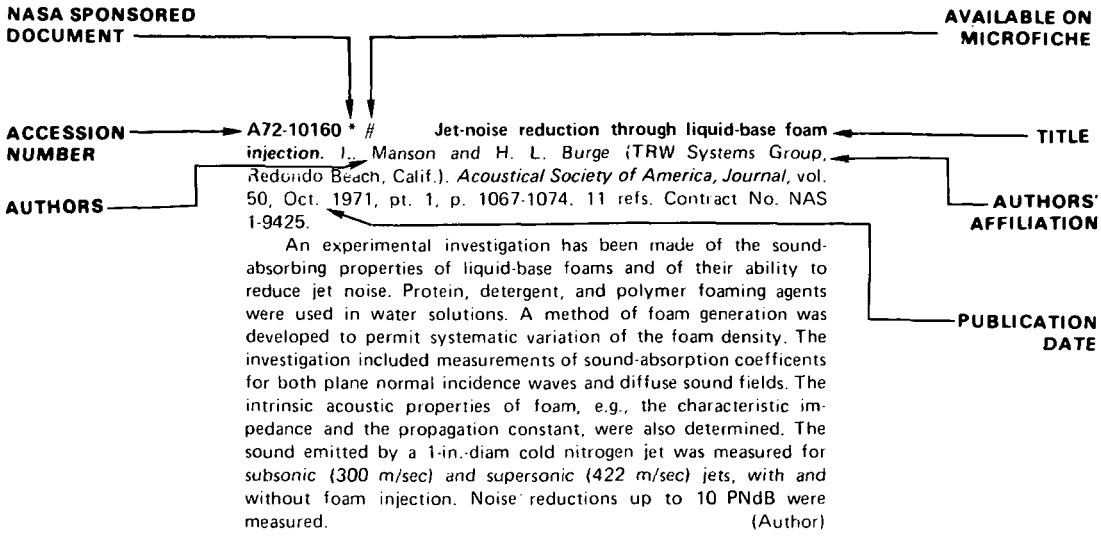

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 16) MARCH 1972

IAA ENTRIES

A72-12910 **Concorde electrics.** H. Hill (British Aircraft Corp., Ltd., London, England). *Electronics and Power*, vol. 17, Oct. 1971, p. 402-405.

Design considerations underlying the development of the electrical power systems of the Concorde aircraft are discussed. Considered are, in particular, the principal system characteristics, the ac and dc system protection, dc supplies, emergency supplies, and installation. In general, the features of the system illustrate how the complexity of civil aircraft systems is increasing, while at the same time the demands on reliability are getting greater. The design disciplines introduced stem from tighter dimensional tolerances combined with exceptionally high integrity. O.H.

A72-12919 # **A multivortex method for axisymmetric bodies at angle of attack.** S. B. Angelucci (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). *Journal of Aircraft*, vol. 8, Dec. 1971, p. 959-966. 18 refs. Research sponsored by the McDonnell Douglas Astronautics Independent Research and Development Program.

A multivortex model made up of a large number of discrete free vortices has been used to represent the actual vortex sheets shed from the lee side of a slender body at an angle of attack. Circulation, strength, and position of the vortices, together with the induced normal forces, are evaluated at various axial positions along the body axis. The viscous inputs to the analysis are the separation or feeding points which are provided by experiment or semi-empirical theories. A discussion of the numerical computations and a comparison with experimental data are presented. (Author)

A72-12920 # **A self-organizing adaptive aircraft control system.** H. M. Richarde, Jr. and E. R. Rang (U.S. Naval Postgraduate School, Monterey, Calif.). *Journal of Aircraft*, vol. 8, Dec. 1971, p. 967-970. 6 refs. Navy-supported research.

Reconfiguration of an adaptive system which yields pitch-axis performance according to the C*-Criterion to give self-organizing behavior. A feedback of normal acceleration, pitch rate and command input combined with variable gains is replaced by three distinct feedbacks of these signals summed with fixed gains. These are then added with variable gains. This allows signal blending from three accelerometers, three rate gyros, and three input transducers. The gain-changing mechanism is found by a gradient technique. Analog simulation shows that the structure provides inherent redundancy and compensates for simulated sensor failures. (Author)

A72-12921 # **Wind-tunnel systems and techniques for aircraft/stores compatibility studies.** S. B. Moore (Vought Aeronautics Co., Dallas, Tex.). *Journal of Aircraft*, vol. 8, Dec. 1971, p. 1000-1007. 8 refs.

A comprehensive presentation of advanced wind-tunnel techniques and facilities used in aircraft store carriage and delivery studies is presented. Extensive static stability, control, and metric store tests aid in predictions of aircraft performance and structural requirements. Investigations with scaled dynamic models are used to determine the flutter boundaries and aeroelastic effects caused by large store aerodynamic and inertia forces. Methods used to obtain mutual aerodynamic interference of wing-pylon-store combinations and external store aerodynamic interference on control surface effectiveness are described. State-of-the-art scaled dynamic separation and captive trajectory systems, their current and potential capabilities and limitations, are discussed. The quality of wind-tunnel simulation, in the general sense, is discussed and present limitations and potential improvements are pointed out. (Author)

A72-12956 **A note on rating scale judgements of aircraft noise.** A. E. Knowler (Department of Trade and Industry, Directorate of Operational Research and Analysis, London, England). *Acustica*, vol. 25, Sept. 1971, p. 183, 184.

The noisiness of a succession of aircraft flyovers was rated by 148 people according to various levels including 'very quiet', 'moderate', 'noisy', and 'very noisy'. In a noise and social survey carried out around Heathrow airport in 1967 a question regarding the rating of aircraft noise was also included. The results obtained in both surveys are compared. G.R.

A72-12972 # **The use of L band in a satellite system for aiding air navigation.** G. Quaglione and E. Vitali (Telespazio S.p.A., Rome, Italy). *(European Space Symposium on Applications Satellites, 11th, Berlin, West Germany, May 24-26, 1971.) British Interplanetary Society, Journal*, vol. 24, Dec. 1971, p. 707-727. 9 refs.

The paper discusses the main technical and operational characteristics of a satellite navigational aid system, particular attention being given to voice communications. The system is based on two geostationary satellites covering the North Atlantic area. Consideration is given to the satellite-aircraft link and to the ground (or aircraft)-satellite link. The results of the study are dependent on the future development of cheaper aircraft antennas. (Author)

A72-12984 **On the generation and detection of artificial atmospheric waves.** L. Liszka and S. Olsson (Kiruna Geofysiska Observatorium, Kiruna, Sweden). *Journal of Atmospheric and Terrestrial Physics,* vol. 33, Dec. 1971, p. 1933-1939. 9 refs. Research supported by the Statens Naturvetenskapliga Forskningsråd.

Preliminary results concerning the detection of atmospheric waves produced by focusing of shocks generated by supersonic aircraft. The flight trajectories were chosen so that the acoustic gravity waves following the shock front were focused on the ground after reflection from the stratosphere, or in the E layer. Infraacoustic waves were detected on the ground using a 2-Hz infraacoustic interferometer-correlator. At the E layer, the waves were detected using a modified vertical sounding technique. Results obtained during 11 test flights have shown that the ray tracing technique may be successfully used for predicting the propagation of atmospheric waves following shock fronts. (Author)

A72-12987 # **On a singular integro-differential equation in aerofoil theory.** D. Porter (Reading, University, Reading, Berks., England). *Cambridge Philosophical Society, Proceedings,* vol. 70, Nov. 1971, p. 451-454.

A brief description is given of a method for reducing a type of singular integrodifferential equation to both an integral equation with a quasi-regular kernel, and an integral equation with a regular kernel. A particular integrodifferential arising in airfoil theory is used as illustration. O.H.

A72-13097 **Airports and noise: Acoustic certification of aircraft - Flight assistance and airports (Aeroporti e rumore: La certificazione acustica degli aeromobili - Assistenza al volo e aeroporti).** V. Fiorini. *Aviazione di Linea - Aeronautica e Spazio,* vol. 9, Oct. 1971, p. 719-723. In Italian.

Discussion of problems connected with the suppression of jet noise near airports. The consequences of developments in engine technology relative to source noise are examined, together with the physical description of noise, and ICAO standards for noise certification. M.M.

A72-13098 **Aeritalia G-222 - A trump to be played abroad (Aeritalia G-222 - Una buona carta spendibile all'estero).** I. Coggi. *Aviazione di Linea - Aeronautica e Spazio,* vol. 9, Nov. 1971, p. 772-775. In Italian.

Description of the design and operating characteristics of the G-222 aircraft. The reasons for the alleged slowdown in the G-222 program are examined, together with problems connected with its marketing abroad. M.M.

A72-13164 * **Finite-state machines as elements in control systems.** G. H. Burgin and M. J. Walsh (Decision Science, Inc., San Diego, Calif.). In: Systems, Man and Cybernetics Group, Annual Symposium, Anaheim, Calif., October 25-27, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 241-246. Contract No. NAS4-1487.

Demonstration that approximate solutions to certain classes of differential and difference equations can be expressed in form of finite state machines. Based on this result, a finite-state machine model of an adaptive gain changer in an aircraft stability augmentation system is developed. Results of simulated flights using the finite-state machine gain changer are presented. M.M.

A72-13189 # **Application of the finite-element method to the calculation of transverse vibrations in one-dimensional systems (Primenenie metoda konechnykh elementov dlia rascheta poperechnykh kolebanii odnomernykh sistem).** V. P. Kandidov and S. S. Chesnokov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia III - Fizika, Astronomiia,* vol. 12, July-Aug. 1971, p. 416-423. 13 refs. In Russian.

Several discrete models composed of finite elements, devised to study transverse vibrations of large-aspect-ratio wings are examined. Analytical solutions to the equations of natural vibrations are obtained for models composed of homogeneous elements. Guidelines for solving boundary value problems with the aid of such models are presented. Several inhomogeneous elements whose stiffness varies along the length according to various laws are developed, and the effectiveness of using them is demonstrated by calculating the natural vibrations of structures. It is shown that a model composed of inhomogeneous elements is twice as accurate as a model with the same number of homogeneous elements. V.P.

A72-13191 # **Energy exchange between a wing and the airflow at the instability limit in the flutter problem (Obmen energii mezhdu krylom i potokom vozdukha na granitse poteri ustoichivosti v zadache o flattere).** Iu. V. Ponomarev (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia III - Fizika, Astronomiia,* vol. 12, July-Aug. 1971, p. 448-451. In Russian.

The mean distribution of the work of aerodynamic forces along a wing at the instability limit is determined on the basis of nonstationary and quasi-stationary theories of wing/airflow interaction. The mode shapes of wing vibrations, responsible for the energy exchange, are obtained from the exact solution of the corresponding homogeneous boundary value problem, using an analog model. Good agreement with the Bubnov-Galerkin method is established. V.P.

A72-13249 # **The influence of fire and smoke emission properties on the selection of materials for aircraft interiors.** M. A. Denney and D. Broadley (British Aircraft Corp., Ltd., Weybridge, Surrey, England). *Plastics Institute, Plastics in Fire Conference, London, England, Nov. 2, 3, 1971, Paper 18.* 17 p. 7 refs.

Six major hazards which arise from an aircraft fire are identified and discussed. Regulations relating to flammability of materials are defined together with test methods for determining the smoke emission characteristics of the materials under direct flame and radiant heating conditions. The influence of smoke and fire regulations on selection of materials is illustrated in a number of areas within civil passenger aircraft. Usage of plastics in aircraft has grown considerably over the past twenty years, but many of these materials will be excluded by the new safety regulations. Some of the requirements for our ideal new plastics materials are given in the conclusions to the paper. (Author)

A72-13250 # **Wreckage trajectory analysis in aircraft accident investigation.** S. G. Bergen-Henengouwen (Department of Transport, Transportation Development Agency, Montreal, Canada). *Canadian Aeronautics and Space Journal,* vol. 17, Nov. 1971, p. 355-361. 8 refs.

The fundamental equations of motion are reviewed for objects falling through an atmosphere with changing wind and density gradients. By applying these equations to a ground wreckage location and wreckage parameters an error function is formed. Minimization of this function gives the flight conditions at the time of aircraft disintegration; that is, the flight velocity vector and altitude. The procedure also may be used to calculate the disintegration sequence and/or to determine the location of objects separated from the aircraft. The methods presented in this article were programmed for a digital computer and were tested by using a real example. (Author)

A72-13401 **Error bounds for eigenvalue analysis by elimination of variables.** M. Geradin. *(British Acoustical Society, Meeting on Finite Element Techniques in Structural Vibrations, University of Southampton, Southampton, England, Mar. 24, 25, 1971.) Journal of Sound and Vibration,* vol. 19, Nov. 22, 1971, p. 111-132. 29 refs.

It is shown that the dynamic analysis of a structure by the finite element method often leads to an eigenvalue problem of such magnitude that its eigensolutions are very expensive to obtain. Possible approaches to solve these large eigenvalue problems are considered. A method for obtaining accurate error bounds for eigenvalue analysis by elimination of variables, based on theorems of Kato and Temple (1952), is proposed. This method has been applied to a large scale problem, namely, a delta wing for which both numerical and experimental analyses are available. The results show that the loss of accuracy for the lower modes is negligible. O.H.

A72-13405 **On the interdependence between acoustic and turbulent fluctuating motions in a moving fluid.** P. E. Doak (Southampton, University, Southampton, England). *(British Acoustical Society and Royal Aeronautical Society, Aerodynamic Noise Symposium, Loughborough University of Technology, Loughborough, England, Sept. 14-17, 1970.) Journal of Sound and Vibration,* vol. 19, Nov. 22, 1971, p. 211-225. 9 refs.

Reference is made to the author's previous work (1970) dealing with an analysis of the transport equations of a continuum, in which the linear momentum density is regarded as the primary, dependent vector field variable. This previous work showed that this analysis provided better possibilities than the traditional field analysis for unambiguously distinguishing among the acoustic, turbulent, and thermal components of fluctuating motion in a wide class of fluid flows. The main features involved in the application of this analysis to aerodynamic and sound problems are outlined and, in a particular application, it is shown that the analysis leads to a satisfactory formulation of the problem of generation and propagation of sound in a fluid containing regions of significantly sheared and turbulent flow. O.H.

A72-13413 # **Integration of services and systems into the total aircraft design.** H. Zeffert (British Aircraft Corp., Ltd., Commercial Aircraft Div., London, England). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 22 p.

Discussion of how observation relates to the basic logic and practice actually used in aircraft systems. Both these techniques (logic and practice) are used together with the results of extensive experience continued from one aircraft to the next; the latter is a most essential factor in achieving the standard that is required. The effects of aircraft utilization and type on systems design and the problem of pilot in the systems loop are discussed. F.R.L.

A72-13414 # **Airport terminal flow systems and related transportation interfaces.** E. B. Tutty (International Air Transport Association, Montreal, Canada). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 7 p.

Considerations are given concerning a more expedient handling of airport passenger traffic to cope with the growing requirements of an expanding air transportation industry. Aspects of airport access, terminal passenger and baggage handling, cargo handling and government controls are discussed in terms of efficiency, convenience and time saving. V.Z.

A72-13415 **Flight planning by air traffic control.** S. Ratcliffe (Royal Radar Establishment, Malvern, Worcs., England). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 9 p.

Discussion of the problems of organizing the flow of traffic out of, between, and into major airports, assuming a theoretically perfect control and navigation system. The improvements which could be expected if aircraft movements were more evenly spaced are evaluated, and problems arising when a runway is fed from a number of converging airways are discussed. It is considered that the only way fully to exploit airspace resources is to introduce a greater degree of automation into both ATC and the flight deck. F.R.L.

A72-13416 # **Aeronautical communication systems.** L. R. Mullin (Marconi-Elliott Avionic Systems, Ltd., Rochester, Kent, England). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 12 p. 5 refs.

Review of the current state of civil aircraft communication systems, covering present and future short and long range communications, aerosatellite channel capacities over the Pacific and Atlantic, and digital data link systems. It is pointed out that a gradual introduction of automatic communications in the airline system can be materialized provided that substantial investments are made by both the ground authorities and the airlines. V.Z.

A72-13417 # **Aircraft integrated data systems in perspective.** A. S. Lucking (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 9 p. 5 refs.

Illustration of some of the problems confronting the aircraft operator in justifying and supporting Aircraft Integrated Data Systems (AIDS) on a worldwide basis. Sufficient development of recording equipment and techniques has taken place over the past decade to allow a conclusion that routine flight data acquisition is technically and administratively possible. Various criteria used to justify AIDS are evaluated. F.R.L.

A72-13418 # **Towards powerplant management.** W. G. E. Lewis and G. E. Munns (National Gas Turbine Establishment, Farnborough, Hants., England). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 20 p. 6 refs.

A concept of powerplant management is described which is applicable to a wide variety of civil and military aircraft. The basic management unit is defined as a single and complete powerplant (integration of the intake, engine, and exhaust system from the control standpoint). Further aspects of the concept's philosophy are: retention of the pilot input as the interface between flying controls and powerplant controls; introduction of multimode control techniques to fully exploit powerplant variability during any phase of flight; combination of executive and monitoring functions into one system; extensive use of digital electronic techniques; and employment of simple redundancy. V.P.

A72-13419 # **The pilot as an aircraft systems manager.** P. J. A. Harper. *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 11 p.

The problems and vexations confronting a modern airlines pilot, under whose command are all the multifarious systems of the machine he operates, and who himself is a vital link in the larger system of the total air traffic environment, are outlined. In addition

to a multitude of minor matters which require attention, there are such major problems as the need to convert repeatedly to new airplane designs (including new autopilots, new radio setups, and even new basic flight instrumentation); the lack of a sophisticated environment required by a sophisticated machine; the need to remain flexible in response to the rapidly changing medium in which the pilot works; and the inadequacy of current safety standards to cope with the steady rise in air traffic, resulting in a steady rise in the rate of air misses. The need for new systems and improvements in this field is emphasized. V.P.

A72-13420 # **Automatic flight control systems for the operational pilot.** J. C. Hall, E. R. Hattendorf, and J. D. Rector (Collins Radio Co., Cedar Rapids, Iowa). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 37 p.

This paper discusses the value of automatic flight control systems to today's operational pilot, while stressing the need for an intimate, responsive, man-machine interface to permit the pilot to function as a fully informed systems manager. Several levels of system automation are treated. Basic aircraft control functions are first discussed. Automatic landing systems are treated next. Control law features provide optimized performance for attaining operations under Category III weather conditions. Channel redundancy, voters, 2-level monitoring, and appropriate warnings and annunciation form the basis for safe landings, even in case of failures, without nuisance disengagements. As being demonstrated in the flight testing of the FCS-110 Automatic Flight Control System in the Lockheed L-1011 TriStar, early operational acceptance and performance achievement can be ensured by a thorough engineering design phase. Automatic flight management represents an additional level of automation to assist the operational pilot. Finally, the implication of the coming microwave landing systems on the avionics control field is discussed. (Author)

A72-13421 **Future landing systems requirements.** J. Edwards (Plessey Radar, Ltd., Weybridge, Surrey, England). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 22 p.

Discussion of currently used landing systems which have a 'stretch potential' for upwards of a decade and those which are still virtually in the concept stage. The requirements of the Navaid element in the changing environment of the pilot during the transition to new standards of flight safety are considered. The treatment relates to operational requirements and usage and is essentially nontechnical. M.M.

A72-13422 * # **Operating systems in the air transportation environment.** G. W. Cherry (NASA, Office of Advanced Research and Technology, Washington, D.C.). *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 39 p.

Consideration of the problems facing air transport at present, and to be expected in the future. In the Northeast Corridor these problems involve community acceptance, airway and airport congestion and delays, passenger acceptance, noise reduction, and improvements in low-density short-haul economics. In the development of a superior short-haul operating system, terminal-configured vs cruise-configured vehicles are evaluated. CTOL, STOL, and VTOL aircraft of various types are discussed. In the field of noise abatement, it is shown that flight procedural techniques are capable of supplementing 'quiet engine' technology. F.R.L.

A72-13423 **Displays in flight management - Evolution and revolution.** A. P. W. Cane. *British Air Line Pilots' Association, Technical Symposium, London, England, Nov. 16-18, 1971, Paper.* 42 p.

The current state and visualized future developments in flight display technology are discussed. The following projections are made for the cockpit of the future: it will consist of a minimum of seven CRTs comprising 2 electronic attitude indicators, 2 automatic chart systems, 1 or 2 multifunction displays and 2 electronic engine displays. These systems will be controlled by 2 multifunction controllers. There will be conventional flight and engine instruments for the event of a total electric failure. The malfunction warning system will be by voice or write-up on one of the CRTs supported by an audible getter. Check lists will be displayed on the multifunction display for normal and emergency operations. Further research is urged to minimize the possibilities of misinformation. V.Z.

A72-13470 # **Investigation of the endurance of the D16AMO alloy subjected to acoustic loading (Issledovanie vynoslivosti splava D16AMO pri akusticheskom nagruzhenii).** L. E. Matokhniuk, Iu. A. Kashtalian, and V. A. Samgin (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti,* vol. 3, Sept. 1971, p. 116-120. 5 refs. In Russian.

Tests are described in which 8-mm sheet samples were subjected to narrow-band and wideband noise of high intensity and also to harmonic loading of an electrodynamic vibrator. The endurance limit is found to have its highest value for harmonic loading, and its lowest value for wideband acoustic loading. V.P.

A72-13471 # **IL-76 - A new generation of air freighters in the USSR (IL-76 - Eine neue Luftfrachtergeneration in der UdSSR).** K.-H. Eyermann. *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 7, no. 10, 1971, p. 442-448. In German.

The IL-76 has the capacity to carry about 90% of all types of transportable industrial equipment and all types of containers. The aircraft is to operate in the high subsonic range. With a payload of 40 tons it can cover a distance of 5000 km. The IL-76 is intended for the transportation of freight in Arctic areas, in Siberia, and in the Far East. The air freighter is not dependent on the availability of large airports. The place of air transportation in the Soviet economy is discussed, giving attention to increases in air traffic within the last few years. G.R.

A72-13472 # **Lift and resistance aids of the Tu-154 (Auftriebs- und Widerstandshilfen der Tu-154).** F. Voloshin, V. Maksimov, S. Poddubnyi, and A. Semenov. (*Grazhdanskaia Aviatsiia,* no. 7, 1971.) *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 7, no. 10, 1971, p. 449-455. In German. (Translation)

The Tu-154 had been designed for an economic cruising speed in the range from 900 to 950 km/hr. In particular, the wing profile selected was intended to provide the most favorable cruising conditions. However, the solution adopted could have had negative effects on the takeoff and landing characteristics of the aircraft. New investigations were conducted to ensure the operation of the Tu-154 from all places which today can be used for the aircraft of the type IL-18 and An-10. It was possible to improve the takeoff and landing characteristics of the Tu-154 without any significant deterioration in aerodynamical quality. G.R.

A72-13473 # **Reflections on the Soviet supersonic airliner Tu-144 (Betrachtungen zum sowjetischen Überschall-Verkehrsflugzeug Tu-144).** P. Bork. *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 7, no. 9, 1971, p. 397-410. In German.

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

A72-13484 * # **Heat shields for aircraft - A new concept to save lives in crash fires.** C. B. Neel, J. A. Parker, R. H. Fish (NASA, Ames Research Center, Chemical Research Projects Office, Moffett Field, Calif.), J. Henshaw, J. H. Newland, and F. L. Tempesta (Avco Corp., Avco Systems Div., Lowell, Mass.). *Astronautics and Aeronautics,* vol. 9, Nov. 1971, p. 18-26. 15 refs.

A passenger compartment surrounded by a fire-retardant shell, to protect the occupants long enough for the fire to burn out or for fire-fighting equipment to reach the aircraft and extinguish it, is proposed as a new concept for saving lives in crash fires. This concept is made possible by the recent development of two new fire-retardant materials: a very lightweight foam plastic, called polyisocyanurate foam, and an intumescent paint. Exposed to heat, the intumescent paint expands to many times its original thickness and insulates the surface underneath it. Demonstration tests are illustrated, described and discussed. However, some problems, such as preventing fuselage rupture and protecting windows, must be solved before such a system can be used. M.V.E.

A72-13485 # **Air transport boundaries for national planning.** R. Smelt (Lockheed Aircraft Corp., Burbank, Calif.). *Astronautics and Aeronautics,* vol. 9, Nov. 1971, p. 27-35. 5 refs.

The interface between technical and political processes is focused upon in a discussion of the current status of air transport vs other means of travel in terms of time, costs, popularity, and technology. The fight against the SST in the U.S. and the growing rate of rejection of new airports by the community are felt to represent a summons to come to grips with the clash of technical, political, and social forces before further advances in air transport can be accomplished. M.V.E.

A72-13486 * # **Airbreathing propulsion system trends.** J. F. Dugan, Jr. (NASA, Lewis Research Center, Advanced Systems Div., Cleveland, Ohio). *Astronautics and Aeronautics,* vol. 9, Nov. 1971, p. 36-45. 17 refs.

Among trends in airbreathing propulsion, the priority is shown to belong to the goal of quieting engines to a level no greater than the natural background noise level of the environment in which they operate. For military engines, not so severely noise-constrained, the possibility of stoichiometric gas-turbine engines is shown to be within reach. Very high bypass ratio propfans are especially suitable for V/STOL aircraft. Evolution of reliable variable-geometry inlets and exhaust nozzles characterizes trends in the supersonic regime. M.V.E.

A72-13487 # **Transonic transports.** L. T. Goodmanson (Boeing Co., Commercial Airplane Group, Renton, Wash.). *Astronautics and Aeronautics,* vol. 9, Nov. 1971, p. 46-56. 15 refs.

Review of recent Boeing studies of advanced technology for transonic air transports. The summarized research, wind-tunnel testing and preliminary design studies are shown to indicate that the near-sonic aircraft can be a strong contender as a future long-range transport. It is shown that operating costs of a 200 passenger Mach 0.98 transport, with a range of 5200 n mi come within about 5% of a comparably sized all-new, advanced technology transport designed to cruise about 100 mph slower (Mach 0.84). The seat-mile cost of this Mach 0.98 transport should be about 15% lower than that of the 707 and DC-8. M.V.E.

A72-13538 # **On the structure of vortex flows in axial gas turbines - Flow analysis at the inlet and outlet of a blade row (Sur la structure des écoulements tourbillonnaires dans les turbomachines axiales - Analyse de l'écoulement à l'entrée ou à la sortie d'une roue).** J.-P. Guiraud (Paris VI, Université, Paris, France) and R. Kh. Zeytounian (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* Sept.-Oct. 1971, p. 237-256. 7 refs. In French.

Attempt to avoid, in the classic plan of mean vortex flow in an axial gas turbine, the difficulty of its invalidity in the vicinities of inlet and outlet surfaces of a blade row. A localized study of these vicinities was carried out which made it possible to fulfill the mean flow plan. The study led to transmission conditions which it is convenient to add to the partial differential equations describing the mean flow in order to obtain a well-defined overall problem. F.R.L.

A72-13539 # **Wind tunnel measurement of aerodynamic pitch damping of an aircraft model oscillating in two degrees of freedom (Mesure en soufflerie de l'amortissement aérodynamique en tangage d'une maquette d'avion oscillant suivant deux degrés de liberté).** M. Canu (ONERA, Modane, Savoie, France). *La Recherche Aérospatiale,* Sept.-Oct. 1971, p. 257-267. In French.

Dynamic pitch stability tests performed on an aircraft model, oscillating about an axis situated at the end of a relatively flexible sting assembly, require an analysis of a two-degree-of-freedom (rotation and translation) system with asymmetrical mass, damping, and stiffness matrices. It is shown that this problem can be reduced to a one-degree-of-freedom system permitting a much simpler solution. The solution accounts for the flexibility of the sting assembly and permits on-line data reduction. T.M.

A72-13541 # **Calculation, by the potential method, of unsteady forces acting on an assembly of lifting surfaces (Calcul, par la méthode du potentiel, des forces instationnaires agissant sur un ensemble de surfaces portantes).** Y. Akamatsu and R. Dat (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* Sept.-Oct. 1971, p. 283-295. 12 refs. In French.

Use of the lifting surface linearized theory in a computer program giving the unsteady aerodynamic forces on a wing and horizontal tail surface in subsonic flow. The computing method differs from classical methods inasmuch as the potential is calculated on the lifting surfaces and their immediate vicinity, and the normal velocity is obtained by numerical derivation. The method offers an advantage in computing time. Numerical examples are presented and compared with theoretical results based on classical methods, thus showing the practical interest of the method. F.R.L.

A72-13545 # **Experimental study of mixing with combustion of two parallel supersonic flows of methane and air (Etude expérimentale du mélange avec combustion de deux écoulements supersoniques parallèles de méthane et d'air).** F. Ducourneau (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* Sept.-Oct. 1971, p. 310-312. In French.

Use of a simple configuration of a supersonic diffusion flame in a duct of constant section to study mixing with combustion. A flow of air is brought to high temperature by an electric arc reheater and held in a two-dimensional nozzle to Mach 3. A parallel flow of methane with variable characteristics is injected in such a way that its static pressure in the section of confluence is identical to that of the

current of air. Curves showing the evolution of concentrations, the isoconcentration of oxygen and methane, and the static temperatures are presented. F.R.L.

A72-13608 Design and dimensioning of a propulsion system with selectively addible propulsion system components for employment in supersonic airliners (Zur Auslegung und Bemessung eines Triebwerks mit wahlweise zuschaltbaren Triebwerkskomponenten für den Einsatz in Überschall-Verkehrsflugzeugen). L. von Bonin (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Luftsaugende Antriebe, Braunschweig, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 19, Nov. 1971, p. 437-448. 9 refs. In German.

A twin spool power plant with high pressure cutoff for operation in supersonic airliners is considered. It is assumed that the aircraft will have to pass a part of the flight in the subsonic range because of supersonic boom considerations. The aircraft is, therefore, designed for two flight conditions including supersonic flight at Mach number 3 at an altitude of 20 km and subsonic flight at Mach number 0.9 at an altitude of 11 km. The structure and method of operation of the engine is briefly discussed, and the system of equations for the determination of the payload in relation to the starting weight is derived. It is found that the engine compares favorably with a turbojet even for a subsonic flight of less than 1200 km. An additional thrust increase by afterburning is necessary for accelerating the aircraft to Mach number 3. G.R.

A72-13609 Wind tunnel corrections for measurements at two-dimensional profiles in the transonic wind tunnel of the Aerodynamische Versuchsanstalt Göttingen (Windkanalkorrekturen bei Messungen an zweidimensionalen Profilen im Transsonischen Windkanal der Aerodynamischen Versuchsanstalt Göttingen). P.-A. Mackrodt (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 19, Nov. 1971, p. 449-454. 16 refs. In German.

Pressure distribution measurements on an airfoil at high subsonic speed were carried out in the transonic wind tunnel of the AVA Göttingen of the DFVLR. The normal force coefficients obtained from these pressure distributions were corrected for wind tunnel interferences and compared with results of theoretical calculations. To this end the wind-tunnel wall corrections for two-dimensional flow given in the literature were adapted to the special case of the transonic wind tunnel of the AVA. (Author)

A72-13610 Tunnel corrections for the transonic wind tunnel of the Aerodynamische Versuchsanstalt Göttingen in measurements at three-dimensional models (Kanalkorrekturen für den Transsonischen Windkanal der Aerodynamischen Versuchsanstalt Göttingen bei Messungen an dreidimensionalen Modellen). W. Lorenz-Meyer (Aerodynamische Versuchsantalt, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 19, Nov. 1971, p. 454-461. 16 refs. In German.

Wind-tunnel corrections which are important to correct test data obtained in ventilated test-section walls like in the Transonic Wind Tunnel of AVA Göttingen (DFVLR) at high subsonic Mach numbers on free-stream conditions are calculated and compared with test results of force measurements on three AGARD calibration models B with different fuselage diameters (D=7.55 cm, 5.88 cm and 3.2 cm). The equations required are taken from the literature under reference. The porosity parameters of the perforated walls are obtained from special experiments. (Author)

A72-13615 Some present uses and future prospects of titanium in airframes. T. W. Coombe and J. H. R. Hurley (British Aircraft Corp., Ltd., Filton, Bristol, England). *(Royal Aeronautical Society, Symposium on the Effect of New Materials on Aircraft Design, London, England, Mar. 4, 1971.) Aeronautical Journal,* vol. 75, Nov. 1971, p. 801-805. Research supported by the Ministry of Aviation Supply.

Room temperature basic strength, stiffness and densities are listed for a range of titanium alloys together with typical aluminum alloy and stainless steel data, and some beryllium data for comparison. It can be seen that higher strength titanium alloys offer a significant advantage over both aluminum and stainless steel. Titanium alloys are already finding a minority use in present day airframes, as lighter replacements of steel items such as bolts or concentrated load carrying items, or in regions where service temperatures are too high for aluminum alloys. Studies have been made to explore the possibility of adopting titanium alloys for airframe shell construction. G.R.

A72-13616 Titanium structures in practice. D. Eccles and W. G. Heath (Hawker Siddeley Aviation, Ltd., Kingston-upon-Thames, Surrey, England). *(Royal Aeronautical Society, Symposium on the Effect of New Materials on Aircraft Design, London, England, Mar. 4, 1971.) Aeronautical Journal,* vol. 75, Nov. 1971, p. 805-809.

The uses of titanium alloys in aircraft structures were investigated, giving attention to such factors as weldability, tensile strength, fatigue and residual strength, and shear-carrying qualities. Problems of a titanium fuselage shell design were also studied. On the basis of the results obtained it is concluded that a case can be made for the substitution of titanium alloy for aluminum alloy in subsonic as well as supersonic aircraft. In the subsonic regime, the case is not as strong, but is based on the advantages of higher specific strength and resistance to fatigue crack initiation. The disadvantages are the high costs of the material and of production. G.R.

A72-13617 The use of high strength titanium alloys in aircraft accessories. S. W. H. Wood (Dowty Rotol, Ltd., Gloucester, England) and D. Hammond (Dowty Boulton Paul, Ltd., Wolverhampton, Staffs., England). *(Royal Aeronautical Society, Symposium on the Effect of New Materials on Aircraft Design, London, England, Mar. 4, 1971.) Aeronautical Journal,* vol. 75, Nov. 1971, p. 809-815.

The physical properties of a range of possible structural materials at room temperature are compared. The titanium alloy is found to be in the first place having a merit mark about 13% superior to the next most attractive material which is the ultra-high tensile steel to the American Specification 300M. At 200 C, the merit marks for both 300M and titanium improve due to the decreased static strength of aluminum alloy, the figure for 300M being about 10% superior to Ti551 at this temperature. Factors of cost-effectiveness are discussed, together with the design of equipment which was made of high strength titanium alloys. G.R.

A72-13618 The effect of titanium on equipment design. D. A. J. Harben (Dunlop Co., Ltd., Coventry, England). *(Royal Aeronautical Society, Symposium on the Effect of New Materials on Aircraft Design, London, England, Mar. 4, 1971.) Aeronautical Journal,* vol. 75, Nov. 1971, p. 815-819.

A number of components of the Concorde wheel and brake have been made of titanium. This resulted in an appreciable weight saving. The use of titanium plated with nickel in the brake cylinder is discussed, together with the design of wheel drive blocks, the brake torque tube, pressure and thrust rings, the torque link pin, the tie bolts, the wheel, and the engine control rams. G.R.

A72-13638 **Foreign civil aircraft at the le Bourget Exposition (Les appareils civils étrangers au Salon du Bourget).** G. Bruner (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 31, 1971, p. 5-18. 5 refs. In French.

Brief description of the general characteristics of the aircraft displayed, some of which are well known, with supplementary information on the less known types. Data are given for the Lockheed L-1011, L-500, and L-100, the MacDonnell-Douglas DC-10 (USA); the DeHavilland of Canada DHC-6 and DHC-7, the Canadair CL-246 (Canada); British Aircraft Corp. QSTOL, Britten-Norman BN-2 (UK); IAI-101 (Israel); and TU-144, Il-76, and V-12 (USSR).

F.R.L.

A72-13640 **Control technique and flight quality of new generation aircraft (Technique de pilotage et qualité de vol des avions de la nouvelle génération).** J.-C. Wanner (Délégation Ministérielle pour l'Armement, Paris, France). *(Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace and the Royal Aeronautical Society, Journée Louis Blériot, 24th, London, England, Apr. 22, 1971.) L'Aéronautique et l'Astronautique,* no. 31, 1971, p. 31-51. In French.

Investigations have shown the necessity of reducing crew workloads in order to improve flight safety of military and civil aircraft. The study led to a definition of the various components of a modern cockpit: a head up display featuring the velocity vector, potential climb angle, horizon, and synthetic runway; a head down display giving the necessary data concerning the flight phases when airborne (climb, cruise, descent, and approach); and a ministick and autopilot to handle the aircraft, with a gust alleviation device to improve passenger and crew comfort. F.R.L.

A72-13642 **Critique of testing techniques for transonic airfoils. I - Industrial test apparatus at S3MA (Critique des techniques d'essais de profils transsoniques. I - Dispositif d'essais industriels à S3MA).** M. Bazin (ONERA, Modane, Savoie, France). *(Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace, Colloque d'Aérodynamique Appliquée, 7th, Lyons, France, Nov. 4, 5, 1970.) L'Aéronautique et l'Astronautique,* no. 31, 1971, p. 69-76. 5 refs. In French.

Results of research carried out in the ONERA S3MA wind tunnel on new transonic airfoil sections in two-dimensional flow, with description of the procedures. The setup is intended for commercial uses, and is suited for tests on large scale models over an extensive range of Reynolds numbers. Experiments on helicopter blades of chord equal to that of blades tested in the SIMA tunnel provide a comparison of two-dimensional flow and rotor functioning.

F.R.L.

A72-13643 **The VFW-614 very short range twin-jet passenger transport (Le biréacteur de transport de passagers sur très courtes distances VFW-614).** G. Bruner (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 31, 1971, p. 77-83. In French.

Description of the VFW-614 aircraft which is designed to carry 40 passengers over distances as short as 150 to 200 km. After analysis of the effects on performance and the economic efficiency of the aircraft which result from the particular service for which it is intended, the wing arrangement and its structure, the fuselage, the tail assembly, the landing gear, the propulsion system, and the circuits and equipment are described in detail. F.R.L.

A72-13679 * **The NASA Quiet Engine Programme.** J. J. Kramer (NASA, Lewis Research Center, Cleveland, Ohio). *Interavia,* vol. 26, Dec. 1971, p. 1373-1375.

Discussion of the experimental Quiet Engine developed under the NASA program to reduce jet aircraft noise levels. The current status of the program is given as follows: Aerodynamic evaluation of the three fans is complete and their acoustic evaluation is partially complete. Tests of fan casing boundary-layer section and of serrated leading edges on the half-scale B fan are complete and are underway on the half-scale C fan. Tests of the first engine with the A fan began in August 1971. V.Z.

A72-13680 **French research in jet engine silencing.** J. Spincourt. *Interavia,* vol. 26, Dec. 1971, p. 1376, 1377.

Discussion of research made at SNECMA facilities in jet noise reduction, covering aircraft in-flight noise measurements, engine noise reduction on the Concorde, and other tests with various retractable silencer configurations. Diagrams are given for the operating principle of a spade silencer for the Concorde, and for overfly noise analysis. V.Z.

A72-13681 **Continuing development of the GE CF6-50.** K. Merten-Feddeler (General Electric Co., New York, N.Y.). *Interavia,* vol. 26, Dec. 1971, p. 1380, 1381.

Discussion of the present stage in the development of the General Electric 50,000-lb class high-bypass two-spool engine. Cracking of the hot section of a cooling air pressure tube, thermal instability of a seal resulting in its failure, and a failure of a second-stage balance weight causing damage in the HP compressor are indicated as development problems which were successfully eliminated. Severe endurance tests are yet to be made on the engine.

V.Z.

A72-13696 # **The economics of short-short haul.** E. G. Stout and L. A. Vaughn (Lockheed-California Co., Burbank, Calif.). *Astronautics and Aeronautics,* vol. 9, Dec. 1971, p. 42-49. 6 refs.

Discussion of the competitiveness of a projected STOL network serving nine commuter ports in the Detroit region. Factors figuring in an evaluation of the feasibility of such a network are cited, such as estimated demand for service, number of aircraft required, and maintenance costs. The proposed STOL network is compared from the economic standpoint with the BART rail system soon to begin operation in the San Francisco Bay Area and with the VTOL system of a Boeing study set in the Bay Area. Some relevant data concerning the operation of Pacific Southwest Airlines are cited as lending support to estimates made for urban STOLs. DOC and IOC comparisons are made between various modes of short-haul urban air transport, including the Boeing VTOL and the Lockheed STOL.

A.B.K.

A72-13697 # **An engine for quiet STOL propulsion.** G. Rosen (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Astronautics and Aeronautics,* vol. 9, Dec. 1971, p. 50-55. 5 refs.

Description of a new propulsor type, intermediate between propellers and fans, with good performance, noise, and weight tradeoffs for STOLs. The proposed propulsor, called the Q-FAN, is distinguished by superior noise characteristics, weight advantage, fast response, and reduced fuel consumption and is designed for a range of bypass ratio between 15:1 and 30:1 that would permit the use of a lightly loaded fan with relatively few blades operating at relatively

low subsonic tip speeds. The Q-FAN with its large mass flow and low efflux velocity is regarded as particularly well suited to power the externally blown flap powered-lift system. The Q-FAN's fine control of thrust modulation over a wide range of positive and negative values results in good ground maneuverability and fast turn-around of commuter-type STOL service. A.B.K.

A72-13698 # **Two safer aircraft instruments.** R. Oswalt (Skidmore College, Saratoga Springs, N.Y.) and T. Landau (Brooklyn College, Brooklyn, N.Y.). *Astronautics and Aeronautics,* vol. 9, Dec. 1971, p. 56, 57.

Demonstration of the dangers inherent in two commonly used flight instruments - namely, the altimeter and the artificial horizon. In tests of both experienced pilots and completely inexperienced subjects a large number of errors in reading these instruments were detected. The existence of alternative, more easily readable instruments is noted, and it is recommended that these modified instruments be used instead of the standard instruments. A.B.K.

A72-13711 **A remote airborne photographic mission recorder.** J. J. Ferrer (Hughes Aircraft Co., Culver City, Calif.). *(Society of Photo-optical Instrumentation Engineers, Seminar-in-Depth on Photo-optical Display Recording, Los Angeles, Calif., Apr. 26, 27, 1971.) SPIE Journal,* vol. 9, Aug.-Sept. 1971, p. 179-183. Contract No. NOw-63-0379 di.

A photographic cathode ray tube (CRT) recorder in which the displayed information of two cockpit displays are simultaneously recorded via a slave 2-inch CRT is described in this paper. One display is a 5-inch storage tube and the other is a 9-inch CRT. Writing speeds on both displays vary greatly and two shades of gray are required. The recording is further complicated by adjacent overlapping lines in the storage tube display in which exposure to film is increased by as much as 100 times. Proper film exposure is achieved by the control of the slave 2-inch CRT beam current to compensate for line overlapping and writing speeds. Because both displays appear simultaneously, resolution and magnification must be weighted to produce the best compromise for information transfer. (Author)

A72-13725 # **Data management system for scientific ballooning.** R. H. Cormack and A. J. Dascher (National Center for Atmospheric Research, Boulder, Colo.). *Facilities for Atmospheric Research,* June 1971, p. 14-16.

Discussion of improved airborne and ground station equipment for data telemetry, command, and balloon flight control. The Consolidated Instrument Package (CIP), which is designed for easy field assembly and maintenance is described. It has 36 channels of command capability, of which at least three channels are used for command cutdown and ballasting, the remainder being available for scientific use. The complete data management system will include a small computer for formatting of digital tapes and for real-time data selection and monitoring. F.R.L.

A72-13877 **Vectored-thrust maneuverability explored.** D. A. Brown. *Aviation Week and Space Technology,* vol. 95, Dec. 13, 1971, p. 36-39.

Initial results of flight tests aimed at determining the maneuverability potential of aircraft capable of inflight thrust vectoring indicate major gains in deceleration capability, normal acceleration g-force and turn-rate capability. A NASA research program conducted involved some air-to-air maneuvering of the Hawker Siddeley Kestrel against a Northrop T-38, but primarily the work has centered on a step-by-step expansion of the Kestrel envelope while using vectoring in forward flight. G.R.

A72-13915 # **The effect of a jet on a circular wing near a solid surface (O vozdeistvii strui na krugloe krylo vblizi tverdoi poverkhnosti).** K. P. Danil'chenko (Khar'kovskii Aviatsionnyi Institut, Kharkov, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 7, Sept. 1971, p. 124-129. 5 refs. In Russian.

Study of the effect of a circular jet discharging perpendicular to a solid surface into a transverse flow on the aerodynamic characteristics of an infinitely thin circular wing. A solution is presented for a high-impulse jet in the case of large ratios between the wing and nozzle areas and large ratios between the velocity heads of the jet and the incident flow, corresponding to motion of an aircraft during vertical takeoff and landing near the earth. The problem is reduced to a determination of the aerodynamic characteristics of the wing near a solid surface and to a determination of the effect of a wall jet on the wing. A.B.K.

A72-13956 * # **Thin wing corrections for phase-change heat-transfer data.** J. L. Hunt and J. I. Pitts (NASA, Langley Research Center, Hampton, Va.). *Journal of Spacecraft and Rockets,* vol. 8, Dec. 1971, p. 1228-1230. 5 refs.

Since no methods are available for determining the magnitude of the errors incurred when the semiinfinite slab assumption is violated, a computer program was developed to calculate the heat-transfer coefficients to both sides of a finite, one-dimensional slab subject to the boundary conditions ascribed to the phase-change coating technique. The results have been correlated in the form of correction factors to the semiinfinite slab solutions in terms of parameters normally used with the technique. G.R.

A72-13960 **Fluid Power International Conference, London, England, September 15-17, 1970, Proceedings.** London, Morgan-Grampian (Publishers), Ltd., 1971. 177 p. $20.

Recent developments in fluid power technology are surveyed in reports dealing with hydrostatic transmission systems and hydraulic control elements. Topics examined include component test procedures, trends in manifold block design, cavitation criteria for hydraulic pumps, development of directional selector valves with proportional flow control characteristics, application of hydraulic logic systems, and design of pneumatic circuits. The hydraulic systems employed by the Concorde aircraft are outlined, together with details of hydraulic transmission systems, machine-tool control systems, hydraulic motors, poppet valves, and leveling devices. T.M.

A72-13962 # **Concorde hydraulic system.** M. Le Feuvre (Société Nationale Industrielle Aérospatiale, Toulouse, France). In: Fluid Power International Conference, London, England, September 15-17, 1970, Proceedings. London, Morgan-Grampian (Publishers), Ltd., 1971, p. H1-H7.

The main hydraulic circuit for the Concorde comprises three systems which are differentiated by color names. Hydraulic power is generated by six engine-driven pumps. Two pumps driven by the emergency power unit are provided as a standby in case of engine failure. Each pump includes an off-loading system consisting of a solenoid which when activated restricts the control system flow to practically zero. After one year of flight testing, including more than 220 flight hours, no significant problems have been found. There have been no technical delays due to hydraulic system failure, and no in-flight incident has been reported. G.R.

A72-14033 Measurement of EMC performance of certain pulse-coded processing systems. A. F. Mautschke (IIT Research Institute, Chicago, Ill.). In: International Electromagnetic Compatibility Symposium, Philadelphia, Pa., July 13-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 169-173. 5 refs. Department of Transportation Contract No. FA70WAI-175; Contract No. F19628-70-C-0291.

A pulse-coded processing system's (PCPS) electromagnetic compatibility (EMC) measurement technique is presented. Various effects of interference on a PCPS are considered, and a measurement configuration is presented. The functional operation is described and later applied to a specific application, namely, to Air Traffic Control Radar Beacon System (ATCRBS) transponders. The measured results of CW and pulsed interference are discussed and presented in graphical form. (Author)

A72-14039 Computer aided compatibility prediction. C. R. Paul (Purdue University, Lafayette, Ind.) and J. H. Edwards (USAF, Rome Air Development Center, Griffiss AFB, N.Y.). In: International Electromagnetic Compatibility Symposium, Philadelphia, Pa., July 13-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 210-214. 7 refs.

Survey of three computer aided intrasystem electromagnetic compatibility (EMC) prediction programs. The mathematical models and program philosophies are discussed to indicate the directions being taken in large scale system compatibility analysis. M.M.

A72-14043 Aircraft power system vs. EMC requirements. H. K. Mertel and A. H. Mills (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: International Electromagnetic Compatibility Symposium, Philadelphia, Pa., July 13-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 254, 255.

This paper is a synopsis of the proposed panel discussion for the System Electromagnetic Compatibility session. A review of the present transient voltage specification for aircraft is presented. Power equipment engineers tend to favor a plus or minus 600-volt transient limit whereas electronic equipment engineers prefer clean power. Present specifications are analyzed and the transient limits of EMC specifications are recommended for inclusions in power system requirements. (Author)

A72-14047 Time - A neglected dimension of EMC. W. G. Duff (Atlantic Research Corp., Alexandria, Va.) and D. C. Ross (Ross Telecommunications Engineering Corp., Washington, D.C.). In: International Electromagnetic Compatibility Symposium, Philadelphia, Pa., July 13-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 287-287d. 7 refs.

Frequency, space and time are the important dimensions of signal space, and, thus, are important considerations in electromagnetic compatibility (EMC). Compatibility may be achieved by separating signals in any one or all of these dimensions. Frequency and spatial separation have been widely used to solve EMC problems; however, practical considerations limit the amount of 'selectivity' that may be achieved. Although the time domain is capable of providing near-perfect discrimination, 'time selectivity' generally has not been used in an effective and efficient manner to control electromagnetic interference. This paper identifies some of the important considerations involved in utilizing frequency, space and time discrimination to achieve compatibility. Problems encountered in the present Air Traffic Control Radar Beacon System (ATCRBS) are presented to illustrate the effects of inadequate separation of signals. The 'Automatic Position Telemetering' (APT) system which uses a time-division technique to eliminate the EMC problems encountered in the present ATCRBS is described. The basic design concepts of the APT system could be used for a variety of applications such as Air Traffic Control (ATC) data acquisition, ship-position reporting, vehicle location, satellite tracking, etc., and the time-division approach can be useful in solving many of the EMC problems that currently exist. (Author)

A72-14098 # The economics of air transport (Ekonomika vozdushnogo transporta). N. N. Gromov, E. V. Mukhordykh, E. A. Ovrutskii, G. A. Parsegov, B. M. Parakhonskii, Ia. I. Prutkin, and L. A. Tsekhanovich. Moscow, Izdatel'stvo Transport, 1971. 248 p. 48 refs. In Russian.

A brief but intelligible account of the basic problems of air transport economics is presented. The main economic patterns of development of air transport in the Soviet Union are discussed on the basis of an analysis of extensive factual material and a generalization of scientific data. Of central concern are problems connected with increasing the efficiency of utilization of air transport and perfecting aircraft control and design. Questions concerning the economics of maintenance and overhauling of aircraft and helicopters are considered. The relation between work and wages in socialist society is reviewed, and some questions connected with the determination of air transport tariffs and of the relation between cost and revenues are examined. Some developmental trends noted in the air transport of capitalist countries are cited. A.B.K.

A72-14151 # Aviation and the environment in the nineteen seventies. P. G. Masefield. *National Aviation Club, American Institute of Aeronautics and Astronautics, and Society of Automotive Engineers, William Littlewood Memorial Lecture, 1st, Washington, D.C., Nov. 19, 1971.* 116 p.

The formative years of air transport through the decade from 1927 to 1937 are reviewed, giving attention to DC-3 development and the first airline service. Data of DC-3 production are discussed together with questions of DC-3 economics. Discussions regarding the development of a new wide-body aircraft capable of flying in and out of small airports began in January 1966. The new aircraft, the DC-10, flew its first scheduled service in August 1971. Operational and economical data for the supersonic Concorde and the B707 and the B747 are compared, and attention is given to possible harmful effects of the SST on the balance of the upper atmosphere. Problems of atmospheric pollution and of noise are examined. Present economic problems in the air transport field are mainly connected with inflation, traffic growth, new equipment, the capacity/load factor/frequency equation and fare structures. G.R.

A72-14196 Computer-aided design of avionic systems aerospace ground equipment. R. Fischer and L. W. Wagner (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: Institute of Electrical and Electronics Engineers, Southwestern Annual Conference and Exhibition, 23rd, Houston, Tex., April 28-30, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 338-345.

Simulation of the real-world environment to be used in the evaluation of equipment design is treated in terms of the use of computer-aided design tradeoffs needed in the definition of equipment used for testing avionic systems. These design tradeoffs are

directed to the evaluation of test equipment use and the optimization of design for support rather than the selection of components. To determine optimum test times, the design can be perturbated by considering various degrees of automation vs manual operation, use of two operators vs one for checking two units simultaneously, and elimination of certain tests vs provision of equipment components which perform the test more rapidly. M.M.

A72-14201 Nondestructive testing - A condition monitored maintenance tool. W. J. Weldon (American Airlines, Inc., Tulsa, Okla.). In: Institute of Electrical and Electronics Engineers, Southwestern Annual Conference and Exhibition, 23rd, Houston, Tex., April 28-30, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 362-367.

Nondestructive testing is the use of advanced electronic technology to permit the monitoring and inspection of materials to determine their integrity. This paper describes a recent change in the maintenance programs employed by the airlines to assure the integrity of their airframes, powerplants, and components. Nondestructive testing plays a very vital role in these maintenance programs by permitting critical areas to be monitored with relatively minor open-up to permit access to perform the inspection. (Author)

A72-14234 Advanced composite cost comparison. D. D. Dial and M. S. Howeth (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *SAMPE Quarterly,* vol. 3, Oct. 1971, p. 17-26.

Relative cost comparisons of advanced composite applications with conventional material components are presented. Specific detailed comparison studies are described on several components selected from the F-111A supersonic fighter-bomber. These comparisons include material and labor required to fabricate the wing trailing edge panel, wing pivot fitting doubler, and wing pivot fairings. The engineering advantages offered by advanced composites are significant and material costs are decreasing; therefore, continued application assessment is imperative. (Author)

A72-14238 Some aspects of the design and performance of protective aircraft coatings. H. Singh (Products Research and Chemical Corp., Burbank, Calif.). *SAMPE Quarterly,* vol. 3, Oct. 1971, p. 45-48. 8 refs.

The basic requirements of an elastomeric protective coating are discussed in the light of the existing electrochemical theories of metallic corrosion. Coating systems based upon two different polymer types and different approaches to offer corrosion protection to the metallic substrate are described and their performances evaluated. On the basis of experience acquired with these two coating systems, the design of a new coating system - superior in performance and versatile in application - is discussed. (Author)

A72-14301 A-300B wings. W. E. Goff. *Flight International,* vol. 100, Dec. 9, 1971, p. 933-937.

Description of the A-300B Airbus mainplane, which consists of the center section and cantilever right and left wings. In structural layout, the wing is a two-and-one-half spar type, but otherwise the wing follows conventional two-spar construction. The procedures for skin forming, skin-stringer assembly, automatic riveting, torsion-box assembly, and machining the root-end profile are outlined in detail. F.R.L.

A72-14419 A mini solution to a maxi problem - Control of surfactants in turbo fuel. *ESSO Air World,* vol. 24, no. 2, 1971, p. 42, 43.

Description of a method of detecting surface active agents (surfactants) in jet fuel. Surfactants cause the filtering process to fail, and contaminants remain in suspension to be carried into the engine. The surfactants also interfere with normal water drain practices by keeping condensed water in suspension. A device is described (the Minisonic Separometer) which uses an ultrasonic vibrating mechanism to emulsify water with fuel. This mixture is filtered through small coalescing disks, and the water retention or turbidity of the filtered sample is determined by a photoelectric cell. F.R.L.

A72-14431 * # A nuclear powered air cushion freighter for the 1980's. J. L. Anderson (NASA, Lewis Research Center, Cleveland, Ohio). *American Nuclear Society, Winter Meeting, Miami Beach, Fla., Oct. 17-21, 1971, Paper.* 33 p. 14 refs.

A design for a transoceanic, dry cargo-carrying freighter is suggested; its use and operation in port are discussed. With a gross weight of 4500 metric tons (5000 tons), more than 50 percent of which is cargo, it will cruise at 50 meters per second (100 knots) in waves 2.4 meters (8 ft) high. Its peripheral jet-flexible skirt air cushion concept and air thrustors will let the freighter go over waves 8 meters high at reduced velocity. Power comes from a 1280 megawatt, helium-cooled thermal reactor. It could dock at any major port in the world, but because it needs no surface contact, it could also travel inland to land-locked ports. A modular terminal design and methods of cargo transfer are suggested. The concept of cargo containerization influences both the freighter and terminal design. (Author)

A72-14450 # Ramjet engine - The propulsion device for future large supersonic aircraft (Statoreactorul - Propulsorul viitorilor giganţi supersonici). A. Curtoglu. *Transporturi Auto, Navale şi Aeriene,* vol. 1 (18), Aug. 1971, p. 431-434, 439. In Rumanian.

Brief description of the ramjet engine, and of certain aspects related to functional thermodynamics. This engine is compared with other engine types for the purpose of obtaining speeds in excess of M = 2.5 (over 2500 km/hr). M.M.

A72-14460 Steady two-dimensional cavity flow past an infinite number of aerofoils using linearized theory. T. V. Davies and S. P. Ho (Leicester, University, Leicester, England). *Quarterly Journal of Mechanics and Applied Mathematics,* vol. 24, Nov. 1971, p. 445-459.

The paper discusses the problem of the flow past an infinite number of identical, sharp-edged, equally spaced aerofoils to which are attached finite vapor-filled cavities in the wakes. An exact solution to this flow problem is obtained using the linearization hypothesis. A detailed study is made of the cavity length, lift and drag on an individual aerofoil and simple formulae are presented in the case of aerofoils of constant slope. An important result is that the cavity length increases and the lift decreases as the spacing of the aerofoils is diminished; the cavity length becomes infinitely long in certain circumstances of spacing and aerofoil slope. Part of the motivation here is the need to understand mutual interference effects in cavity flows past turbine blades and the present problem was posed to assess this in as simple a geometry as possible. (Author)

A72-14484 Air traffic control for the North Atlantic. R. Hershkowitz (U.S. Department of Transportation, Transportation

Systems Center, Cambridge, Mass.). In: FEC '71; Institute of Electrical and Electronics Engineers, Fall Electronics Conference, Chicago, Ill., October 18-20, 1971, Proceedings.
New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 261-269. 23 refs.

Summary of the essential features of a North Atlantic (NAT) traffic study undertaken at the Transportation Systems Center. The emphasis is on summarizing the important aspects of the collision risk model currently used to assess safety standards. This model derived by Reich, and adopted and extended by the North Atlantic Systems Planning Group, relates accident levels to aircraft and airspace parameters. Extensions of the original model are briefly discussed, and preliminary results are presented. These extensions seek to include the effects of inertial navigation and positive air traffic control on the routing structure in the NAT region. G.R.

A72-14591 **Accelerated testing set for F-14A.** D. A. Brown. *Aviation Week and Space Technology,* vol. 95, Dec. 20, 1971, p. 49-53.

Discussion of an accelerated Navy/Grumman test program for the F-14A fighter aimed at a roughly 18-month cut of the normal development cycle to make the craft operable in 1973. Details are given on a series of 20 specific tests covered by the program. It is expected that the craft will have more than 3600 hr of flight test time when it is ready for BIS trials in January 1973. V.Z.

A72-14592 **Telemetry system may cut F-14 test time.** K. J. Stein. *Aviation Week and Space Technology,* vol. 95, Dec. 20, 1971, p. 54-57.

Discussion of an automated telemetry system developed by Grumman Aerospace Corp. to provide a real-time analytical capability for the Navy/Grumman test program. The system makes data largely available during the flight and totally available for postflight debriefing sessions. It is anticipated that the use of the system may reduce by half the aircraft flight test time. V.Z.

A72-14676 # **Fine structure of the medium and upper stratosphere: Detection of clear air turbulence - Application to flights anticipated for supersonic transport aircraft (Structure fine de la stratosphère moyenne et élevée: Détection de la turbulence en ciel clair - Application aux vols envisagés pour les avions de transport supersoniques).** G. D. Barbé (Etablissement d'Etudes et de Recherches de la Météorologie Nationale, Paris, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 37 p. 14 refs. In French.

Discussion of the vertical and horizontal distribution of the circulation and air temperature of the stratosphere, which in certain cases is very turbulent, more so, it appears, than the troposphere. Clear air turbulence (CAT) can be encountered at altitudes several km above the levels flown by present-day transports. Temperature variations amounting to several degrees have been measured within air layers about 100 m thick and 10 km long. In certain cases, this temperature variation affects thicker layers. A certain correlation appears to exist between CAT and the 'irregularities' measured either in a vertical or horizontal plane involving temperature and the horizontal wind vector. F.R.L.

A72-14677 # **Airport fog dispersal in the United States.** W. B. Beckwith (United Air Lines, Inc., Chicago, Ill.). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 17 p. 17 refs.

Crushed dry ice is the common cold fog seedling agent which has been employed successfully by the airport fog seeder for eight years. Liquid propane is one of the several low boiling point compounds which has been dispensed from ground units to disperse cold fog. Problems of an operational evaluation are discussed, and an economic evaluation of fog dispersal methods is presented. G.R.

A72-14678 # **On the determination of minimum flight time routes at SST flight altitudes (Sur la détermination des routes à temps de vol minimal aux altitudes de vol S.S.T.).** J. Bessemoulin (Etablissement d'Etudes et de Recherches de la Météorologie Nationale, Paris, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 14 p. In French.

Consideration of the problem of optimal routes for the SST, which problem is of importance because of its economic consequences. The major factor is temperature, followed by unfavorable meteorological conditions and winds. It is shown to be possible to take account of these effects with a simple model. Using this model, an actual situation is studied. F.R.L.

A72-14680 # **Meteorological assistance for Concorde test flights (L'assistance météorologique aux vols d'essai Concorde).** H. R. Cazale (Etablissement d'Etudes et de Recherches de la Météorologie Nationale, Toulouse, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 19 p. 6 refs. In French.

Application of meteorological information to the various phases of the test flights. The essential element of flight records is the vertical cut of temperatures and winds, with location of clear air turbulence zones. The two most important problems are prediction of the turbulence in the high troposphere in the course of special tests or in the transonic phase of flights, and the prediction of the temperature in the lower stratosphere during flights at Mach 2. The large thermal variation in the low stratosphere requires instruments which are more accurate than those currently in use. F.R.L.

A72-14681 # **The dynamics of the upper atmosphere and supersonic flight (La dynamique de la haute atmosphère et le vol supersonique).** C. Dousset and R. Joatton (Société Nationale Industrielle Aérospatiale, Paris, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 24 p. In French.

Discussion of turbulence in the upper atmosphere, the existence and prediction of which is important for supersonic transport. Meteorological conditions and the associated temperature gradients react on the dynamics of the aircraft and the comfort of the passengers. The knowledge of the correlations between meteorological data and the dynamic conditions is thus one of the objectives of the prototype Concorde. These prototypes furnish information on the frequency and amplitude of accelerations, associating them progressively to temperature gradients and concentrations of ozone, water, and dust. F.R.L.

A72-14682 # **The use of specially instrumented aircraft in support of environmental research.** H. A. Friedman (NOAA, Research Flight Facility, Miami, Fla.). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 10 p. 10 refs.

Efforts of the U.S. Department of Commerce to obtain environmental data with specially instrumented aircraft had its beginning in 1956 under the National Hurricane Research Project. The research program was continued by the Weather Bureau and then by the Research Flight Facility. Instrumented drones were used to support both domestic and world-wide research projects such as Project Stormfury, the International Indian Ocean Expedition and the Barbados Oceanographic and Meteorological Experiment. G.R.

A72-14683 # **Severe storm effects on operations of supersonic aircraft.** J. L. Goldman. *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 8 p. 6 refs.

It is shown that a severe storm can affect the operations of supersonic aircraft significantly out to a radius of about 1500 miles from the storm. Waves initiated at the storm top and propagated along the tropopause may have vertical velocities of 10 m/sec acting on the aircraft at distances out to 1500 miles from the storm center. These velocities will act for 30 seconds and 15 seconds for aircraft speeds of Mach 1 and Mach 2. The amplitude of the perturbation increases toward the storm by a factor of 3. G.R.

A72-14684 # **Meteorology and gliding flight (Météorologie et vol à voile).** N. Gerbier (Etablissement d'Etudes et de Recherches de la Météorologie Nationale, Paris, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 11 p. In English and French.

Examination of the close relationship between aerology and gliding flight which is necessary to enable the pilot to take the best advantage of atmospheric energy. The effectiveness of meteorological assistance depends not only on the capabilities of the forecaster, but also on numerous personal contacts with pilots. Forecast formats and symbols used during international competitions are presented. F.R.L.

A72-14687 # **The aircraft as an observing platform.** S. J. Lacy (NOAA, National Weather Service, Silver Spring, Md.). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 12 p.

The history of the collection and use of meteorological reports from aircraft in the U.S. is traced from the early 1900s to the present. The current system for collection and dissemination of these data and their application and utilization by the National Weather Service is described. The value of a system for providing continuous in-flight monitoring of meteorological parameters to the meteorological service and its users is outlined. Some of the problems related to the establishment of such a system are discussed. (Author)

A72-14688 # **Exploitation of category IIIa minima at Air Inter (Exploitation des minima catégorie IIIa à Air Inter).** Larribiere and Lacombe. *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 9 p. In French.

Use of the Sud Lear all-weather landing system by Air Inter as a means of keeping schedules. The preparations for putting the system in service, and the actual setting up of the system are discussed. This involved crew training and obtaining of minima. Since the installation of the system schedules have been kept so well that passenger bookings have not declined during the winter. F.R.L.

A72-14691 # **Measurement of altitude of the cloud base by optical telemetry (Mesure de l'altitude de la base des nuages par télémetrie optique).** J. Morch (Schlumberger Instruments et Systems, Vélizy-Villacoublay, Yvelines, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 10 p. In French.

Description of the TNN 1000 apparatus for measurement of cloud base altitude. Telemetry determines the altitude by measuring the time taken by a brief emission of light to cross the outward and inward distance between the ground and the base of a cloud which rediffuses the light. The measurement field of the TNN 1000 is between 15 and 1000 m of altitude. Compared to earlier apparatus, the device takes advantage of very modern technology and offers greatly reduced maintenance. It integrates itself easily into the complex assemblies of airports operating automatic weather stations. F.R.L.

A72-14693 # **In-flight aircraft turbulence.** E. R. Reiter (Colorado State University, Fort Collins, Colo.). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 21 p. 9 refs.

Severe clear-air turbulence (CAT) is strongly intermittent. It, therefore, does not satisfy all the assumptions underlying turbulence theory for the inertial subrange. Similar intermittency conditions apply very likely for turbulence in convective clouds. Examples are given from mountain-wave induced turbulence. Under severe CAT conditions a 'gap' appears in most kinetic energy spectra of atmospheric motions at eddy scales somewhat larger than 1 km. This implies that most atmospheric conditions causing CAT in conventional jet aircraft may affect an SST with even greater eddy kinetic energies. G.R.

A72-14694 # **Warm fog dissipation programs in the United States.** B. A. Silverman (USAF, Cambridge Research Laboratories, Bedford, Mass.). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 25 p. 13 refs.

Warm fog dissipation research in the United States is focused on the development of four main techniques - i.e., helicopter downwash mixing, the application of heat, hygroscopic particle seeding, and seeding with polyelectrolytes. The computational, laboratory, and experimental studies that are being conducted in connection with this research are described. The significant results of these studies are summarized. Problems associated with the further development, acceptance, and implementation of these techniques are discussed. (Author)

A72-14695 # **The problems posed by the meteorological equipment of a large airport and the solutions adopted for Roissy en**

France (Les problemes que pose l'équipement météorologique d'un grand aéroport et les solutions adoptées pour Roissy en France). P. Wagner-Autesserre (Etablissement d'Etudes et de Recherches de la Metéorologie Nationale, Paris, France). *Société Météorologique Française and American Meteorological Society, Colloque sur la Météorologie Aéronautique, Paris and Orly, France, May 24-26, 1971, Paper.* 8 p. In French.

Study of an automated grouping of meteorological services, certain elements of which could be extended to the terminals of other airports in the Paris area. A large system of meteorological telemetry will ensure the equipping of the runways and the meteorological coverage of the airport. A system of aeronautic interrogation response is described. F.R.L.

A72-14726 Aircraft integrated data systems. H. C. Vermeulen and F. H. Hawkins (KLM - Royal Dutch Airlines, Schiphol Airport, Netherlands). *Shell Aviation News,* no. 401, 1971, p. 6-11.

Review of the history and current status of aircraft integrated data systems, which started with an analog phase, and later made use of digital systems. Airline experience suggests that AIDS data can be used most effectively in the areas of flight safety analysis, crew proficiency, autoland evaluation and perfection, engine health monitoring, operations and logistics, aircraft and engine performance monitoring, and ad hoc analysis. Technical details of AIDS are discussed. F.R.L.

A72-14742 Designing with composite materials; Institution of Mechanical Engineers, One Day Discussion, London, England, October 28, 1971, Proceedings. London, Institution of Mechanical Engineers, 1971. 125 p.

Economics aspects of composite materials are discussed together with the use of fiber composites in engineering, designing with short fiber composite materials, and the use of glass reinforced thermosetting resins for pipeline applications. Other subjects covered include the design and the application of boron/aluminum to flight structures, the design of airframe components, and materials selection for carbon fiber reinforced sliding components. Uses of reinforced thermoplastics for gears and bearings and general questions regarding the design with composite materials are also considered.

G.R.

A72-14743 # Some economics aspects of composite materials. B. Locke (National Research Development Corp., London, England). In: Designing with composite materials; Institution of Mechanical Engineers, One Day Discussion, London, England, October 28, 1971, Proceedings. London, Institution of Mechanical Engineers, 1971, p. 5-18. 10 refs.

Composite articles and components will sell into applications where there is overall economic advantage in using them - and the prices which customers will pay will then determine the manufacturing costs that can be borne. The costs of making composite articles from their various constituents in turn depend on the methods the designer uses to achieve the properties that the customer wants. Design techniques derive from the opportunities that high-property reinforced technology can make available. Design in advanced composites should not and cannot rely on the body of experience of materials properties, behavior, fabrication, use, standards, and testing that is ordinarily taken for granted when conventional materials are used. With high-property composites analogous experience along these and other lines will need to be encouraged to evolve almost from the beginning. G.R.

A72-14745 # Design and application of boron/aluminum to flight structures. J. D. Forest (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: Designing with composite materials; Institution of Mechanical Engineers, One Day Discussion, London, England, October 28, 1971, Proceedings. London, Institution of Mechanical Engineers, 1971, p. 61-70.

Major advantages of composites in flight structures are high strength and stiffness coupled with low density, which can produce dramatic reductions in system weight and major performance increases. Of the several types of advanced composites - graphite and boron/epoxy, boron/aluminum, etc. - boron/aluminum possess somewhat lower specific strength and stiffness. There are several other advantages of boron/aluminum, however, that can result in this system being the most suitable choice for many applications. Advantages include higher transverse and shear properties, higher buckling resistance, greater thermal stability, higher thermal and electrical conductivity, and more freedom in secondary fabrication and joining. The major drawback of boron/aluminum at present is its high cost, but there are indications that major cost reductions will be possible in the near future. (Author)

A72-14746 # Design of airframe components in carbon fibre composite. I. C. Taig (British Aircraft Corp., Ltd., London, England). In: Designing with composite materials; Institution of Mechanical Engineers, One Day Discussion, London, England, October 28, 1971, Proceedings. London, Institution of Mechanical Engineers, 1971, p. 71-79.

Unusual characteristics of carbon fiber composites are compared with conventional materials and the design technology to exploit these characteristics is outlined. Several facets of design are considered in more detail to illustrate the amount of new thinking, research, data collection and analytical development which are needed. The selected topics are design criteria, design of laminates to carry specific loads and analysis and design of components. The concluding section on actual structures under development shows the disparity between the methods currently used for prototype development and those needed for routine design. (Author)

A72-14809 Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. Conference sponsored by the American Institute of Aeronautics and Astronautics and the Federal Aviation Administration. New York, American Institute of Aeronautics and Astronautics, Inc., 1971. 480 p. Members, $40.; nonmembers, $50.

Papers made available at the conference cover both philosophical and technological aspects of air transportation, including environmental considerations, planning, operations, designs, and projections for the future. Sonic boom and other noise problems, advanced landing systems, air turbulence detection, and computer technology are covered.

V.Z.

A72-14810 # Technologic and economic impact of air traffic control on aviation's future public value. G. Litchford. In: Air

transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 63-73. 26 refs.

The impact of advancing electronic technology on flight operations is discussed in terms of the future public value of aviation. Special attention is given to the economic impact of a new microwave landing system, visualizing its potential money saving rewards. Further acceleration of the Air Traffic Control Beacon Program with full altitude reporting by air is recommended. V.Z.

A72-14811 # **The future of conventional aircraft.** J. M. Swihart (Boeing Co., Seattle, Wash.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 75-97. 7 refs.

Requirements for better solutions to inhibiting elements of the American aviation system are discussed with projections through 1990. Forecasts are given for the possible growth of the passenger and freight markets and for the airplane types that may come up to handle this growth. The role of the FAA in coping with the future situation to maintain the economic health of the industry is discussed. V.Z.

A72-14812 * # **Fog dispersal technology.** W. A. McGowan (NASA, Washington, D.C.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 99-110.

The state-of-the-art in fog dispersal technology is briefly discussed. Fog is categorized as supercooled fog, occurring in air temperatures below freezing, and warm fog, occurring at above-freezing temperatures. Operational techniques are available to disperse supercooled fog in the airport area. It is much more difficult to cope with warm fog. Various known concepts to disperse warm fog are evaluated as to their operational merits. The most effective concept for immediate use involves heating the air to cause fog evaporation. Use of helicopter downwash has some application, possibly complementing the promising concept of seeding with sized hygroscopic particles. These latter two concepts appear to have future application, pending further research. The concept using polyelectrolytes is of uncertain value, lacking both a scientific explanation and a substantive evaluation of reported operational successes. (Author)

A72-14813 # **Closing the information gap in the cockpit.** W. C. Schultz (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 111-124. 45 refs.

Situations in which the pilot of a large jet transport lacks information for a quick decision to identify danger are discussed. Some crashes are referred to in a characterization of such situations. It is suggested that a large central readout in the prime area of the panel showing most critical information at a given time be added to alphanumeric cockpit displays to overcome occasional gaps in cockpit information transfer to the pilot. V.Z.

A72-14814 # **Air transport maintenance technology needs a new regulatory model.** T. D. Matteson. In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 125-137. 11 refs.

Suggestions are given as to how the highest operating safety levels and the improved effectiveness of the air transport maintenance process can be integrated in a single National Aviation System program. The definition of airworthiness, the regulatory models of air transport maintenance technology, and safety and reliability vs design requirements are discussed. V.Z.

A72-14815 * # **Sonic boom generation propagation and minimization.** A. Ferri (New York University, New York, N.Y.) and I. R. Schwartz (NASA, Supersonics, Aerodynamics and Vehicles Systems Div., Washington, D.C.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 139-164. 78 refs. Grant No. NGL-33-016-119.

Factors influencing the generation and propagation of sonic boom are discussed, covering predictions of sonic boom levels, effects of atmospheric conditions, and effects of ground characteristics. Also discussed are experimental techniques for sonic boom studies, and approaches to the reduction of sonic boom signatures. V.Z.

A72-14816 # **Time/frequency technology for collision avoidance.** A. Browde (McDonnell Douglas Corp., St. Louis, Mo.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 165-169.

The Time/Frequency Collision Avoidance System, the EROS II Collision Avoidance Unit, and the Micro CAS system are discussed. Other collision avoidance techniques and their modifications worked upon at McDonnell Douglas are given a brief evaluation. It is pointed out that the operation of a collision avoidance system of this design reduces cockpit and controller workload. V.Z.

A72-14817 # **Technology for terminal area traffic guidance and control.** D. Graham (Princeton University, Princeton, N.J.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 171-179. 14 refs.

Automation of terminal area traffic control, all-weather precision approach and landing, and an improved failure detection with increased redundancy are discussed as approaches to a more effective area traffic guidance. Phased array radars, guidance for curved approaches and the windproofing of the approach and landing are suggested as elements facilitating this goal. V.Z.

A72-14818 # **General aviation and air traffic control long range planning.** B. Alexander (General Research Corp., Santa Barbara, Calif.). In: Air transportation and society; Proceedings of

the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 181-197. 15 refs.

It is anticipated that general aviation demand for services will continue to grow, that the general aviation fleet and pilots will increasingly be equipped for the infrared, that transponders will be widely used and that the data box for IPC will find a market in the future. It is also visualized that FAA terminal and flight service functions will be conspicuous features of general aviation by the early 1980's. V.Z.

A72-14819 # **Effects of aircraft operation on community noise.** M. C. Gregoire and J. M. Streckenbach (Boeing Co., Commercial Airplane Group, Seattle, Wash.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 199-208. 10 refs.

Several means of reducing community noise through changes in airplane operations are discussed and specific examples given. The discussion is divided into two general areas of responsibility: regulatory changes affecting traffic in the airport vicinity and operational or procedural changes available to the airlines. The latter category is further divided into those procedures currently optional to the pilot and airline and those that can be made available through airplane system modifications. Flight profiles for specific airplanes at specific airports are included, along with the noise reductions available. System block diagrams and actual flight data are provided when available. It is concluded that significant reductions in community noise can be attained through operating changes, without affecting safety, and at low cost. Recommendations are made for a course of action to define and implement feasible techniques. (Author)

A72-14820 # **Status of fan and compressor noise.** M. J. Benzakein (General Electric Co., Cincinnati, Ohio). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 209-233. 12 refs.

Evaluation of work made by the aircraft industry over the last two decades in noise minimization which resulted in engine noise level reductions from 13 to 15 PNdB's and has led to the development of aircraft types which meet the FAA noise requirement, FAR-36. Details are given on the projected noise requirements to be met by CTAL and STAL aircraft in the next five to ten years. Fan noise, compressor and turbine noise, and secondary noise sources of the turbofan engine are covered. The intensive R&D work to be done to meet the environmental noise minimization requirements of the 1980's for economically feasible aircraft is discussed. V.Z.

A72-14821 # **Microwave landing system guidance and control considerations.** G. Yingling. In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 235-246.

The results of an analysis of measuring system requirements for instrument low-approach are discussed. Considerations are given on the application of a general dynamic model of low approach operations for computation of landing guidance and control system elements to determine the translational motion of aircraft in an earth-fixed coordinate system. The model is applied to A-7D and DC-8 aircraft. V.Z.

A72-14822 * # **Remote detection of turbulence in clear air.** W. A. McGowan (NASA, Washington, D.C.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 251-288. 60 refs.

Various concepts for remote detection of turbulence in the clear air are reviewed. It is concluded that there is at present no technique available for operational use to remotely detect and measure turbulence in the clear air. Several techniques with good potentials for future application currently being studied include a laser Doppler radar method for airborne and ground-based use and an approach utilizing ground-based ultrasensitive microwave Doppler radars. G.R.

A72-14823 # **Collision avoidance.** R. M. Buck (FAA, Washington, D.C.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 289-308.

The principal items discussed are the collision avoidance systems (CAS) and the pilot warning instruments (PWI). A PWI is a device to assist a pilot in locating his traffic. To minimize cost, maximum use is made of the pilot's ability to detect, evaluate, and execute any necessary avoidance maneuver. The functions to be performed by a CAS include the detection of an intruder, the evaluation of the hazard, the determination of the maneuver, and the indication of the time for performing the operations. G.R.

A72-14824 # **The National Aviation System goals for technology.** R. E. Hage (Douglas Aircraft Co., Long Beach, Calif.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 317-327.

It is pointed out that the rapid growth rates of air transportation require timely and effective action in connection with environmental and economic problems. The wide-body jets now being introduced incorporate features that are significant technical advances. The high-bypass-ratio turbofan engines are not only quieter and smokeless, but consume 20% less fuel per pound of thrust than low-bypass-ratio engines. Advances in all-weather technology have provided increases in safety and operational flexibility. Problems of collision avoidance are also discussed, together with approaches to eliminate smoke and reduce aircraft noise. G.R.

A72-14825 # **A survey of airbreathing propulsion technology for aircraft.** F. Berger (Grumman Corp., Bethpage, N.Y.). In: Air transportation and society; Proceedings of the Conference, Key

Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 329-356.

A wide range of aircraft and powerplants are encompassed in the general aviation field, including 2-place aircraft with approximately 100 hp reciprocating powerplants to large executive jets that utilize the same turbofan powerplants as the commercial carriers. Current production helicopters are reciprocating engines of 180 to 300 hp ratings and turboshaft engines of 300 to 5000 hp. Other aircraft discussed include V/STOL and CTOL aircraft, subsonic transport aircraft, and supersonic aircraft. G.R.

A72-14826 # **An air surveillance system for recognizing the aircraft utilizing the RCA satellite system.** R. F. Buntschuh (RCA, Astro Electronics Div., Princeton, N.J.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 357-365.

Studies of a potential fourth-generation ATC system employing artificial earth satellites have indicated the superiority of the range-difference measurement technique from noninterrogated aircraft beacons. The aircraft autonomously emits a signal to pairs of satellites. The satellites relay the data to ground stations which determine the serial numbers of the emitting aircraft and compute the position from differences in the signal times of arrival at each satellite of a pair. User equipment, satellite requirements, and ground operations are detailed. T.M.

A72-14827 # **Technology status and prospects for electronic instrument landing systems.** S. B. Poritzky (Air Transport Association of America, Washington, D.C.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 367-370.

Outline of research and development efforts which must be pursued to achieve maximum utility of the existing international standard vhf instrument landing system for Category I, Category II, and Category IIIa operations within the next decade. In addition to the improvement and refinement of the existing ILS, it is argued that further efforts must be made to achieve national and international agreement on a single universal approach and landing guidance system which can meet the broad range of future needs that are presently being defined. T.M.

A72-14829 # ***Improved safety for non-precision approach procedures.*** G. Litchford. In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 377-381.

Discussion of the use of crossed-beam radar systems to provide low-cost nonprecision approach procedures in small airports serving general aviation and business aircraft. It is shown that crossed-beam radar provides height error even at off-zenith positions, cross-track error, longitudinal error, actual height above threshold elevation, correct setting of altimeter regardless of pressure reference, direct vhf voice reports to pilot, and other functions. No added aircraft equipment is required. T.M.

A72-14830 # **Collision avoidance for general aviation.** W. R. Lewis (American Standard, Inc., Wilcox Div., Kansas City, Mo.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 383-386.

Discussion of limited functional requirements for airborne CAS equipment to be used with various classes of general aviation aircraft. Equipment design problems are illustrated in terms of tradeoffs among complexity, protection probability, and interaction with present Air Traffic Control procedures. Logic functions, transmission modes, data handling capabilities, and equipment details are compared for limited-capability versions of airborne CAS equipment. T.M.

A72-14831 # ***Development of airborne remote clear air turbulence (CAT) detection equipment.*** A. S. Carten, Jr. and W. H. Paulsen (USAF, Cambridge Research Laboratories, Bedford, Mass.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 405-414. 16 refs.

Review of research and development efforts on methods of detecting CAT ahead of an aircraft by laser and infrared techniques, electrical charge and electric field measurements, low-frequency radar, and Doppler measurements of aircraft drift. The principal contending approaches are shown to be the pulsed Doppler laser and infrared radiometry. The laser systems are much more cumbersome and expensive, while relatively inexpensive infrared systems are virtually developed for operational deployment. T.M.

A72-14832 # **Future advances in the ATCRBS.** H. Huebscher and J. H. Gutman (Hazeltine Corp., Greenlawn, N.Y.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 415, 416.

Current limitations of the Air Traffic Control Radar Beacon System (ATCRBS) are identified, and expected developments are outlined in terms of both the technology employed and the operational and functional needs served by the system. Improvements envisioned for the next decade include the use of diversity transponders, control of the interrogator environment, development of electronic-scan cylindrical array antennas, and the introduction of a discrete address mode. T.M.

A72-14834 # **A projection of computer technology for the 1980 air traffic control system.** J. C. Nelson (Sperry Rand Corp., Univac Defense Systems Div., Washington, D.C.). In: Air transportation and society; Proceedings of the Conference, Key Biscayne, Fla., June 7-10, 1971. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1971, p. 441-490. 12 refs.

Projection of available computer technology in terms of both cost and performance over the 1970 decade, including a determination of the candidate data processing systems which may be available by the end of the decade. Since the cost-performance factors of the future air traffic control computer complex will primarily be

influenced by technology improvements in the costs and speeds of logic components, main memories, mass memories, peripherals, and communication lines and adapters (modems), a separate analysis is made of each of these areas. Initially, a baseline system of a single unit processor is assumed, and its limitation in processing throughput is determined. Subsequently, multiprocessors and array processors are considered under the subject of architectural enhancements, and their effective throughput is estimated. A.B.K.

A72-14843 Assessment of annoyance due to varying noise levels with particular reference to aircraft noise. J. L. Muller (South African Council for Scientific and Industrial Research, National Mechanical Engineering Research Institute, Pretoria, Republic of South Africa). *Journal of Sound and Vibration,* vol. 19, Dec. 8, 1971, p. 287-298. 14 refs.

This paper considers the influence of the temporal characteristics of varying noise levels, such as aircraft noise, on noise assessment. It is concluded that corrections to account for subjective response to temporal characteristics may be carried out in a simple and effective manner and that a corrected form of the equivalent noise level is the appropriate measure to employ for land use planning. (Author)

A72-14849 An improved method for assigning a dynamic magnification factor to N-waves. G. Koopmann and R. M. Orris (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 19, Dec. 8, 1971, p. 373-376.

The limitations are discussed of existing methods for assessing, in terms of N-wave typifying dynamic magnification factors (DMF), the maximum response of systems involving dynamic effects of sonic bangs on complicated structures. A modified method is then proposed that produces a significant improvement in the grouping of the DMFs. M.V.E.

A72-14914 What's new in forging. J. E. Coyne and J. D. McKeogh (Wyman-Gordon Co., Grafton, Mass.). *Machine Design,* vol. 43, Dec. 23, 1971, p. 39-44.

Advances in forging techniques and applications are discussed with special attention to a new process for a titanium bulkhead in the YF-12A aircraft. The topics include diffusion bonding which provides joints with properties matching those of the parent metal, die shimming for massive component production, the application of incremental forging to jet engine high temperature superalloys, beta forging for sophisticated titanium applications, and powder forging. V.Z.

A72-14925 Engine industry in the fight against noise - Early results (L'industria motoristica nella lotta al rumore - I primi risultati). P. L. Guida. *Aviazione di Linea - Aeronautica e Spazio,* vol. 9, Dec. 1971, p. 882-885. In Italian.

Following a brief description of the main causes of modern jet-engine noise, the various techniques adopted by manufacturers in connection with the most recent turbojets in an attempt to reduce the noise level existing in the various stages of flight are briefly reviewed. In all cases manufacturing companies are devoting utmost consideration to the new antinoise standards currently being enforced in the U.S. and other countries. M.M.

A72-14971 Theoretical distribution of the pressure and the convective heat flow at the surface of the central body of an air inlet with a live point and axial symmetry (Répartition théorique de la pression et du flux de chaleur convectée à la surface du corps central d'une entrée d'air à pointe vive et symétrie axiale). J.-P. Guibergia and R. Marmey (Aix-Marseille, Université, Marseille, France). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques,* vol. 273, no. 22, Nov. 29, 1971, p. 1109-1112. 6 refs. In French.

Consideration of bodies consisting in general of a conical forepart of variable length to which a skirt is attached tangentially, the half-meridian of which is a circular arc. In a calculation where the rotationality of the flow outside the boundary layer is neglected, the Navier-Stokes equations written in a system of intrinsic axes have been reduced, by use of the classical hypotheses of the theory of the laminar boundary layer, to a system of partial derivative equations allowing of similar solutions (local similitude). F.R.L.

A72-15071 # A route charges system for the whole of Europe. C. Silvain. *Eurocontrol,* vol. 2, no. 4, 1971, p. 4-12. Translation.

The seven Eurocontrol Member States have decided to introduce a common route charges system beginning on Nov. 1, 1971. General developments which led to this step are discussed, and it is shown that route charges are a financial necessity. A regional system holds manifest advantages for users. It became an accepted principle that route charges should be related to the cost of the facilities and services actually deployed and available to users. Under the system adopted, a flight in the Eurocontrol region attracts a single charge no matter how many countries are overflown. The overall charge for a given flight is the sum of the charges calculated individually for each State. G.R.

A72-15072 # Eurocontrol and 'Concorde' - The Toulouse-Brétigny link. J. Nouhant (CEE) and G. Frétigny (Société Nationale Industrielle Aérospatiale, Paris, France). *Eurocontrol,* vol. 2, no. 4, 1971, p. 16-20. Translation.

The link involves the ATC simulator at the Eurocontrol Experimental Centre in Brétigny and the experimental simulator installed in the Aérospatiale laboratories in Toulouse. The experimental simulator consists mainly of a cockpit, the inside of which is an exact replica of the cockpit of the Concorde. The ATC simulator will be used for assessing the effect of specific aircraft on the control system, while the flight simulator will be employed for determining the influence of ATC on aircraft utilization. G.R.

A72-15090 Honeycomb structure and its application to the Concorde rudder. J. Hamer (British Aircraft Corp., Ltd., Commercial Aircraft Div., Weybridge, Surrey, England). *Composites,* vol. 2, Dec. 1971, p. 242-245.

Description of the design and manufacture of the metal-skin/honeycomb composite structure of the Concorde rudder. The Concorde rudder is a split control surface comprising two slender wedge sectioned units hinged one above the other on the rear fin spar which are independently operated through external power control unit (PCU) arms by hydraulic jacks mounted on the fin. Each upper or lower rudder is further subdivided into two segments at the PCU arm position during manufacture and is mechanically fastened together to form the complete rudder unit. A typical rudder segment

consists of machined aluminum alloy boundary members which form the trailing edge, the upper or lower closing out rib, the front spar containing the locations for the hinges, and the PCU arm which forms the other closing out rib, the two skins and associated doubler plates, and the honeycomb core. A.B.K.

A72-15117 * Autorotating wings - An experimental investigation. E. H. Smith (NASA, Langley Research Center, Langley, Va.). *Journal of Fluid Mechanics,* vol. 50, Dec. 14, 1971, p. 513-534. 12 refs. Grant No. DAHC04-68-C-0027.

The autorotation of a flat plate about its spanwise axis was experimentally studied. Most of the work was done with a wing mounted in a 5 x 7 ft low-speed wind tunnel. The measurements consisted of the unsteady lift, drag, angular acceleration and the wing rotation rate. The flow pattern was very different from that over a static wing. The maximum and average lift, drag and angular acceleration were measured for Reynolds numbers from 25,000 to 250,000. The effect of applying driving and retarding torques to the wing was studied. A variety of wing configurations were tested, together with freely falling wings. For Reynolds numbers above 4000 the average lift and drag coefficients were comparable to those observed in the fixed axis tests, and it appeared that the flow pattern was similar. M.M.

A72-15167 # The aircraft is getting quieter (Flygplanen blir tystare). S. Engström and B. Ljungström. *Teknisk Tidskrift,* vol. 101, Dec. 9, 1971, p. 14-16, 18, 22. In Swedish.

The characteristics of the noise generated by jet aircraft are briefly outlined, and the major noise sources are identified. A review is presented of the various measures adopted so far with the aim to reduce the noise level. In particular, engine design modifications performed in several models of current jet aircraft in order to improve considerably their noise characteristics are discussed in detail. A comparison of these characteristics is made. Possibilities of additional noise elimination in future types of aircraft engines are examined. O.H.

A72-15238 Aerostructures: Selected papers of Nicholas J. Hoff. Edited by R. B. Testa (Columbia University, New York, N.Y.). New York, Pergamon Press, 1971. 309 p. $20.

A biography of Nicholas J. Hoff and a complete list of his published works precede a selection of reprints dealing with aerospace structures. Topics covered by the reproduced papers include stress analysis of aircraft frameworks, general instability of monocoque cylinders, the applicability of Saint-Venant's principle to airplane structures, concentrated load effects in reinforced monocoque structures, bending and buckling of rectangular sandwich plates, buckling of elastic columns, rapid creep in structures, creep buckling, thermal buckling of supersonic wing panels, buckling of a thin cylindrical shell under hoop stresses varying in axial direction, and axially symmetric creep buckling of circular cylindrical shells in axial compression. T.M.

A72-15246 # Gas turbines of flight vehicles (Gazovye turbiny dvigatelei letatel'nykh apparatov) /2nd revised and enlarged edition/. G. S. Zhiritskii, V. I. Lokai, M. K. Maksutova, and V. A. Strunkin. Moscow, Izdatel'stvo Mashinostroenie, 1971. 626 p. 164 refs. In Russian.

The theory, working processes, and methods of thermal and gasdynamic design of gas turbines used in aircraft engines and liquid propellant rocket engines are examined. The role played by the gas turbine in the overall arrangement of the engine is illustrated by a review of the principal gas-turbine engine designs and their operational cycles. Theoretical aspects of the computation of three-dimensional flows in turbine stages are discussed. Much attention is given to methods of cooling turbine components and to methods of calculating temperature fields in these components. The influence of cooling on the working process is assessed. The design of the principal turbine components, and the calculation of such components as blades, disks, and shafts are examined. The text book should be useful also to the gas turbine designer. V.P.

A72-15267 Sound attenuation in lined rectangular ducts with flow and its application to the reduction of aircraft engine noise. S.-H. Ko (Boeing Co., Seattle, Wash.). *Acoustical Society of America, Journal,* vol. 50, Dec. 1971, pt. 1, p. 1418-1432. 25 refs.

An investigation is made of the sound attenuation in a rectangular duct with two sides lined and with a uniform steady flow. It is found in the study of modal attenuation that the fundamental mode is not necessarily the least attenuated in lined ducts. It is shown that sound attenuation is influenced by the fluid flow; tuning frequency shifts to higher frequency with decreasing peak attenuation for downstream propagation and to lower frequency with increasing peak attenuation for upstream propagation. The effect of acoustic impedance on sound attenuation for a given duct geometry is presented as well as the effect of duct geometry on sound attenuation for a given acoustic impedance. Theoretically predicted attenuation spectra are compared with experimental results (test data for both rectangular flow duct and Boeing 747/JT9D engine). The predicted attenuation spectra are in very good agreement with the experimental results for downstream propagation. However, the present theory overpredicts the sound attenuation for upstream propagation. (Author)

A72-15357 Fluid dynamics. K. O. Friedrichs (New York University, New York, N.Y.) and R. von Mises. New York, Springer-Verlag New York, Inc. (Applied Mathematical Sciences. Volume 5), 1971. 360 p. $6.50.

The volume is composed of lectures in which the theory of perfect fluids is developed by dividing the processes in the following four steps: placing observed data into physical laws; putting the physical laws in mathematical form (thus obtaining a logically consistent system of basic equations); drawing conclusions from these differential equations; and verifying the results experimentally. The theory of perfect fluids is supplemented by a theory of viscous fluids. The systems of partial differential equations of each of these theories apply to laminar flows. The solution of boundary value problems for these systems is examined. V.P.

A72-15461 # Basic investigation on an unswept rectangular wing with an externally blown flap. P. Kuehl and D. Welte (Dornier AG, Friedrichshafen, West Germany). *Aircraft Engineering,* vol. 43, Dec. 1971, p. 12-14.

Study of the phenomenon of the jet flow spreading between the engine nozzle and the flap trailing edge, using a simple wind tunnel model of an externally blown flap. The results of initial tests with an unswept rectangular wing, intended to improve the deflection

efficiency of a single-slotted flap for a V/STOL transport aircraft without impairing the jet flap effect in flight, are reported. It is concluded that each flight phase of a flight configuration characterized by the momentum coefficient and the flap deflection has its optimum slot width. A correlation is shown which is generally valid for externally blown flaps of approximately the same geometry. F.R.L.

A72-15462 # **The theory of governing for aircraft turbo alternators.** D. O. Burns. *Aircraft Engineering*, vol. 43, Dec. 1971, p. 20-24.

Development of a basic theory of governing that can be applied to any form of turbine whether radial or axial or to any type of governor control loop, either electrohydraulic or mechanical-hydraulic. The dynamics of the throttle/turbo-alternator sequence are outlined. A throttle actuator comprising a signal amplifier, capable of accepting frequency error signals, that operates an electromagnetic torque motor coupled to an oil pilot valve controlling the motion of a ram, which can be used successfully to govern turbo-alternators, is described. Attention is given to governor loop stability, and some alternative methods of stabilization are discussed. F.R.L.

A72-15504 **Suboptimal control of the motion of an elastic rotor blade for helicopters in high-speed flight (Suboptimale Regelung der Bewegung eines elastischen Rotorblattes für Hubschrauber im Schnellflug).** J. Lückel (München, Technische Universität, Munich, West Germany). *Ingenieur-Archiv*, vol. 40, no. 6, 1971, p. 353-376. 23 refs. In German.

The motion of helicopter rotor blades in high speed flight is very sensitive to disturbing gusts, while the bending loads of the single blades highly increase. Therefore, in building up a controller, at least the flapwise bending distortion of the blades must be considered. A simplified equation of motion with flapwise bending is derived and transformed with the method of eigenfunctions. Thus it is possible to compute the transient response of an elastic rotorblade under the influence of aerodynamic loads with flapwise distortion. For the motion of a rigid rotorblade, in the linearized case being described by a differential equation of 2, order with time-varying coefficients, a suboptimal controller with low authority and bounded control is built up using a quadratic cost function. The controller's efficiency for the nonlinear case of rigid and elastical blades is investigated. Despite very small control angles and vertical gusts of 10 m/s the controller greatly decreases the flapping motion and the bending loads. (Author)

A72-15507 **Effect of strong contact discontinuities on supersonic flow around slender bodies (Der Einfluss starker Kontaktunstetigkeiten auf die Überschallströmung um schlanke Körper).** G. Böhme (Darmstadt, Technische Hochschule, Darmstadt, West Germany). *Ingenieur-Archiv*, vol. 40, no. 6, 1971, p. 420-432. 6 refs. In German.

The unsteady disturbance of flow, produced by a body crossing a contact discontinuity with supersonic speed, is treated analytically. This problem arises in shock tube studies. For slender plane bodies and bodies of revolution the problem is solved by integral transformations in a linear approximation. The contact discontinuity may be of arbitrary strength. In certain special cases simple formulas for the pressure disturbance can be found. Some results are shown in diagrams. (Author)

A72-15542 * **Characteristics of slush and boiling methane and methane mixtures.** C. F. Sindt and P. R. Ludtke (National Bureau of Standards, Institute for Basic Standards, Boulder, Colo.). In: International Congress of Refrigeration, 13th, Washington, D.C., August 27-September 3, 1971, Proceedings. Paris, International Institute of Refrigeration, 1971, p. 1-6. NASA-sponsored research. NASA Order W-12893.

Methane gas of two purities, 99.97% and 99%, was condensed to study the characteristics of the boiling liquid and the slush. In addition, binary mixtures of nitrogen and methane, and those of ethane and methane, and propane and methane, were also studied. Potential advantages of these gases when employed as fuels for high-performance aircraft, rocket engines, and motor vehicles are emphasized. O.H.

A72-15551 **Association Technique Maritime et Aéronautique, Session, 71st, Ecole Nationale Supérieure des Techniques Avancées, Paris, France, May 10-14, 1971, Proceedings.** *Association Technique Maritime et Aéronautique, Bulletin*, no. 71, 1971. 687 p. In French.

The papers considered research carried out in the fields of marine engineering and aerospace. Among them were an application of the method of perturbations to the calculation of proper modes of a structure; some practical applications of the measurement of superficial stresses by X-ray diffractometry; formation of surface recession in the course of ablation of a silicophenolic material; study of periodic pressure fluctuations on the fixed blades of a high power axial compressor; similarity of the performances of compressors using gases with different thermodynamic properties; oscillations of liquid masses contained in tanks; and a nonlinear calculation of potential flow around a wing of finite span of arbitrary form. F.R.L.

A72-15552 **Application of the method of perturbations to the calculation of the proper modes of a structure (Application de la méthode des perturbations au calcul des modes propres d'une structure).** R. Valid (ONERA, Division de Recherches, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Technique Maritime et Aéronautique, Session, 71st, Ecole Nationale Supérieure des Techniques Avancées, Paris, France, May 10-14, 1971.) Association Technique Maritime et Aéronautique, Bulletin*, no. 71, 1971, p. 77-85; Discussion, p. 86, 87. 8 refs. In French. (ONERA-TP-968)

Study of certain proper modes of vibration of an aerospace structure, certain of which have a particular importance in the development of dangerous or injurious phenomena such as aeroelastic instabilities or fatigue. To judge the influence of structural modifications on these privileged modes, or couplings with other structural elements, it is most often necessary to calculate numerous other modes. A step-by-step perturbation method is proposed which makes it possible to follow these effects on one or several modes selected to the exclusion of others. The important case of confusion of frequency is discussed. An elementary application makes it possible to judge the accuracy of the algorithm. F.R.L.

A72-15558 **Nonlinear calculation of the flow with potential around a wing of finite span of arbitrary form (Calcul non linéaire de l'écoulement à potentiel autour d'une aile d'envergure finie de forme arbitraire).** T. S. Luu, G. Coulmy (CNRS, Centre de Calcul Analogique, Châtillon-sous-Bagneux, Hauts-de-Seine, France), and J. Sagnard (Société d'Etudes de Constructions de Souffleries, Simulateurs et Instrumentation Aérodynamique, Paris, France). *(Association Technique Maritime et Aéronautique, Session, 71st,*

Ecole Nationale Supérieure des Techniques Avancées, Paris, France, May 10-14, 1971.) Association Technique Maritime et Aéronautique, Bulletin, no. 71, 1971, p. 243-251; Discussion, p. 252-254. 6 refs. In French.

Development of a method of calculation based on the technique of singularities to treat the three-dimensional flow of a perfect incompressible fluid around a wing. The condition of exact sliding is applied, this condition defining a Neumann problem for the potential of velocities which is generated by two distributions of simple and double layer on the superficial surface of the wing, and of double layer on the sheet of free vortexes. The technique of singularities of discretized distribution leads to a numerical solution of the problem. An example of application dealing with an arrow-shaped wing with nonzero thickness is presented. F.R.L.

A72-15566 * **A generalized theory on the noise generation from supersonic shear layers.** S. P. Pao (Wyle Laboratories, Inc., Huntsville, Ala.). *(British Acoustical Society and Royal Aeronautical Society, Aerodynamic Noise Symposium, Loughborough University of Technology, Loughborough, Leics., England, Sept. 14-17, 1970.) Journal of Sound and Vibration*, vol. 19, Dec. 22, 1971, p. 401-410. 14 refs. Contract No. NAS8-25893.

A generalization is presented of Phillips' (1960) theory of noise generation by supersonic turbulent shear layers. Both Mach wave radiation and non-Mach wave noise radiation mechanisms are considered. The range of validity of Phillips' theory has been expanded to include the low supersonic and transonic ranges. These generalizations are important not only for their analytical rigor, but also for their prospective applications to practical problems in jet noise prediction and control. The noise generation mechanisms in a supersonic jet are found to differ from those in a subsonic jet. The theory is considered to offer some prospects of answering important questions in supersonic jet noise, such as noise source distribution, mean flow refraction effects, directivity, spectrum, and efficiency of noise radiation. M.V.E.

A72-15568 * **A note on multiple pure tone noise.** M. Kurosaka (GE Corporate Research and Development Center, Schenectady, N.Y.). *Journal of Sound and Vibration*, vol. 19, Dec. 22, 1971, p. 453-462. 10 refs. Contract No. NASw-1922.

A theoretical investigation of multiple pure tone noise is presented. An analysis based on a two-dimensional inviscid flow model is developed to predict the generation and subsequent evolution of multiple pure tone noise from prescribed blade-to-blade nonuniformities in the rotor geometry. The results show that even small nonuniformities within manufacturing tolerances can be a significant source of multiple pure tone noise. Among the nonuniformities investigated, errors in blade spacing are less significant multiple pure tone noise sources than errors in blade stagger or blade contours. (Author)

A72-15625 **Are wind measurements of mountain stations usable in guiding small aircraft traffic (Können die Windmessungen von Bergstationen zur Beratung des Kleinflugverkehrs herangezogen werden).** K. W. Grober. *Meteorologische Rundschau*, vol. 24, Nov.-Dec. 1971, p. 188-192. In German.

Wind measurements of four German mountain-stations are compared with neighboring radar-winds. The result of this comparison is the knowledge in the same level wind direction as well as wind velocity differ from each other partly in a considerable manner. Noticing moreover the fact that wind conditions change in vertical direction much differently, dates concerning wind, given by mountain-stations, may not be used for briefing sport-pilots. (Author)

A72-15652 # **Tethered rotor platform for naval missions.** G. Kannamüller. *Dornier-Post* (English Edition), no. 3-4, 1971, p. 34-36.

The Kiebitz system, a tethered rotor platform intended for reconnaissance, fire control, and radio transmission assignments is described. The characteristics of the system (according to military specifications) are: a stable payload platform hovering several hundred meters above the ground; ECM safety, all-weather capability; and low risk of detection. Some additional requirements (as compared to the Army version) are placed on the Navy version of the system. The characteristics of the communications system with naval vessels, and of the ship-to-ship and ship-to-air fire control systems are discussed. V.P.

A72-15666 **Advanced military inertial systems.** M. Powley (Ferranti, Ltd., Hollinwood, Lancs., England). *Flight International*, vol. 100, Dec. 23, 1971, p. 1007, 1008.

The current trend in military aircraft is to design and install the inertial navigation system as a single piece of equipment. Recent developments which improve the accuracy of the heading reference are described in terms of requirements posed by military operations. Gyroscope details are discussed, and a new digital inertial navigation system is shown to incorporate a rapid gyro-compassing alignment feature. This system provides a performance measure of 0.5 mph CEP (circle of equal probability) after normal alignment and 1 mph CEP after rapid alignment. T.M.

A72-15713 **Information retrieval - United Air Lines operations system.** J. T. Kirkpatrick (United Air Lines, Inc., Chicago, Ill.). *(Institute of Electrical and Electronics Engineers, INTERMAG Conference, Denver, Colo., Apr. 13-16, 1971, Paper 23,3.) IEEE Transactions on Magnetics*, vol. MAG-7, Dec. 1971, p. 835-838.

The development of United Air Lines operational computer system is described. This is a medium-volume general-purpose on-line system with off-line capability, the need for such a system arose from the decentralized nature of airline operations coupled with the increasing need to automate many areas of company operations in addition to the traditional reservations and accounting functions. The computer utility is designed to handle all of the airline's message switching, flight planning and monitoring, and aircraft parts inventory control. Also under evaluation and implementation are applications involving airport terminals and air freight control. (Author)

A72-15741 # **On the symmetrically deformed delta wing, considering the flow separation at the leading edges.** E. Carafoli and Şt. Staicu (Bucureşti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 16, no. 6, 1971, p. 1151-1175. 10 refs.

This paper deals with the supersonic flow past a deformed thin delta wing, having a symmetrical distribution of incidences. As in the case of the flat delta wing, the flow detaches from the leading edges, giving rise to a layer of vortices which are located on the wing upper surface, turning into two concentrated nuclei of the same intensity and opposite signs. The formation of vortices results in the inducing of a complex downwash field, which will alter the flow such that the pressure will be finite at the leading edges. Taking account of the influence of vortices on the flow past the wing, the authors determine the pressure distribution and the aerodynamic characteristics of the wing by means of a fictitious wing, equivalent from the aerodynamical standpoint to the real wing. (Author)

STAR ENTRIES

N72-11853*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NUMERICAL METHOD OF CALCULATING THE BOUNDARY-INDUCED INTERFERENCE IN SLOTTED OR PERFORATED WIND TUNNELS OF RECTANGULAR CROSS SECTION
James D. Keller and Ray H. Wright Washington Nov. 1971 22 p refs
(NASA-TR-R-379; L-7913) Avail: NTIS CSCL 20D

A numerical method is presented for calculating the boundary-induced interference at subsonic speeds. The wind tunnel slot width or wall porosity can vary throughout the test section. The interference can be computed at any point in the test section. The model can be any configuration and can be located anywhere in the test section. Several examples are given, and comparison is made with other methods where available. Author

N72-11854# Advisory Group for Aerospace Research and Development, Paris (France).
FACILITIES AND TECHNIQUES FOR AERODYNAMIC TESTING AT TRANSONIC SPEEDS AND HIGH REYNOLDS NUMBER
Aug. 1971 409 p refs Presented at the Fluid Dyn. Panel Specialists Meeting, Goettingen, 26-28 Apr. 1971
(AGARD-CP-83-71) Avail: NTIS HC $6.00/MF $0.95

Theoretical methods and wind tunnel facilities for transonic aerodynamic testing of aircraft at high Reynolds numbers are outlined. Requirements of test facilities are clarified and possible improvements in existing facilities and testing techniques are discussed.

N72-11855# Royal Aircraft Establishment, Farnborough (England).
SCALE EFFECTS IN FLOWS OVER SWEPT WINGS
M. G. Hall *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 22 p refs
Avail: NTIS HC $6.00/MF $0.95

A review is given of the effects of variations in Reynolds number on the possible types of flow over a swept wing and the boundaries between them. Three main flow regimes are discussed in turn: the attached boundary layer which may be laminar or turbulent and where the position of transition is important; the thin wake which extends downstream from the trailing edge of the wing; and the regime of separated flow. Their interactions with the external flow and with each other are included. The flow structures are three dimensional in general. Reynolds number effects are best understood where simple extensions from two dimensions can be made. The most serious gaps in understanding are found where compressibility and strong interactions are important. Author

N72-11856# Royal Aircraft Establishment, Bedford (England).
SOME ASPECTS OF VISCOUS INVISCID INTERACTIONS AT TRANSONIC SPEEDS, AND THEIR DEPENDENCE ON REYNOLDS NUMBER
J. E. Green *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 12 p refs
Avail: NTIS HC $6.00/MF $0.95

Current understanding of viscous-inviscid interactions is reviewed, with particular reference given to the characteristics of interactions on transonic swept wings and their dependence upon Reynolds number. Interactions of three different degrees are discussed: the weak interaction between boundary layer and wake development overall and the flow field at large; the strong but localized interaction beneath shockwaves and at trailing edges in fully attached flow; and the strong interactions which involve boundary layer separation and hence have an important effect on the entire flow field. Finally, the possibilities are discussed of manipulating the boundary layer in order to simulate, in the wind tunnel, the viscous-inviscid interactions found at flight Reynolds numbers. Author

N72-11857# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
A METHOD FOR CALCULATING THE TRANSONIC BUFFET BOUNDARY INCLUDING THE INFLUENCE OF REYNOLDS NUMBER
F. Thomas and G. Redeker *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 14 p refs
Avail: NTIS HC $6.00/MF $0.95

A purely theoretical method for calculating the buffet boundary of straight and swept wings including the effects of Reynolds numbers is reported. In the procedure of calculation, Sinnott's method for estimating the pressure distribution in a transonic flow with shock waves is used, as well as the methods of Walz and Cumpsty and Head for calculating turbulent boundary layers in two- and three-dimensional compressible flow. The agreement of the theoretical calculation with experimental results from wind tunnel and flight tests at various Reynolds numbers is very satisfactory. Author

N72-11858# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
A TYPE OF STALL WITH LEADING EDGE TRANSONIC FLOW AND REAR SEPARATION
J. Osborne and H. H. Pearcey *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs
Avail: NTIS HC $6.00/MF $0.95

Surface pressure measurements are presented for a leading edge, transonic flow which occurs for high angles of incidence and for stream speeds in the medium subsonic range. A shock induced separation develops in the first 5% of the chord, and also present is the rear separation that would be expected in the low speed stall of an aerofoil having a thickness/chord ratio/greater than about 10%. Results for transition fixed and free reproduce respectively the classical features for turbulent and laminar-type interactions at the leading edge shock; these leave different disturbances in the reattached turbulent layer which then react differently on the rear separation. A few results are included for an intermediate effect on transition. The Reynolds number for all the tests was in the region of 2 x 1 million based on aerofoil chord. Author

N72-11859*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REYNOLDS NUMBER REQUIREMENTS FOR VALID TESTING AT TRANSONIC SPEEDS
William B. Igoe and Donald B. Baals *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 5 p refs

(NASA-TM-X-67412) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

The variation of wing shock location with Reynolds number has been examined for configurations for which both flight and wind tunnel wing pressure distribution data were available to determine if there is a minimum level of Reynolds numbers, short of full scale, at which reliable flow simulation can be achieved in transonic test facilities. The shock locations as a function of Reynolds numbers at conditions of constant Mach number and angle of attack were normalized so that shock position was obtained in relative terms from zero to unity for each configuration and condition studied. Normalizing the shock location permitted the comparison of data for different configurations and conditions on a common basis. Not enough data have been analyzed thus far to obtain conclusive results.
Author

N72-11860# Northrop Corp., Hawthorne, Calif. Aircraft Div.
RECENT EXPERIENCE IN THE TRANSONIC TESTING OF TWO DIMENSIONAL SWEPT AND STRAIGHT WINGS WITH HIGH LIFT DEVICES
W. E. Grahame, J. W. Headley, and L. W. Rogers *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 17 p refs

Avail: NTIS HC $6.00/MF $0.95

The results of a series of transonic tests of two dimensional wings with various high lift devices are presented. The tests were performed in an aerodynamic transonic wind tunnel on an unswept wing with a jet flap and a swept wing with boundary control devices. Both wings were tested through a Mach range of M = 0.70 to M = 0.95 and a Reynolds Numbers range of 2.5 to 5.5 million per foot. Additional tests included a supercritical wing with slot blowing and a leading edge flap with a jet flap. Comparisons of wing pressure distributions and flow visualization studies illustrate the effectiveness of the jet flap and also the high lift devices in controlling flow separation. Longitudinal characteristics which show the effects of Reynolds number are also presented. Comparative analyses indicating the improvement obtained with each of the high lift devices is shown. Author

N72-11861# National Aeronautical Establishment, Ottawa (Ontario).
THE TRANSONIC PERFORMANCE OF TWO DIMENSIONAL, JET FLAPPED AEROFOILS AT HIGH REYNOLDS NUMBERS
D. J. Peake, H. Yoshihara, D. Zonars, and W. Carter *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 39 p refs

Avail: NTIS HC $6.00/MF $0.95

Tests in the Na transonic wind tunnel were conducted to determine the effect of Reynolds numbers on the transonic performance of a 10% aft-cambered profile with jet flaps - in particular the effect on the pressure distribution, drag divergence, and buffet onset. Distributed suction was applied on the sidewalls in the vicinity of the model to insure that the interaction of the shock was primarily with the airfoil boundary layer. The absence of sidewall suction had a significant effect upon the upper surface flow, with the shock being displaced upstream by about 15% of the chord. In the range of the Reynolds number tested, there was a noticeable effect of Reynolds number on drag divergence, and a significant effect on buffet onset. Author

N72-11862# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
EXPERIMENTAL INVESTIGATION OF THE DRAG OF WINGS WITH A BLUNT TRAILING EDGE AT TRANSONIC SPEEDS
M. Tanner *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 6 p refs
Avail: NTIS HC $6.00/MF $0.95

The possible improvement of aerodynamic profiles due to blunt trailing edges, drag and lift measurements was studied on two wings of finite span in a transonic wind tunnel. The Mach number had values from 0.5 to 2.2 and the Reynolds number was about R = 1,500,000. From these results it was possible to conclude that in order to achieve a drag reduction at transonic speeds the trailing edge thickness should not be excessive and the boattailing angle should be small. Furthermore, a special broken shape of the trailing edge is favorable for low drag at these Mach numbers. At supersonic speeds the attainable drag reduction at zero lift is greater than predicted by Chapman. The lift curve slope is greater for the wing with a blunt trailing edge than for the wing with a conventional sharp trailing edge. With the most efficient blunt trailing edge the maximum lift to drag ratio at transonic speeds is only a few per cent lower than for the wing with a sharp trailing edge. Author

N72-11863# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
FORCE AND PRESSURE MEASUREMENTS ON A SLENDER DELTA WING AT TRANSONIC SPEEDS AND VARYING REYNOLDS NUMBERS
W. Stahl, K. Hartmann, and W. Schneider *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs

Avail: NTIS HC $6.00/MF $0.95

Transonic wind tunnel investigations were carried out on a slender delta wing with aspect ratio A = 0.52 at Mach numbers 0.5; 0.7; 0.8; 0.9; 0.95; 0.975; 1.0; 1.1; and 1.2 for angles of incidence up to about 30 deg. Normal force and pitching moments were measured, as well as spanwise pressure distributions on the wing's pressure and suction side at five cross sections. The Reynolds number was held constant at a value of Re = 2,700,000 for all Mach numbers. The normal force and pitching moment coefficients showed a noticeable dependence on Reynolds number, the pressure distribution was influenced mainly around the suction peak. Successful attempts were made at low Reynolds number to influence the boundary layer on the wing's suction side by means of a carborundum band. Insight was obtained into the structure of the flow field, near sonic velocities, by using a newly developed smoke visualization technique and with the help of oil flow pictures.
Author

N72-11864# Army Missile Command, Huntsville, Ala.
BODIES OF REVOLUTION AT TRANSONIC SPEEDS: THE ESTIMATION OF REYNOLDS NUMBER EFFECTS
T. H. Moulden, D. J. Spring, R. O. Saisi, K. Aoyama, and J. M. Wu *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 13 p refs
Avail: NTIS HC $6.00/MF $0.95

The experimental data presented are taken from a series of tests on a body of revolution at transonic speeds. The test Reynolds number was of the order of one million. Both mounting strut and tunnel wall interference effects are discussed. A theoretical procedure is developed to take account of the viscous effects on the body. It is shown that the potential flow theory of

Wu and Aoyama gives close agreement with experimental data. However, and particularly to study separation and Reynolds number effects, it is necessary to introduce boundary layer effects in the theoretical work. Taking the displacement surface as an equivalent body for the second approximation, it is shown that only a small change in surface pressure distribution on the body is realized. Hence, it follows that in the absence of separation a large change in Reynolds number is of little significance as far as surface pressures are concerned. The general conclusion is that for a body of revolution, tunnel and mounting interference effects are more significant than Reynolds number effects, provided the flow is not separated. Author

N72-11865# Grumman Aerospace Corp., Bethpage, N.Y.
TRANSONIC AERODYNAMIC CHARACTERISTICS AND THEIR EVALUATION
Arthur A. Lambert *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 4 p refs
Avail: NTIS HC $6.00/MF $0.95

The need for more systematic transonic wind tunnel testing to spin down the effects of flow and environment combinations and to establish a more scientific basis for flight simulation and analysis is outlined. The discussion includes the effects of steady, unsteady, and mixed flow phenomena on tools used for design and evaluation of the important transonic flight performance parameters of modern aircraft i.e., max g capability, maneuvering buffet, level flight buffet, control problems, and peak drag characteristics. The design tools include trailing edge angle criteria, the effect of various sweep lines, and wing leading edge development. Wind tunnel evaluation tools include isobar contours, pressure taps, accelerometers, tuft stands, and oil flow techniques. The effects of scale and Reynolds Number in connection with various flow phenomena and associated flight conditions are also discussed. Author

N72-11866# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TRANSONIC TESTING OF THE ENGINE NACELLE AIR INTAKE AND AFTERBODY [ENTREE D'AIR ET ARRIERE CORPS DE FUSEAU MOTEUR EN TRANSSONIQUE]
J. Leynaert *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC $6.00/MF $0.95

An example is presented of the study of a double-flux engine nacelle at high subsonic Mach numbers, the investigation being made at high Reynolds numbers with two separate models for the air intake and the afterbody. The test on the afterbody shows that the conditions of variable jets do not react significantly on the upstream flow around the nacelle intake and cowl, apart from the immediate vicinity of the exhaust; this fact justifies the large scale, study of the air intake with a model supported downstream by a cylindrical tube replacing the jet. In the same way, mass-flow rate variations of the air intake do not react on the flow around the afterbody, in a given margin; this allows the study of the afterbody on an upstream sting. Author

N72-11867# Aircraft Research Association, Ltd., Bedford (England).
POSSIBILITIES FOR SCALE EFFECT ON SWEPT WINGS AT HIGH SUBSONIC SPEEDS: RECENT EVIDENCE FROM PRESSURE PLOTTING TESTS
A. B. Haines *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs
Avail: NTIS HC $6.00/MF $0.95

The possibilities for scale effect on swept wings under supercritical flow conditions at high subsonic speeds are discussed on the basis of evidence from pressure plotting tests on a variety of wings. For the Super VC.10, comparison of pressure distributions measured in flight, and in model tests at R = 5.4 x 1 million shows some scale effect. For other designs however, the scale effect could be much greater: the paper shows that the underfixing technique has limitations when applied to a sweptback wing. Examples are included where the flow patterns are very complex with many interacting features; in such cases, it is often difficult even to forecast whether the scale effect is favourable or unfavourable. Further improvements in swept wing design will increase the likelihood of serious scale effect. Author

N72-11868# Aeronautical Research Inst. of Sweden, Stockholm.
CORRELATION OF SOME TRANSONIC WIND TUNNEL TEST DATA TO FLIGHT TEST RESULTS FOR TWO SLENDER WING AIRPLANES
Sven Erik Nyberg *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p
Avail: NTIS HC $6.00/MF $0.95

Some of the flight test data obtained on two slender wing airplanes have been correlated to transonic wind tunnel test data obtained with 1/30 and 1/50 scale models. Static stability and control derivatives as well as damping and period in pitch and dutch roll oscillations as predicted by the wind tunnel tests show good agreement with flight tests. The predicted zero lift drag for one of the airplanes was higher than the flight test drag whereas the agreement in lift induced drag was satisfactory. Predicted component loadings have been found to agree well with flight test results. Air inlet pressure recovery was slightly higher in flight than in the wind tunnel. Flow distortion at engine face shows good correlation even at high angles of attack. It is concluded from these results, that for slender wing configuration, transonic wind tunnel test data are in general reliable, even if obtained at relatively low Reynolds number. Author

N72-11869*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A COMPARISON OF SOME AERODYNAMIC DRAG FACTORS AS DETERMINED IN FULL-SCALE FLIGHT WITH WIND-TUNNEL AND THEORETICAL RESULTS
Edwin J. Saltzman and Donald R. Bellman *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 22 p refs

(NASA-TM-X-67413) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

Reliable techniques for defining flight values of overall aircraft drag and turbulent skin friction, and the drag associated with local regions of separated flow are reported. Selected results from these studies are presented for several types of aircraft, including the X-15, the XB-70, lifting bodies, and military interceptors. These flight results are compared with predictions derived from windtunnel models or, for friction, with the Karman-Schoenherr relationship. The flight experiments have defined the turbulent skin friction to Reynolds numbers somewhat above 10 to the 8th power, the overall drag of two airplanes, base pressure coefficients for aircraft and for an aft-facing step immersed in a thick boundary layer. A flight application of a splitter plate for reducing base drag is discussed along with examples of the drag associated with afterbody flow separation for shapes having relatively large afterbody closure angles. Author

N72-11870*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FEASIBILITY OF TESTING A LARGE-CHORD, SWEPT-PANEL MODEL TO DETERMINE WING SHOCK LOCATION

AT FLIGHT REYNOLDS NUMBER

Jones F. Cahill (Lockheed-Georgia Co.), Stuart L. Treon, and William R. Hofstetter *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs

(Contracts F33615-69-C01256; F33615-67-C-1777)

(NASA-TM-X-67414) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

As a part of a study of methods for simulating high Reynolds number aerodynamic characteristics of large aircraft, tests have been conducted in an 11-foot transonic wind tunnel to determine the feasibility of using a large chord wind panel model to investigate the variation of shock location with Reynolds number. The model was untwisted and was of constant chord and thickness. The airfoil section was that from one station on the span of a high speed transport airplane for which a substantial amount of flight and wind tunnel pressure distribution data had previously been obtained at widely different Reynolds numbers with indications of a large scale effect on shock lokation. The major findings from this study were that the variation of shock location on the panel model was identical in character, but considerably smaller over the Reynolds number range from 8.8 million to 28.0 million than that indicated by existing data on the complete wing. Generally, the panel model data on shock location and trailing-edge pressure recovery tended toward better agreement with flight data than with previous wind tunnel data on smaller complete models. Author

N72-11871# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

WIND TUNNEL QUALIFICATION BY PERFORMANCE PREDICTION AND FLIGHT VERIFICATION [VALIDITE DE LA SOUFFLERIE POUR LA PREVISION DES PERFORMANCES ET DES QUALITES DE VOL]

Ph. Poisson-Quinton *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 15 p refs In FRENCH

Avail: NTIS HC $6.00/MF $0.95

Summaries of brief data sheets are presented that contain information on new analytical prediction methods and flight tests for the development of transonic wind tunnels. Points of agreement as well as of disagreement are illustrated to stimulate new research for improving wind tunnel qualities. Author

N72-11872*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TRANSONIC TESTING IN EXISTING WIND TUNNELS c11

J. Lloyd Jones *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs

(NASA-TM-X-67415) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The problems of obtaining representative transonic aerodynamic data in existing wind tunnels are examined. The problems are approached by reviewing those factors which influence the accuracy of measurement and flow simulation. Examples of flow simulation anomalies are given. Demands for increased accuracy and requirements for conducting transonic investigations under conditions increasingly more susceptible to simulation anomalies are cited. Author

N72-11873# Lockheed-Georgia Co., Marietta.

SIMULATION OF FULL SCALE FLIGHT AERODYNAMIC CHARACTERISTICS BY TESTS IN EXISTING TRANSONIC WIND TUNNELS

Jones F. Cahill *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs

Avail: NTIS HC $6.00/MF $0.95

Although newly evolving concepts will enable the construction of relatively inexpensive wind tunnels capable of producing transonic aerodynamic data at flight Reynolds numbers, a substantial portion of future aircraft development testing will be done at subscale conditions. It is imperative, therefore, that methods be developed for accurate simulation of flight aerodynamic characteristics during tests at low Reynolds numbers. Several concepts for high Reynolds number simulation have been advanced, and some have been demonstrated for isolated cases. Some of these concepts are reviewed in the light of existing data. Author

N72-11874# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).

SIMULATION OF TWO DIMENSIONAL AEROFOIL FLOW AT HIGH SUBSONIC MACH NUMBERS AND HIGH REYNOLDS NUMBERS BY MEANS OF AN EQUIVALENT BODY OF REVOLUTION

W. Lorenz-Meyer *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p refs

Avail: NTIS HC $6.00/MF $0.95

In order to study the effect of high Reynolds numbers on the transonic flow past two-dimensional aerofoils, an equivalent body of revolution was constructed, having a four to five times larger chord size than the corresponding aerofoil, and giving the same rate of tunnel blockage. The contour of the body was calculated by means of a source-sink distribution. Force and pressure measurements have been performed in a transonic tunnel at Mach numbers from 0.5 to 0.925 and Reynolds numbers from Re sub l = 4 million to 16 million. In the subcritical range the results show good agreement with the calculated first-order potential flow. The evaluation of minimum pressure coefficient and shock position show that from Re sub L = 8 million no significant dependence on Reynolds number exists either at subcritical or supercritical speeds. Author

N72-11875# Hawker Siddeley Aviation, Ltd., Kingston upon Thames (England).

ON THE POSSIBILITY OF DEDUCING HIGH REYNOLDS NUMBER CHARACTERISTICS USING BOUNDARY LAYER SUCTION

Cliff L. Bore *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs

Avail: NTIS HC $6.00/MF $0.95

It seems that the most crucial differences of characteristics from wind tunnel models to full scale aircraft stem from the fact that the boundary layers on the model are usually relatively too thick. Consequently it has been suggested that full-scale behaviour may be more accurately simulated if the thickness of the boundary were reduced appropriately by means of suction through porous strips in the surface of the models. A suitable technique would afford convenient means for varying the boundary layer thickness without stopping the wind tunnel, and should be applicable to more model configurations than conventional underfixing of transition. The implications of these propositions are examined in the light of boundary layer calculations and data. Author

N72-11877# New York Univ., N.Y.

ENGINE AIRPLANE INTERFERENCE AND WALL CORRECTIONS IN TRANSONIC WIND TUNNEL TESTS

Antonio Ferri *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 6 p

Avail: NTIS HC $6.00/MF $0.95

Recent developments of high performance airplanes have generated requirements for the prediction of the aerodynamic performance of airplane designs with extremely high accuracy. A critical review of present experimental methods led to the initiation of two separate efforts related to experiments in transonic flows: (1) determination of Reynolds number effects and the design of high Reynolds number wind tunnels; and (2) correct representation in wind tunnel tests of the interaction between engine flow and airplane characteristics, and wall interference at high lift. Author

N72-11878*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC FREE-FLIGHT MODEL TESTING AT LARGE SCALE
Clarence L. Gillis *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p refs
(NASA-TM-X-67416) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

The use of free flight models for transonic testing at high Reynolds numbers is discussed. Several specific examples of experimental investigations are briefly reviewed to illustrate the scope of research that can be conducted by utilizing the advantages of free flight models. These advantages are primarily the lack of interference or constraints imposed by test facilities and model support systems and the dynamic freedom possessed by free flight models. High Reynolds numbers are obtained by using large models flown at relatively low altitudes. It is shown that models 10 meters or more in length will be required for research at Reynolds numbers sufficiently high to provide representative simulation of flow conditions for large modern aircraft. Several methods for launching models of this size are discussed. These methods include free drops from airplanes or balloons and ground launches with the use of internal or external rocket motors. All the launching methods discussed have been successfully demonstrated on flight vehicles of the size and weight required to attain the necessary test conditions. Author

N72-11879*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE USE OF FREON-12 FOR INCREASING REYNOLDS NUMBER IN WIND-TUNNEL TESTING OF THREE DIMENSIONAL AIRCRAFT MODELS AT SUBCRITICAL AND SUPERCRITICAL MACH NUMBERS c11
Stuart L. Treon, William R. Hofstetter, and Frank T. Abbott *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs
(NASA-TM-X-67417) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The aerodynamic suitability of Freon-12 for general wind-tunnel testing was investigated at low and high subsonic speeds. Static aerodynamic characteristics of two transport airplane models were determined from strain gage balance measurements in both air and Freon-12 at several Reynolds numbers. A low-speed high-lift configuration was evaluated at Mach number 0.25, and a high-speed cruise wing-fuselage combination was tested at Mach numbers up to 0.825. The data obtained in air and in Freon-12 agree well, even in stalled flow, until compressibility effects evidently become significant in air and in Freon-12 agree well, even in stalled flow, until compressibility effects evidently become significant in air. Author

N72-11880*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FACILITY CONCEPT FOR HIGH REYNOLDS NUMBER TESTING AT TRANSONIC SPEEDS c11
Donald D. Baals and George M. Stokes *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 12 p refs
(NASA-TM-X-67418) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The critical need for high Reynolds number experimental capability at transonic speeds has been broadly recognized, because there have been demonstrated significant transonic scale effects on wing-shock position with related effects on drag-rise Mach number, buffet boundary, and pitching-moment characteristics. Of the various ground-based transonic facilities considered for provision of high Reynolds number capability, the conventional wind tunnel operated in a semicontinuous mode and utilizing an energy storage system is considered to have the greatest potential. A hydropumped-storage system is proposed to provide hydraulic energy on an intermittent schedule at the rate of 500,000 horsepower to propel hydraulic turbines directly coupled to the wind-tunnel fans. Author

N72-11881# ARO, Inc., Arnold Air Force Station, Tenn. Von Karman Gas Dynamics Facility.
HIGH REYNOLDS NUMBER TRANSONIC WIND TUNNELS: BLOWDOWN OR LUDWIEG TUBE? c11
Jack D. Whitfield, C. J. Schueler, and Rogers F. Starr *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 17 p refs
(Contract F40600-71-C-0002)
Avail: NTIS HC $6.00/MF $0.95

The results are given of a detailed comparison between a conventional blowdown transonic wind tunnel and a Ludwieg tube driven transonic wind tunnel, both designed to cover the same Mach-Reynolds number regime. It is concluded that the Ludwieg tube driven tunnel will provide superior flow at a significantly lower cost. The data production capabilities of a Ludwieg tube driven tunnel, with appropriate design features, were surprisingly high. The production capability of the Ludwieg tube exceeds the conventional blowdown tunnel at very high Reynolds numbers and compares favorably with existing transonic tunnels at intermediate Reynolds numbers. Experimental results from a small Ludwieg tube-driven transonic research tunnel are presented and discussed. The research tunnel is equipped with variable-porosity test-section walls and an independently controlled plenum exhaust. Both static and dynamic pressure measurements are presented in preliminary form. Author

N72-11882*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MSFC HIGH REYNOLDS NUMBER TUBE TUNNEL c11
A. Richard Felix *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs
(NASA-TM-X-67419) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

A high Reynolds number tube tunnel is described and illustrated by drawings and photographs. Its mode of operation and performance characteristics are also described. This impulse-type tunnel has a test section diameter of 32 inches and a Mach number range from 0.2 to 2.0. The transonic test section is equipped with a variable porosity perforated wall. A maximum unit Reynolds number of 200 million per foot is produced at a Mach number of 1.3 and the maximum tunnel charge pressure of 700 psig. The useful test time is 150 milliseconds or more at all operating conditions. Some typical test section calibration results are included. Author

N72-11883# Royal Aircraft Establishment, Farnborough (England).
SOME FACTORS RELEVANT TO THE SIMULATION OF FULL SCALE FLOWS IN MODEL TESTS AND TO THE SPECIFICATION OF NEW HIGH REYNOLDS NUMBER TRANSONIC TUNNELS c11

J. Y. G. Evans and C. R. Taylor *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 13 p refs
Avail: NTIS HC $6.00/MF $0.95

Limitations and difficulties of achieving representative flow simulation in model tests are considered. Particular attention is given to obtaining design data for swept-winged aircraft at high lift coefficients, when the flow over the wing is locally transonic and sensitive to scale. Examination of the limitations due to model strength suggests that the maximum tunnel static pressure for tests at high-lift conditions is about 5atm, and consequently that full scale Reynolds numbers could only be obtained in very large tunnels. Author

N72-11884# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD STUDY OF HIGH REYNOLDS NUMBER WIND TUNNEL REQUIREMENTS FOR THE NORTH ATLANTIC TREATY ORGANIZATION NATIONS c11
Robert O. Dietz In AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p
Avail: NTIS HC $6.00/MF $0.95

Performance and operating characteristics required in two new, high Reynolds number wind tunnels are defined, and conceptual tunnel designs which meet these requirements are given. One tunnel of the Ludwieg tube type should duplicate transonic flight Reynolds numbers and have a run time of about one second. The second, a blowdown type wind tunnel, should provide Reynolds numbers that are three or four times the maximum presently available and have a run time of about ten seconds. Author

N72-11885# Air Force Special Weapons Center, Holloman AFB, N.Mex.
HIGH REYNOLDS NUMBER TESTING BY MEANS OF ROCKET SLEDS c11
Hans J. Rasmussen *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs
Avail: NTIS HC $6.00/MF $0.95

Most aerodynamic ground testing is conducted in facilities which move air under controlled conditions over ground-fixed test models. This paper invites attention to the opposite approach. Aerodynamic ground testing by moving test specimen through ambient air along a rigorously defined straight line path by means of rocket sleds is reported. Some basic technical facets of rocket sled testing are reviewed and characteristics as well as current capabilities of this technique are discussed with emphasis on aerodynamic and structural design of the test vehicles, on typical test trajectories, and on electronic and photo-optical data acquisition. Similitude considerations governing aerodynamic testing by this technique are discussed and typical examples of past, current, and planned test activities in this area are reviewed. Concluding, merits and limitations of this technique as compared to other ground test approaches and to flight tests are outlined. Author

N72-11886# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
WIND TUNNEL INVESTIGATION OF BUFFET LOADS ON FOUR AIRPLANE MODELS
R. Vanino and E. Wedemeyer *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 15 p refs
Avail: NTIS HC $6.00/MF $0.95

Buffet loads and buffet boundaries have been investigated in a transonic wind tunnel by measurements of bending moments at the wing roots for high subsonic Mach numbers. These tests were carried out for four airplane models having wings of different thicknesses and aspect ratios and also different angles of sweep. Simultaneous observation of oil flow patterns provided the means to study the relation between flow separation and buffeting. The test Reynolds numbers ranged from Re = 1 million to 2 million. Securing turbulent boundary layer at the shock position by means of artificial transition, no effect of Reynolds number of buffet boundaries was observed. For the models tested it was found that low sweep and low aspect ratio yield favorable buffet boundaries. Author

N72-11887# Royal Aircraft Establishment, Farnborough (England).
A SCHEME FOR A QUIET TRANSONIC FLOW SUITABLE FOR MODEL TESTING AT HIGH REYNOLDS NUMBER c12
J. Y. G. Evans *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 5 p refs
Avail: NTIS HC $6.00/MF $0.95

A wind tunnel suitable for future research and development towards better transonic aircraft should be able to achieve a Reynolds number, based on the mean chord of a typical swept-winged aircraft, of at least 40 million. Practical limits to model strength and stiffness dictate stagnation pressures below 7 atmospheres and consequently the test section must be at least 5 m in width. For this duty, a new type of facility is proposed, which combines the good driving efficiency of the continuous tunnel with the stored-energy advantage of intermittent running. Of particular importance, the tunnel would be relatively quiet to operate and should provide an extremely clean and steady flow. Author

N72-11888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SEVERAL POROUS CASING TREATMENTS ON STALL LIMIT AND ON OVERALL PERFORMANCE OF AN AXIAL FLOW COMPRESSOR ROTOR
Walter M. Osborn, George W. Lewis, Jr., and Laurence J. Heidelberg Washington Nov. 1971 48 p refs
(NASA-TN-D-6537; E-5973) Avail: NTIS CSCL 20D

Several geometrically different porous casings were tested with an axial-flow compressor rotor to determine their effects upon the rotor stall-limit line and overall performance. The tests were conducted using both uniform and nonuniform inlet-flow conditions. The rotor performance with the various casing treatments is compared with that obtained with a solid casing. The ability of the various casing treatments to displace the rotor stall-limit line to lower weight flows was observed. Significant stall-margin increases were obtained with several of the porous casings. Peak efficiencies with two of the porous casings were as high as or slightly higher than that obtained with solid casing. Author

N72-11889*# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 5A: EFFECTS OF TORSIONAL BLADE FLEXIBILITY ON SINGLE BLADE RANDOM GUST RESPONSE STATISTICS
Kurt H. Hohenemser and Gopal H. Gaonkar Jun. 1971 49 p refs
(Contract NAS2-4151)
(NASA-CR-114386) Avail: NTIS CSCL 01A

Quasi-steady aerodynamics were assumed, as well as a torsion mode where the amplitude is proportional to the distance from the rotor center. Aerodynamic torsional moment inputs are limited to the region of reverse flow where the aerodynamic center and the section center of gravity are separated by half the blade chord. Thus negligible effects of blade torsional flexibility are obtained for rotor conditions with negligible reverse flow effects. Numerical examples refer to conditions with 1.6 rotor

advance ratio. It was found that the random flapping response is only moderately affected by torsional flexibility. However large random torsional loads and deflections occur even if flapping is completely suppressed. The coupling of the actual flapping motion into the blade torsional motion produces a substantial increase in the random torsional loads or deflections. Author

N72-11890*# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 5B: ANALYSIS OF GUST ALLEVIATION METHODS AND ROTOR DYNAMIC STABILITY
Kurt H. Hohenemser and S. K. Yin Jun. 1971 87 p refs
(Contract NAS2-4151)
(NASA-CR-114387) Avail: NTIS CSCL 01A

The effects of various gust alleviation methods on the random blade response in flapping were studied analytically, assuming a rigid rotor support. The analytical model assumes rigid flapping blades with elastic root restraints. Linearized equations which are approximately valid at low lift conditions were used. Because of the interblade coupling from the feedback devices, the method of multiblade generalized coordinates was most convenient and was extended to include coning, differential coning, and warping of the rotor. The numerical examples cover the dynamic stability characteristics as affected by feedback gains of three- to six-bladed rotors. The number of blades had large effects on stability limits and modal time functions at these limits. The random flapping response of the blades to atmospheric turbulence was determined at 1.6 rotor advance ratio using feedback gains below the stability limit. The most effective reduction of the flapping response per unit gain was achieved with a rotor coning angle feedback. Author

N72-11891*# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 5C: DEVELOPMENT OF EXPERIMENTAL METHODS
Kurt H. Hohenemser and S. T. Crews Jun. 1971 41 p refs
(Contract NAS2-4151)
(NASA-CR-114388) Avail: NTIS CSCL 01A

Test equipment which was built and the calibration tests are described. The test equipment consists of a two-bladed rotor of 16-in. diameter, the blades of which are elastically hinged in flapping. The feathering shaft of the blades can be harmonically rotated with the help of a cam mechanism located inside the hollow rotor shaft. The frequency range measured in the rotating system can be adjusted between 0 and 80 cps and the rotor speed between 0 and 40 cps. The test equipment is for measuring the flapping response of the blades to harmonic feathering excitation. Author

N72-11892# Royal Aircraft Establishment, Farnborough (England).
FLUTTER RESEARCH IN THE UNITED KINGDOM, 1969-1971
D. L. Woodcock and A. Jocelyn Lawrence Sep. 1971 25 p refs
(RAE-TM-813) Avail: NTIS

Research projects on the subject of flutter in fixed wing aircraft are discussed. Emphasis is placed on aeroelasticity and research involving unsteady aerodynamics and vibrations. The use of hinge moment derivatives by a forced response technique is described. A numerical analysis of the aerodynamics of bodies in supersonic flow is presented. Author

N72-11895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL TECHNIQUES FOR EVALUATING STEADY-STATE JET ENGINE PERFORMANCE IN AN ALTITUDE FACILITY
John M. Smith, Chi Y. Young, and Robert J. Antl Washington Nov. 1971 39 p refs
(NASA-TM-X-2398; E-6392) Avail: NTIS CSCL 20D

Jet engine calibration tests were conducted in an altitude facility using a contoured bellmouth inlet duct, four fixed-area water-cooled exhaust nozzles, and an accurately calibrated thrust measuring system. Accurate determination of the airflow measuring station flow coefficient, the flow and thrust coefficients of the exhaust nozzles, and the experimental and theoretical terms in the nozzle gross thrust equation were some of the objectives of the tests. A primary objective was to develop a technique to determine gross thrust for the turbojet engine used in this test that could also be used for future engine and nozzle evaluation tests. The probable error in airflow measurement was found to be approximately 0.6 percent at the bellmouth throat design Mach number of 0.6. The probable error in nozzle gross thrust measurement was approximated 0.6 percent at the load cell full-scale reading. Author

N72-11896*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF SEVERAL METHODS FOR ESTIMATING LOW SPEED STABILITY DERIVATIVES
Herman S. Fletcher Washington Nov. 1971 33 p refs
(NASA-TN-D-6531; L-7914) Avail: NTIS CSCL 01B

Methods presented in five different publications have been used to estimate the low-speed stability derivatives of two unpowered airplane configurations. One configuration had unswept lifting surfaces, the other configuration was the D-558-II swept-wing research airplane. The results of the computations were compared with each other, with existing wind-tunnel data, and with flight-test data for the D-558-II configuration to assess the relative merits of the methods for estimating derivatives. The results of the study indicated that, in general, for low subsonic speeds, no one text appeared consistently better for estimating all derivatives. Author

N72-11897*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF QUADRATIC OPTIMIZATION TO SUPERSONIC INLET CONTROL
Bruce Lehtinen and John R. Zeller [1971] 11 p refs Presented at the 5th Congr. of the Intern. Federation of Autom. Control, Paris, 12-17 Jun. 1972
(NASA-TM-X-67907; E-6512) Avail: NTIS CSCL 01C

The application of linear stochastic optimal control theory to the design of the control system for the air intake (inlet) of a supersonic air-breathing propulsion system is discussed. The controls must maintain a stable inlet shock position in the presence of random airflow disturbances and prevent inlet unstart. Two different linear time invariant control systems are developed. One is designed to minimize a nonquadratic index, the expected frequency of inlet unstart, and the other is designed to minimize the mean square value of inlet shock motion. The quadratic equivalence principle is used to obtain the best linear controller that minimizes the nonquadratic performance index. The two systems are compared on the basis of unstart prevention, control effort requirements, and sensitivity to parameter variations. Author

N72-11898*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DRAG OF A SUPERCRITICAL BODY OF REVOLUTION IN FREE FLIGHT AT TRANSONIC SPEEDS AND COMPARISON WITH WIND TUNNEL DATA
J. W. Usry and John W. Wallace Washington Dec. 1971 40 p

refs
(NASA-TN-D-6580; L-8019) Avail: NTIS CSCL 20D

The forebody drag of a supercritical body of revolution was measured in free flight over a Mach number range of 0.85 to 1.05 and a Reynolds number range of 11.5 x 10 to the 6th power to 19.4 x 10 to the 6th power and was compared with wind-tunnel data. The forebody drag coefficient for a Mach number less than 0.96 was 0.111 compared with the wind-tunnel value of 0.103. A gradual increase in the drag occurred in the Langley 8-foot transonic pressure tunnel at a lower Mach number than in the Langley 16-foot transonic tunnel or in the free-flight test. The sharp drag rise occurred near Mach 0.98 in free flight whereas the rise occurred near Mach 0.99 in the Langley 16-foot transonic tunnel. The sharp rise was not as pronounced in the Langley 8-foot transonic pressure tunnel and was probably affected by tunnel-wall-interference effects. The increase occurred more slowly and at a higher Mach number. These results indicate that the drag measurements made in the wind tunnels near Mach 1 were significantly affected by the relative size of the model and the wind tunnel. Author

N72-11901*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC CHARACTERISTICS OF A LARGE SCALE MODEL WITH A SWEPT WING AND AUGMENTED JET FLAP

Michael D. Falarski and David G. Koenig Jul. 1971 104 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab.
(NASA-TM-X-62029) Avail: NTIS CSCL 01A

Data of tests of a large-scale swept augmentor wing model in the 40- by 80-foot wind tunnel are presented. The data includes longitudinal characteristics with and without a horizontal tail as well as results of preliminary investigation of lateral-directional characteristics. The augmentor flap deflection was varied from 0 deg to 70.6 deg at isentropic jet thrust coefficients of 0 to 1.47. The tests were made at a Reynolds number from 2.43 to 4.1 times one million. Author

N72-11902*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LARGE SCALE WIND TUNNEL INVESTIGATION OF A SEMISPAN WING EQUIPPED WITH AN EXTERNALLY-BLOWN JET FLAP

Michael D. Falarski and Thomas N. Aiken Jul. 1971 97 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab.
(NASA-TM-X-62079) Avail: NTIS CSCL 01A

A wind tunnel investigation was made of the aerodynamic characteristics of a 14.5 foot semispan, externally-blown jet flap model. The model was equipped with a single 30-inch diameter, ducted fan with a 1.03 pressure ratio. The effects of flap size, fan vertical location, and wing sweep on the longitudinal aerodynamic characteristics were studied. Author

N72-11903# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

TWO-DIMENSIONAL LOW-SPEED TUNNEL TESTS ON THE NACA 0012 SECTION INCLUDING MEASUREMENTS MADE DURING PITCHING OSCILLATIONS AT THE STALL

G. F. Moss and P. M. Murdin London Aeron. Res. Council 1971 43 p refs Supersedes RAE-TR-68104; ARC-30682
(ARC-CP-1145; RAE-TR-68104; ARC-30682) Avail: NTIS; HMSO: 60p; PHI: $2.55

Lift measurements were made on a 10% thick 0012 section under static conditions and during pitching oscillations in an attempt to provide sectional data for use in calculations on helicopter rotors. Strong three dimensional effects were found at the stall, however, which seemed to be inherent in the aerodynamics of the stall itself. Also, the cyclic variation of lift during the pitching oscillations was found to be intermittent between two distinct types during both of which considerable hysteresis was observed and during one of which very large increases in maximum lift were encountered. Author (ESRO)

N72-11904# National Physical Lab., Teddington (England). Aerodynamic 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. OReilly, and D. J. Hall London Aeron. Res. Council 1971 31 p refs Supersedes NPL-AERO-1309;
(ARC-CP-1146; NPL-AERO-1309; ARC-31702) Avail: NTIS; HMSO: 45p; PHI: $1.95

Three-dimensional patterns were obtained in appreciable regions of separated flow on both thick and thin aerofoils at high and low Mach numbers. A form of boundary-layer control prevented separation of flow in the corners at the aerofoil ends but did not inhibit development of the three-dimensionality. Author (ESRO)

N72-11905# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

GUN TUNNEL FORCE MEASUREMENTS ON SOME THIN DELTA WINGS SUITABLE FOR HYPERSONIC CRUISING FLIGHT

T. Opatowski Aeron. Res. Council 1971 87 p refs Supersedes ARC-30997 Sponsored by Natl. Phys. Lab.
(ARC-CP-1148; ARC-30997) Avail: NTIS; HMSO: 1.15; PHI: $4.90

Lift, drag, and pitching moment measurements are presented for six thin delta wings at a Mach number of 8.3 and compared with theoretical estimates. Consideration is given to hypersonic cruise vehicles in the atmosphere and the relevance of tunnel tests to full scale conditions. An optimum thickness is derived and compared to the tunnel results. Author (ESRO)

N72-11906# Aircraft Research Association, Ltd., Bedford (England).

RESULTS AND ANALYSIS OF PRESSURE MEASUREMENTS ON TWO ISOLATED SLENDER WINGS AND SLENDER WING-BODY COMBINATIONS AT SUPERSONIC SPEEDS. PART 1: ANALYSIS

K. A. Fellows and E. C. Carter London Aeron. Res. Council 1970 60 p refs
ARC-31724
(ARC-CP-1131; ARA-12; ARC-31724) Avail: NTIS; HMSO: 80p; PHI $3.35

The results of the measurements taken made it possible to isolate the contributions to the overall normal force made by the wing upper surface, wing lower surface, forebody, cylindrical body, and the mutual wing-body interference. Each item was compared with theoretical and empirical prediction methods currently available. Significant differences between theory and practice were discovered, particularly for the most slender wing, at high pitch angles. The vortex induced lift on the wing upper surface continues up to very high incidences especially on the most slender wing, with much higher suctions than had been predicted. New values of k, the limiting suction level, are proposed and an empirical formula relating the upper surface normal force to Mach number, leading edge sweep angle, and pitch angle is suggested for the range of these particular wings. Body interference on the wing falls off rapidly above about 10 deg but there is no loss of non-linear lift on the body due to the presence of the wings. Author (ESRO)

N72-11907# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
LOW-SPEED WIND-TUNNEL TESTS ON A FAMILY OF CAMBERED WINGS OF MILD GOTHIC PLANFORM OF ASPECT RATIO 1.4
P. J. Butterworth London Aeron. Res. Council 1971 41 p refs Supersedes RAE-TR-70185; ARC-32686
(ARC-CP-1163; RAE-TR-70185; ARC-32686) Avail: NTIS; HMSO: 55p; BIS: $2.20

The longitudinal characteristics of a family of one symmetrical and two cambered mild gothic wings of aspect ratio 1.4 and thickness-to-chord ratio of 0.09 were investigated and the results are presented with analysis. The two cambered wings were designed to have attached leading edge flow at lift coefficients of 0.1 and 0.2 respectively, at a specified angle of incidence. The force measurements and flow visualization show that the design criteria have in fact been satisfied though additional inboard shoulder separations near the apex were observed under certain conditions. Author (ESRO)

N72-11910# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
AN IMPROVED METHOD FOR CALCULATING GENERALISED AIRFORCES ON OSCILLATING WINGS IN SUBSONIC FLOW
G. Long 1971 21 p refs Supersedes RAE-TR-69073; ARC-31480
(ARC-R&M-3657; RAE-TR-69073; ARC-31480) Avail: NTIS; HMSO: 55p; BIS: $2.20

A lifting-surface theory of the Multhopp-type was revised to include an improved method of spanwise integration and programmed in FORTRAN 4. Generalized aerodynamic forces were calculated for three wings, and the effects of varying the number of collocation points and the accuracy of spanwise integration are discussed. Author (ESRO)

N72-11911# Office of Naval Research, London (England).
LIGHT HOVERCRAFT BY HOVER-AIR LIMITED
Richard D. Mathieu 7 Jun. 1971 16 p
(AD-726163; ONRL-R-17-71) Avail: NTIS CSCL 01/3

The development of light hovercraft for the performance of tasks which require an amphibious capability to travel in inaccessible areas is progressing at a rapid pace. One of the largest manufacturers of light hovercraft has been Hover-Air Limited of England. The report summarizes the design data and performance data of four craft, and discusses their potential applications. Author (GRA)

N72-11912# Army Foreign Science and Technology Center, Charlottesville, Va.
ON THE QUESTION OF CONSTRUCTION OF TANGENTS TO THE CROSS SECTIONS OF AN AIRPLANES'S WING, UTILIZING A DISCRETE NUMBER OF POINTS
M. A. Manevich 21 Jul. 1971 7 p refs Transl. into ENGLISH from Kvoprosu O Postrdenii Kasatelnykh K Poperechnym Secheniyam Kryla Samoleta Zadannym Diskretnymi Ryadami Tochek, Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn., Kazan
(AD-728651; FSTC-HT-23-523-71) Avail: NTIS CSCL 01/3

A method of construction of tangents to the cross section of the wing of an airplane by plotting a discrete number of *points, is described.* GRA

N72-11914# Institut Franco-Allemand de Recherches, St. Louis (France).
AIRCRAFT BOOM DISTRIBUTION DURING SUPERSONIC FLIGHT IN QUIET ATMOSPHERE. PART 2: HORIZONTAL TURN AT CONSTANT VELOCITY [PROPAGATION DU BRUIT BALISTIQUE D'UN AVION DANS L'ATMOSPHERE NON PERTURBEE. 2 PARTIE: AVION EN VOL HORIZONTAL A VITESSE CONSTANT. APPLICATION AU VIRAGE]
F. Reggiani 1970 48 p refs In FRENCH
(ISL-12/70) Avail: NTIS

A FORTRAN IV program for the IBM 360 yielded the geometric elements of shock layers as a function of aircraft trajectory. Propagation of shock waves through tubes was considered. The airplane was assumed to fly at constant velocity and altitude, in an atmosphere with constant temperature gradient and without wind. The trajectory was a circular arc transitioned halfway to the right. Grounded traces of isoemission and isoreception surfaces were calculated, as well as the position of singular points (points of transition and upturn) and the radii of curvature of the surfaces at these points. Numerical results are presented for Mach 1.3 and 1.7. Transl. by K.P.D.

N72-11915# Advisory Group for Aerospace Research and Development, Paris (France).
HELICOPTER GUIDANCE AND CONTROL SYSTEMS
Sep. 1971 261 p refs Partly in ENGLISH and partly in FRENCH Presented at the 12th Meeting of the Guidance and Control Panel of AGARD, Konstanz, West Germany, 7-9 Jun. 1971
(AGARD-CP-86-71) Avail: NTIS

Papers on military helicopter technology are presented. The topics covered include helicopter requirements, system operation and integration, subsystems, advanced developments, and test results and operational experience.

N72-11916# Defense Dept., Washington, D.C.
UNITED STATES ARMY HELICOPTER EXPERIENCES AND FUTURE REQUIREMENTS
Conrad L. Stansberry *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p
Avail: NTIS

The U.S. Army has found the helicopter to be an extremely versatile vehicle in performing all functions of combat. It has been integrated into organizations throughout the Army force structure. The concepts of airmobility have been validated during combat operations in a counterinsurgency environment in Vietnam. At this time, the U.S. Army is in a period of transition requiring an assessment of the applicability of the airmobile concept in the mid and high intensity warfare environment. To improve the existing capability, new helicopters and evaluations of different types of units with organic airmobile elements to optimize the effectiveness of our combat units must be developed. It is expected that the concepts of airmobility warfare brought to fruition with the advent of the helicopter and applied so successfully in Vietnam can be applied with equal success on other battlefields in other areas in the future. Author

N72-11917# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
OPTIMIZATION OF AUTOMATIC FLIGHT CONTROL CONCEPTS FOR LIGHT HELICOPTERS WITH ALL WEATHER CAPABILITY
H. Koenig and H. Schmitt *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs

Avail: NTIS

All-weather equipment of minimum complexity for light helicopters is presented. The criteria for its selection include mission performance requirements as well as consideration of weight, complexity and cost. The special features of a helicopter with hingeless rotor are discussed. The flight control system being developed is shown by a step-by-step process up to an optimal equipment for civilian and military application in

all-weather flight. This report presents the validation of flight control systems of SAS and ASE performance level. Successful flight tests of the Ferranti FAS.2 and the BSW-FRG.14 flight control equipment have been conducted on the helicopter MBB-BO 105. Good agreement has been found between theoretical and simulation studies. The systems can be used for many important military purposes. Author

N72-11918# Service Technique Aeronautique, Paris (France).
FLIGHT SAFETY WITH AUTOMATIC CONTROL: REQUIREMENTS AND IMPLEMENTATION [LA SECURITE DU VOL EN PILOTAGE AUTOMATIQUE EXIGENCES ET REALISATIONS]
A. Guibaud and D. Autechaud *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p In FRENCH

Avail: NTIS

The breakdown of automatic pilots or auxiliary stabilization systems may have grave consequences for helicopter flight, since these aircraft often operate at low altitudes. Safety requirements constitute one part of a theoretical study of breakdowns; requirement implementation and testing were also studied. A probability analysis of simple and double breakdowns was undertaken. In the case of active breakdown of the automatic pilot, it is necessary to limit the rapid evolution of the apparatus and thus to increase the time allowed to the pilot to react and resume manual flight control. Surveillance devices are necessary on the automatic pilot in order to detect active breakdown and to rapidly suppress the erroneous command. Such compatibility and thereshold devices are available on the Puma and Alouette 3 aircraft. Finally, surveillance of the flight control chain, from detectors to servo-command, can be done internal organization of the automatic pilot, extending the possibilities for surveillance devices without increasing cost. Transl. by K.P.D.

N72-11919# Royal Aircraft Establishment, Farnborough (England).
THE IMPLICATIONS OF OPERATING HELICOPTERS IN POOR VISIBILITY
J. E. Nethaway *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 20 p refs
Avail: NTIS

A method of weather minima calculation is proposed for small sites and is extended to allow an estimate to be made of the instrument or automatic approach performance requirements if the weather minima are to be achieved. As an example of the estimation technique an assumption is made of a 6 deg approach path coupled with a 60 kn (111 km/h) approach speed and it is suggested that 120 ft/700 yd (36m/640m) weather minima should be attainable. The equipment requirements necessary to achieve the weather minima are considered and possible developments for the future are discussed. The future developments could include improved displays based on cathode ray tubes, and also various levels of automatic flight path control. A radio/radar guidance aid is required and the overlap between it and the visual guidance system is discussed. The approach and landing system described implies a weight penalty, the extent of which depends on the severity of the weather to be overcome. With this in mind a tentative estimate is made of the equipment weight which may be necessary to achieve various weather minima. Finally, a study has been made of the statistical occurrence of low visibility in the UK from which it has been deduced that, for the approach conditions assumed, a helicopter should be able to complete approaches to land on about 98% of occasions in the year. Author

N72-11920# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
PROGRESS OF THE USAF INFLIGHT PROGRAM: LOW SPEED CONTROL TO LANDING ON INSTRUMENT IN HELICOPTERS
Charles A. Scolatti *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 15 p refs
Avail: NTIS

A functional flight control-display system is described which provides the small and medium sized helicopter a manual-on-instrument capability from take-off to landing. The display solution is based upon extending the capability of the flight director as it is employed today in helicopters for flying fixed wing type profiles to encompass the unique portion of the low speed regime. With respect to automatics, pilot workload has been reduced and control maneuverability enhanced by introducing innovations to the design of stability augmentation systems in the yaw and collective channels. The flight control-display system was developed using beam guidance in anticipation of the upcoming guidance system proposed by the SC-117 Committee. Testing of the system elements is complete. Evaluation of the synthesized system will be completed by the end of the year. Work is beginning on having user command personnel test the system in its applied form on two UH-1N helicopters at the USAF Instrument Pilot Instructors School. Author

N72-11921# Ambac Industries, Inc., Garden City, N.Y. Arma Div.
AN OPTIMUM MILITARY HELICOPTER NAVIGATION SYSTEM
Marvin Taylor *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 11 p refs
Avail: NTIS

A low-cost, all-weather, self-contained navigation system was studied in order to fully exploit the many military capabilities of helicopters. Inertial, Doppler-Magnetic, and Doppler-Gyroscopic Navigation systems are analyzed to determine parametric requirements (such as gyro drift, torque scaling, and computer requirements) as a function of navigation accuracy. A study of these alternate candidate systems indicates an optimum approach is the combination of Doppler velocity with an accurate heading indicator utilizing low drift gyroscopes that can rapidly gyro-compass to true North during ground alignment. For subsonic application less precise gyro drift is required with this approach than for an equivalent all-inertial system. The various system configurations are functionally defined and cost vs performance analysis using typical parameters is performed for the alternate candidate systems. Author

N72-11922# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
SOME PROBLEMS IN THE DEVELOPMENT OF AN AUTOMATIC FLIGHT CONTROL SYSTEM FOR LIGHT HELICOPTERS
W. Wellern *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 15 p refs
Avail: NTIS

Some of the problems and their solution are discussed arising in the development of an automatic flight control system for light helicopters. The control system is the FRG 14/Stab. The cross coupling between the axes makes it essential to regard the helicopter control as multiloop control and to take account of all six degrees of freedom of the vehicle. These investigations were done with the aid of a program drawn up recently for analysis applied first to a light helicopter which is equipped with a hingeless rotor (BO 105). This type of rotor shows very high control effectiveness and very fast reactions to control inputs. Thus it seems to be necessary to include the nonlinearities of actuators and hydraulic booster in the investigation and to perform a simulation on the analog computer. Here the problem of limit cycles due to backlash arises. The limit cycles are reduced by means of special nonlinear networks so that they are no longer perceived by passengers. Development of the FRG 14 System was continued by hardware simulation and concluded with good results in flight tests. Author

N72-11923# Siemens A.G., Munich (West Germany).
DIFFERENCES AND COMMONALITIES IN HELICOPTER AND FIXED WING DOPPLER SENSOR TECHNOLOGY
K. Maerz *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 5 p refs
Avail: NTIS

The possibilities and limitations of rotary and fixed wing compatible Doppler sensor designs are discussed. Measurement of velocities near zero at often relatively high values for the drift angle is a requirement for helicopters only. For fixed wing aircraft on the other hand operation at high altitudes at high speeds influence antenna and transmitter design. The lower mean speeds in helicopters put more weight on these measurement errors, which are constant relative to velocity, whereas in fixed wing aircraft in most cases measurement errors dominate which are proportional to velocity. In helicopters and VTOL aircraft fixed antenna installation is generally preferred. Whereas the use of noncoherent pulse systems is limited to fixed wing aircraft, continuous wave and FM Doppler sensors are successfully used in helicopter navigation systems. Author

N72-11924# Teledyne Systems Co., Northridge, Calif.
AN INTEGRATED LOW ALTITUDE FLIGHT CONTROL SYSTEM FOR HELICOPTERS
James P. Murphy, Herman L. Walker, and Lawrence A. Kaufman *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 20 p refs
Avail: NTIS

After a brief introduction that highlights the need for the system and some design philosophies, the basic concepts for low altitude flight are presented indicating the modes of flight employed by IHAS, terrain following (TF), and terrain avoidance (TA). This is followed by a dissertation on the functional approach used to provide the relatively high degree of TF capability required. Block diagrams are utilized to identify the system sensors, central computer and output devices, i.e., displays and flight controls. Prior to a discussion of the equations solved by the central digital computer, the equipment mechanization is briefly described to familiarize the reader with the IHAS equipments. A commentary is presented on the setup and results of a simulation of the automatic TF system and is followed by a description and limited listing of results of the IHAS flight test program. It is shown that the high degree of TF capability provided agreed very well with the results predicted by analysis and simulation. Finally, some concluding remarks are provided to identify the significant accomplishments of the IHAS low altitude control system development. Author

N72-11925# Singer-Kearfott, Pleasantville, N.Y.
OPERATIONAL CONSIDERATIONS AND APPLICATIONS OF THE TALAR(R) 4 LANDING AID TO HELICOPTERS c21
R. Hohol and J. Taylor *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs

Avail: NTIS

The requirements of helicopter operations are discussed for using the Talar 4 system, currently in operational use by the United States Air Force to provide a portable landing aid for fixed wing tactical transport aircraft. The Talar 4 ground station characteristics are presented with helicopter flight test evaluations in Europe. It is concluded that the Talar 4 system is capable of meeting tactical helicopter operational requirements. F.O.S.

N72-11926# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
AUTOMATIC APPROACH AND HOVER COUPLER FOR HH-53 HELICOPTERS
Robert A. Andes *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 7 p refs
Avail: NTIS

The Automatic Approach and Hover Coupler which provides the HH-53 rescue helicopter with the capability to automatically transition from forward flight, anywhere within the HH-53 flight envelope, to a hover over flat or rolling terrain, independent of gross weight and center of gravity is discussed. The approach coupler design is based on an approach trajectory characterized by a constant longitudinal deceleration of .8 knots/seconds and a constant rate of descent of 300 feet/minute until a groundspeed of 40 knots is reached. At this point the rate of descent is reduced to 100 feet/minute. The hover coupler provides altitude retention within + or - 3 feet and zero knot groundspeed within + or - 1.5 knots of the Doppler radar measured velocity. A hover trim control is also provided to permit a limited repositioning of the aircraft by the pilot/copilot/ crewman during the rescue operation. The couplers satisfactorily completed environmental qualification tests at Sikorsky Aircraft Company, Stratford, Connecticut, and operational test and evaluation by the Military Airlift Command, Eglin Air Force Base, Florida. Author

N72-11927# Army Electronics Command, Fort Monmouth, N.J.
TERRAIN AVOIDANCE RADAR FOR US ARMY c07
Otto H. Schoenberger *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 14 p refs

Avail: NTIS

The objectives and the conduct of the U.S. Army's development program are reported for providing a terrain avoidance/terrain following capability for Army rotary-wing aircraft. The over-all program goals are described. Control aspects of helicopters were considered in light of TA/TF requirements with an immediate realization of their importance in any TA/TF application. As such, the control system was developed first, including terrain following command computation and coupling provision to the flight control system. A unique method of in-flight simulation of terrain and radar sensor was conceived. This airborne terrain and radar simulator allows full in-flight evaluation of the control system, and offers unlimited flexibility as to the type of terrain over which the system is to be tested without subjecting the aircraft and crew to the hazards of testing a control system in close proximity to terrain. A variable parameter terrain avoidance radar is described to replace the terrain and radar simulator after initial evaluation of the control system. The primary objective for this radar was to provide a terrain sensor with technical flexibility sufficient to allow TA/TF performance evaluation over the complete performance spectrum, ranging from simple fixed beam manual terrain following to sophisticated simultaneous terrain following and terrain avoidance, using transverse profile type display and coupling into the flight control system. Technical details of the radar design are given, including selection of the parameters. Author

N72-11928# Royal Aircraft Establishment, Farnborough (England).
THE EFFECTS OF SEMIRIGID ROTORS OF HELICOPTER AUTOSTABILISER DESIGN
H. B. Johnson *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs
Avail: NTIS

Theoretical studies carried out into the basic problems posed by 'semi-rigid' rotor designs are described, and the directions in which automatic stabilizers for these aircraft are likely to develop are indicated. Two problems in particular were examined, viz the pitching instability with angle of attack and forward speed, and the interaction between aircraft of motion and those of the rotor dynamics. The latter problem is concerned with the rolling motion termed the 'pendulum' mode resulting primarily from the increased coupling between fuselage and rotor. It is shown that a potential resonance between the 'pendulum' mode and the in-plane blade motion exists. Means of avoiding this by suitable design of the autostabilizer are suggested. Author

N72-11929# Societe Nationale Industrielle Aerospatiale, Paris (France).
AN AUTONOMOUS NAVIGATION SYSTEM FOR HELICOPTERS [SYSTEME DE NAVIGATION AUTONOME POUR HELICOPTERES] c21
M. Fourcade *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 8 p In FRENCH

Avail: NTIS
An autonomous navigation system which was developed for the SA-330 helicopter is described. A discussion of the components, functions, and essential characteristics of the system is presented. Flight test methods are considered for utilization in performance determination. Transl. by K.P.D.

N72-11930# Elliott Flight Automation, Ltd., Rochester (England). Flight Controls Div.
SOME DESIGN ASPECTS OF THE STABILITY AUGMENTATION SYSTEM FOR THE WG13 RIGID ROTOR HELICOPTER
D. Sweeting *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 12 p
Avail: NTIS
Some features of the AFCS designed for the Anglo-French WG13 rigid rotor helicopter are described and in particular those arising from the concept of a modular multi-role helicopter, designed both for high speed maneuverable flight at low altitudes and for operation in tightly controlled autopilot modes. A brief description of the system configuration including redundancy, safety features, sensors, and actuation system is given together with an indication of system size and weight, and electronics technology employed. The design requirements for the pitch stability augmentation system (SAS) are examined in relation to the conflicting requirements for low SAS authority for safety against the high control gains combined with large attitude changes required for stability and maneuverability. The concept of a collective autostabilizer independent of the pitch SAS is introduced which alleviates these design problems of the pitch channel and reduces considerably the effects of a pitch runaway. The design of the roll SAS channel is similarly influenced by the requirement for stability at high angles of bank during maneuvers while using the minimum of control authority; a type of roll rate demand system designed to operate over a wide range of bank angle is described together with the control system developed for the yaw axis. Author

N72-11931# United Aircraft Corp., Stratford, Conn. Avionics, Control and Support Systems Branch.
A FEASIBLE FEEL AUGMENTATION SYSTEM FOR HELICOPTERS
Harold S. Oakes *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 7 p
Avail: NTIS
A description and evaluation are given of the feel augmentation system (FAS). The FAS differs from most traditional automatic flight control systems in that, instead of augmenting the pilot's input to the control system by providing swash plate motion to stabilize the helicopter, it introduces only forces on the pilot's hand. If the pilot resists these forces, he then experiences the feel desired for continuing the maneuver he has started. If he does not resist the force, the stick will move and stabilize the aircraft so that it will stay in steady state trimmed flight. An extensive flight evaluation of the system in a CH-53A indicated a significant improvement in the handling qualities of the helicopter at high speeds, and that the aircraft could be maneuvered precisely at all airspeeds, permitting the pilot to use the entire V-N envelope. D.L.G.

N72-11932# Societe Francaise d'Equipments pour la Navigation Aerienne, Neuilly-Sur-Siene (France). Dept. Pilotage Helicoptere.
STABILITY AUGMENTATION SYSTEMS (SAS) [LES SYSTEMES D'AUGMENTATION DE STABILITE (SAS)]
Henrot *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 5 p In FRENCH
Avail: NTIS
A simple system for increasing helicopter stability is discussed. The components of the calculator and jack are described. Transl. by K.P.D.

N72-11933# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
HELICOPTER IFR FLIGHT PATH CONTROL SYSTEM
Theodor A. Dukes *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 10 p refs
(Contract DA-28-043-AMC-02412(E))
Avail: NTIS
Various aspects of piloted flight path control, including positioning, are discussed according to their significance in making decisions about the structure of the control system. The translational loop requirements, the choice of a nominal error coordinate system, and a discussion of the pilot's role, lead to a control system in which errors and error rates are displayed explicitly and the pilot uses essentially acceleration control in his main effort to control error rates or velocities in three dimensions. An integrated display contains all the information needed for the continuous loop closures. The proposed system is applicable to trajectory control in general so that considerable commonality in flying various tasks can be achieved. Author

N72-11934# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
PRECISE IFR HOVERING: AN OPERATIONAL NEED AND A FEASIBLE SOLUTION
William P. Keane and R. Joseph Milelli *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 9 p

Avail: NTIS
A man-machine simulation program was conducted which indicates the feasibility of developing an IFR hover capability with state-of-the-art sensors, controls and displays. Display alternatives included a simple hover indicator, a flight director and a fully integrated multi-colored CRT dispiay. Control alternatives for the CH-54 aircraft included the CH-54 ASE and two alternate systems employing load cable information feedback and velocity feedback. IFR hover was shown to be a reasonable task from a pilot workload standpoint. Displays and controls couple strongly in finding the best solution. A wide range of performance was achieved with the best systems providing a hover accuracy of 1-2 feet. All tests were performed under simulated gust conditions. A formal analysis of variance was performed on the data. These results indicate the feasibility of accomplishing more precise construction and logistical tasks by the helicopter in the near future through the use of instrument hover. The unloading of containerized ships by the helicopter is a possible application with both commercial and military advantage. Author

N72-11935# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
ADVANCED DOPPLER INERTIAL NAVIGATION SYSTEM FOR TRANSPORT HELICOPTER c21
V. Krogmann *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 14 p refs
Avail: NTIS
Conventional ground and in-air gyrocompassing techniques together with Doppler-inertial navigation are treated briefly. Main attention is paid to optimal ground and in-air alignment and Doppler-inertial-mixing. As far as the optimization is concerned, Kalman filter technique with a ten to fourteen element state

vector is compared to a simple digital filter-technique based on recursive or non-recursive least squares. Comparison between the least-square-technique and the Kalman-filter shows that their respective performance is roughly in the same order of magnitude without position fixes. The least-square-technique is recommended because its airborne computer requirements are by far lower than the Kalman-filter loading. This technique, as well as the Kalman-filter has the ability to recover the position error caused by initial misalignment and the performance does not depend on the magnitude of the initial misalignment. The proposed system is based on the least-square technique. Assuming a 2 - 3 minutes ground-alignment, the operational sequence for in-air alignment and Doppler-Inertial Navigation is described. The computer loading for both the ground and in-air alignment of this system is considered. Author

N72-11936# Mullard Research Labs., Redhill (England).
DESIGN AND EVALUATION OF A HELICOPTER GUIDANCE AID c21
R. N. Alcock, D. Atter, S. J. Robinsin, and R. P. Vincent *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 4 p
Avail: NTIS

A description of the microwave aircraft digital guidance equipment (MADGE) system is given. The system is designed as an approach aid for V/STOL and fixed wing aircraft and is particularly suited for military tactical applications and for use by helicopters. A typical MADGE ground installation comprises three man-portable units: (1) an azimuth approach angle measuring unit incorporating a transponder and means for encoding azimuth and elevation measurements; (2) an elevation, or glide-slope, angle measuring unit, and (3) an azimuth missed-approach angle measuring unit. In the aircraft there is a control panel, on which the approach data may be set by the pilot, and a transmitter-receiver, with circuits for distance measurement and for decoding the angle information. In civil applications the approach path can be pre-set for individual aircraft types. One or two monopole aerials, depending on aircraft aerial siting and observation problems, are used to give wide angle coverage. D.L.G.

N72-11937# Honeywell, Inc., Minneapolis, Minn.
FLIGHT TEST OF A HYDROFLUIDIC THREE-AXIS DAMPER ON A HELICOPTER
R. A. Evans and G. W. Fosdick *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 12 p refs

Avail: NTIS

Tests were conducted on a fixed-gain, three-axis hydrofluidic stability augmentation system (FSAS) in a UH-1C helicopter. The FSAS used a vortex rate sensor, two or more stages of amplification, and various shaping networks (lag, lag/lead, and high-pass) in each of the three axes, all mechanized with hydrofluidics. The system was designed, developed, bench tested and qualified for the environment. Reliability testing previously conducted estimated MTBF at 83,000 hours per axis (excluding servoactuator). Flight test results indicate pilot approval, operation over all airspeeds including hover, and excellent handling qualities. The FSAS performance was rated as better than that of the mechanical stabilizer bar by the pilots. Predicted high reliability was supported by a 60-hour, trouble-free fluidic controller operation. Author

N72-11938# Computing Devices of Canada, Ltd., Ottawa (Ontario).
PROJECTED MAP NAVIGATION IN MILITARY HELICOPTERS: APPLICATIONS AND OPERATIONAL EXPERIENCE c21
R. I. MacNab and J. C. Alexander *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 10 p refs

Avail: NTIS

Extensive flight experience has confirmed the feasibility of the projected map navigation systems (PMS) as ideally suited for military tactical aircraft, particularly helicopters. The reasons for this conclusion are explained in detail, and by documented comment from flight trial reports. The basis for concluding that the PMS are fundamentally superior to present day conventional navigation systems is also explained. In addition, a recommendation is made for implementing a particular projected map system which has been developed to the flyable prototype stage. D.L.G.

N72-11939# Centre d'Essais en Vol, Bretigny-Sur-Orge (France).
EXPERIENCE OF THE FRENCH FLIGHT TEST CENTER IN ALL-WEATHER HELICOPTER LANDING [EXPERIENCE DU CENTRE D'ESSAIS EN VOL FRANCAIS DANS LE DOMAINE DE L'ATTERRISSAGE TOUT TEMPS SUR HELICOPTERE] c21
P. Bloch *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p In FRENCH
Avail: NTIS

Approach and landing under bad visibility conditions was the object of numerous tests for more than ten years. The performance and safety of systems was evaluated with an eye to their certification. A five-year study on the utilization of a radioelectronic rectilinear array for helicopter guidance is discussed. Transl. by K.P.D.

N72-11940# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF CRYOGENIC NITROGEN AS A FIRE-EXTINGUISHING AGENT FOR AIRCRAFT POWERPLANT INSTALLATIONS Final Report
George Chamberlain and Eugene Klueg Nov. 1971 147 p refs (Proj. 502-301-15X)
(FAA-RD-71-58) Avail: NTIS

Proposals were made to carry relatively large quantities of liquid nitrogen (LN2) aboard commercial aircraft for the purpose of fuel tank inverting. Secondary uses, such as powerplant fire extinguishing, were suggested. Testing was conducted to determine the feasibility of using LN2 as an aircraft powerplant fire extinguishing agent and to determine its characteristics when used as an extinguishant. These tests were made in a fire test facility using a full scale aircraft turbojet engine and nacelle for subsonic, low altitude flight condition simulation. A mockup engine/nacelle facility was also used, in which nacelle volume and airflow could be varied. JP-4 jet fuel was employed and was spray released and spark ignited. In addition, the experimentation is described, which was conducted to determine the design criteria required for an effective agent quantity, discharge rate and conditions, and distribution system configuration. The effects of an inadvertent discharge on engine components, effects of a damaged cowling, and the cooling of potential re-ignition sources are considered. Author

N72-11941# All American Engineering Co., Wilmington, Del.
RESEARCH STUDY OF COST EFFECTIVENESS OF AUXILIARY LAUNCH SYSTEMS APPLICABLE TO COMMERCIAL TRANSPORTS FOR PURPOSES OF NOISE ABATEMENT
F. M. Highley Jun. 1971 268 p refs
(Contract DOT-FA70WA-2224; Proj. 550-004-03H)
(FAA-EQ-71-1) Avail: NTIS

A cost effectiveness study was made to determine the feasibility of reducing the noise associated with aircraft taking off by applying auxiliary launch power during aircraft acceleration on the ground. Auxiliary launch system categories considered were reaction jets, catapults, aircraft exhaust augmentation, and accelerating vehicle systems. The most optimum system studied was the Steam Zipper catapult. It was selected on the basis of

its ability to handle the full range of aircraft (75,000 to 1,5000,000 pound gross weight), its high speed capability (resulting in abbreviated take-off time and reduced noise level duration), shorter launch stroke (3882 feet versus 10,000 feet), ease of achieving bi-directional capability, and economy of operation. Author

N72-11942*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIGITAL AUTOPILOTS: DESIGN CONSIDERATIONS AND SIMULATOR EVALUATIONS
Stephen Osder (Sperry Flight Systems Div.), Frank Neuman, and John Foster Oct. 1971 251 p refs
(NASA-TM-X-62094; Pub-70-1364-00-00) Avail: NTIS CSCL 01D

The development of a digital autopilot program for a transport aircraft and the evaluation of that system's performance on a transport aircraft simulator is discussed. The digital autopilot includes three axis attitude stabilization, automatic throttle control and flight path guidance functions with emphasis on the mode progression from descent into the terminal area through automatic landing. The study effort involved a sequence of tasks starting with the definition of detailed system block diagrams of control laws followed by a flow charting and programming phase and concluding with performance verification using the transport aircraft simulation. The autopilot control laws were programmed in FORTRAN 4 in order to isolate the design process from requirements peculiar to an individual computer. Author

N72-11943*# North American Aviation, Inc., Los Angeles, Calif.
XB-70 AERODYNAMIC, GEOMETRIC, MASS, AND SYMMETRIC STRUCTURAL MODE DATA
John H. Wykes and Alva S. Mori Mar. 1970 91 p refs
(Contract NAS4-1580)
(NASA-CR-116773; NA-70-158) Avail: NTIS CSCL 01A

XB-70-1 mass, structural, and aerodynamic data were updated to reflect as closely as possible the characteristics of the airplane at three specific flight conditions which were actually flown; a nominal Mach number of 0.90 at an altitude of 25,000 feet (two cases) and a nominal Mach number of 1.6 at an altitude of 40,000 feet (one case). In-flight response characteristics at a number of points on the vehicle were obtained by exciting a pair of shaker vanes on the nose of the airplane. Data were recorded with the basic stability augmentation system (SAS) operating both alone and together with the identical location of accelerometer and force (ILAF) structural mode control system. Detailed total vehicle weight, mass characteristics, structural frequencies, generalized masses, all aerodynamic data used in the present analyses, and a description of the actual mode shapes are tabulated and presented. Author

N72-11945# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: COMMUTER AIRLINES INC., BEECHCRAFT C-45H (INFINITE 2), N497DM, BROOME COUNTY AIRPORT BINGHAMTON, NEW YORK, 22 MARCH 1971
26 Aug. 1971 26 p refs
(NTSB-AAR-71-13) Avail: NTIS

Commuter Airlines, Inc. Flight 502, a scheduled air taxi operation, crashed after a rejected takeoff from Runway 16 at the Broome County Airport, Binghamton, New York, on March 22, 1970, at approximately 1611 EST. There were nine passengers and two flight crew members on board the aircraft. The captain and two passengers were fatally injured. The Safety Board determined that the probable cause of this accident was the attempt of the pilot in command to take off with snow adhering to the airfoil surfaces. This snow caused a degradation of aircraft performance and loss of control following lift-off. This required the captain to reject the takeoff beyond a point where a safe emergency landing could be effected within the confines of the runway. Author

N72-11946# Pratt and Whitney Aircraft, East Hartford, Conn.
FAN-COMPRESSOR NOISE: PREDICTION, RESEARCH, AND REDUCTION STUDIES Final Report, 9 Jan. 1969 - 29 Jan. 1971
E. A. Burdsall and R. H. Urban Feb. 1971 407 p refs
(Contract DOT-FA69WA-2045; Proj. 550-001-01H)
(FAA-RD-71-73) Avail: NTIS HC $6.00/MF $0.95

A two-year comprehensive program on fan compressor noise was undertaken, under contract to the Federal Aviation Administration. An accurate prediction system was considered, based on theoretical concepts and empirical data, and enabling the selection of proper acoustical design choices for future engines. Experimental programs were conducted using a variety of test rigs to provide acoustic data and to validate theoretical considerations. Mathematical models were developed for each type of fan noise, and their applicability to actual engines was evaluated. Progress in understanding particular noise-generating mechanisms and the capability to predict fan noise is discussed. Author

N72-11947# Goodyear Tire and Rubber Co., Akron, Ohio.
AN INVESTIGATION OF METHODS TO CONTROL POST-CRASH FUEL SPILL FROM INTEGRAL FUEL TANKS Final Report, 1 Jul. 1969 - 31 Jan. 1971
K. D. Robinson Dec. 1971 70 p Proposed for presentation at the US Intern. Transportation Exposition, Washington, D. C., 27 May - 4 Jun. 1972
(Contract DOT-FA69NA-432; Proj. 503-101-01X)
(FAA-RD-71-75; FAA-NA-71-32) Avail: NTIS

The use of elastomer coatings, curtains, and other materials as containment methods to eliminate or control post-crash spill from aircraft integral fuel tanks was investigated. Elastomeric liner, curtain, and multilayer liner concepts were selected for evaluation in aircraft wing sections. Aircraft wing section drop tests show that very little improvement was realized with the various systems installed. The structural damage to the wing sections was of such magnitude that none of the systems were capable of success. Author

N72-11948*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GROUND NOISE MEASUREMENTS DURING LANDING, TAKE-OFF, AND FLYBY OPERATIONS OF A FOUR-ENGINE TURBOPROPELLER STOL AIRPLANE
David A. Hilton, Herbert R. Henderson, and Domenic J. Maglieri Washington Dec. 1971 40 p refs
(NASA-TN-D-6486; L-7054) Avail: NTIS CSCL 01B

Noise measurements were obtained for a four-engine turbopropeller STOL airplane during a Federal Aviation Administration flight evaluation program at the National Aviation Facilities Experimental Center. These noise measurements involved landing-approach, takeoff-climbout, and flyby operations of the airplane. A total of 13 measuring positions were used to define the noise characteristics around a simulated STOL port. The results are presented in the form of both physical and subjective measurements. An appendix is included to present tabulated values of various subjective reaction units which may be significant for the planning and operation of STOL ports. The main source of noise produced by this vehicle was found to be the propeller, and noise levels decrease generally in accordance with the inverse-distance law for distances up to about 457 meters. For similar slant ranges, somewhat lower noise levels were experienced during flyby than during takeoff or landing. Author

N72-11949*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION OF SONIC BOOM GENERATED BY THIN, NONLIFTING, RECTANGULAR WINGS
Sanford S. Davis Washington Dec. 1971 43 p refs
(NASA-TN-D-6619; A-4109) Avail: NTIS CSCL 20A

A theory is described for predicting sonic boom pressure signatures emitted by nonlifting rectangular wings. Comparisons are made with previous (Whitham) theory and with experimentally determined near field signatures. Although both theories agree with experiment for low aspect ratio wings, Whitman's theory seriously overpredicts signature length for high aspect ratio wings. No experiments were conducted in the far field, but the two theories predict nearly identical results in this region. Author

N72-11950*# Virginia Polytechnic Inst., Blacksburg. Dept. of Aerospace Engineering.
INVESTIGATION OF AN AIRCRAFT TRAILING VORTEX USING A TUFT GRID
W. H. Mason and J. F. Marchman, III Sep. 1971 46 p refs
(Grant NGL-47-004-067)
(NASA-CR-62077; VPI-E-71-17) Avail: NTIS CSCL 01B

With the increasing capacity of airport terminal areas, and the use of the new large jet transports, it has become important to understand the turbulent wake created by these aircraft. A study of the trailing vortex of a wing has been made using a tuft grid in a 6 foot wind tunnel. The study included an investigation of the use of mass injection at the wing tip as a means of destroying the vortex. Test results show that a fully developed, stable, vortex exists at least a distance of thirty chord lengths downstream of the wing, and that the swirl of the vortex can be reduced or eliminated by mass injection at the wing tip. Author

N72-11951*# National Aeronautics and Space Administration, Washington, D.C.
AIRCRAFT WAKE TURBULENCE AVOIDANCE
William A. McGowan Ottawa Can. Aeron. and Space Inst. 1971 19 p refs Presented at 12th Anglo-Am. Aeron. Conf., Calgary, Can., 7-9 Jul. 1971 Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in Mar. 1972
(NASA-TM-X-67448; Rept-72/6) Avail: NTIS CSCL 01C

Analytical studies and flight tests are used to describe the formation and severity of trailing vortices and the spatial extent of their influence. This information is then used to outline procedures for ready application by pilots, tower operators, and others concerned with the flow of traffic. The procedures provide the necessary appreciation of the physical attributes of trailing vortices, the potential hazards involved when encountering them, and how best to avoid the dangerous portions of the wake during flight operations. Author

N72-11952# Greater London Council (England).
HELICOPTER OPERATIONS AND HELIPORTS
[1971] 24 p
(S12/222) Avail: NTIS

A summary of the use of helicopters in Great Britain is presented, along with a detailed account of the Battersea heliport and its use. Particulars of helicopter operations and heliports or projected heliports in various European countries are discussed. Similar information for several countries outside western Europe is also given. The developing role of helicopters in London is considered, and the uncertainties surrounding the timing and future scale of operations is mentioned. Author

N72-11953# Social and Community Planning Research, London (England).
HELICOPTER NOISE IN CENTRAL LONDON
Jean Morton-Williams and Richard Berthoud Nov. 1970 39 p (P-184) Avail: NTIS

An experimental situation from which to assess the possible effects of helicopters landing and taking off in the center of London, is reported. A helistop is a scaled down heliport with minimal facilities. The purpose of the experiment was to measure the noise created by the machines, and to investigate the extent to which this noise, and any other side-effects, distracted or annoyed people who lived or worked in the vicinity. The overall conclusion of this report is largely favourable to the helistop, in that not many people complained of the noise or disapproved of the use of the site. It should, however, be pointed out at this early stage that the application of this conclusion is limited. The helicopters used were small and relatively quiet; the site was rarely used; novelty value had perhaps not worn off; the area already suffered from very heavy traffic noise. Author

N72-11954# National Inst. of Law Enforcement and Criminal Justice, Washington, D.C.
THE UTILIZATION OF HELICOPTERS FOR POLICE AIR MOBILITY
Feb. 1971 96 p refs
(ICR-71-2) Avail: SOD $0.45

Uses of helicopters in the United State in support of law enforcement activities are described. Many law enforcement agencies which use helicopters were surveyed to ascertain the types of activities for which the helicopters are used. While the main emphasis continues to be on traffic surveillance, speed law enforcement, traffic control, and search and rescue activities, other types of activities are becoming increasingly evident. These growing activity areas include air evacuation, air and water pollution control, emergency cargo transportation, riot control, narcotics detection, fire fighting, night patrols for crime prevention, and covert surveillance. Also included in the survey were the types and numbers of helicopters employed, their annual utilization rates, and the types of special law enforcement-related equipment installed. Author

N72-11956*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEPLOYMENT LOADS DATA FROM A FREE-FLIGHT INVESTIGATION OF ALL FLEXIBLE PARAWINGS HAVING 371.612 SQ METERS (4000 SQ FEET) OF WING AREA
Delwin R. Croom Washington Nov. 1971 510 p refs
(NASA-TM-X-2326; L-7843) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

A free-flight test program to determine the deployment characteristics of all-flexible parawings was conducted. Both single-keel and twin-keel parawings having a wing area of 4000 square feet with a five-stage reefing system were tested by use of a bomb-type instrumented test vehicle. Several twin-keel-parawing tests were also made by using an instrumented controllable sled-type test vehicle. The systems were launched from either a C-130 or a C-119 carrier airplane, and a programer parachute was used to bring the test vehicle to a proper dynamic pressure and near-vertical flight path prior to deployment of the parawing system. The free-flight deployment loads data are presented in the form of time histories of individual suspension-line loads and total loads. Author

N72-11957*# Boeing Co., Seattle, Wash. Commercial Airplane Group.
THE EXPERIMENTAL DETERMINATION OF ATMOSPHERIC ABSORPTION FROM AIRCRAFT ACOUSTIC FLIGHT TESTS
R. L. Miller and P. B. Oncley Washington NASA Nov. 1971 107 p refs
(Contract NAS1-10272)

(NASA-CR-1891; D6-25492) Avail: NTIS CSCL 01B

A method for determining atmospheric absorption coefficients from acoustic flight test data is presented. Measurements from five series of acoustic flight tests were included in the study. The number of individual flights totaled 24: six Boeing 707 flights performed in May 1969 in connection with the turbofan nacelle modification program, eight flights from Boeing tests conducted during the same period, and 10 flights of the Boeing 747 airplane. The effects of errors in acoustic, meteorological, and aircraft performance and position measurements are discussed. Tabular data of the estimated sample variance of the data for each test are given for source directivity angles from 75 deg to 120 deg and each 1/3-octave frequency band. Graphic comparisons are made of absorption coefficients derived from ARP 866, using atmospheric profile data, with absorption coefficients determined by the experimental method described in the report. Author

N72-11958# Federal Aviation Administration, Washington, D.C. Office of Noise Abatement.

THE FEDERAL AVIATION ADMINISTRATION AIRCRAFT NOISE ABATEMENT PROGRAM, FY 1971 - 1972

William C. Sperry [1971] 54 p refs Presented at the Seminar on Noise Pollution of the Urbon Environment, Madison, Wis., 16-17 Nov. 1970

Avail: NTIS

The FAA aircraft noise abatement program is reviewed. The goals of the program and the objectives of research for noise evaluation and control are given. Itemized operational procedures for noise abatement include: takeoff procedures, approach procedures, takeoff and approach routes, cruise procedures and routes, and limiting operations. Bibliographies of FAA aircraft noise reports and environmental papers are included along with lists of FAA noise pollution and exhaust emission projects.

F.O.S.

N72-11959# Federal Aviation Administration, Washington, D.C.

GOVERNMENT'S NEEDS IN ACOUSTICS: AIRCRAFT NOISE ABATEMENT AND REGULATION

William C. Sperry 1969 28 p refs Presented at Am. Soc. for Eng. Educ. Ann. Meeting, University Park, Pa., 23-26 Jun. 1969 (Rept-61) Avail: NTIS

The United States Government's requirements in acoustics are examined from the standpoint of an agency with the responsibility for regulating aircraft noise. The airport community noise problems are delineated in terms of economic and social costs to the public and the inhibition of normal growth for an important portion of the national economy. The Government's contributions to a solution are represented as noise control research, economic analyses of the noise control potential, and noise regulations. The primary functions of the acoustical engineer are classified as research planning and management, standards preparation, committee activities, and legal coordination. His corresponding training requirements are described in detail, with emphasis on the fundamentals. Author

N72-11960# National Physical Lab., Teddington (England). Aerodynamics Div.

SCALE EFFECTS ON OSCILLATORY CONTROL-SURFACE DERIVATIVES

A. W. Moore London Aeron. Res. Council 1971 42 p refs Supersedes NPL-AERO-1283; ARC-31368 (ARC-CP-1151; NPL-AERO-1283; ARC-31368) Avail: NTIS; HMSO: 60p; PHI: $2.55

The limited evidence available indicates that provided boundary layer separation is not a flow feature, wind tunnel measurements of control surface derivatives should be made without fixing boundary layer transition on a model. Aerodynamic hinge moment stiffness tends to increase with Reynolds number but decreases sharply when the transition is fixed. The damping follows a similar pattern in two-dimensional tests, but with three-dimensional tests, neither an increase in Reynolds number nor fixing the boundary layer transition appears to have any significant effect. Author (ESRO)

N72-11961# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

THE AERODYNAMIC EFFECT OF GROUND PROXIMITY ON LATERAL CONTROL OF SLENDER AIRCRAFT IN THE LANDING APPROACH

W. J. G. Pinsker London Aeron. Res. Council 1971 32 p refs Supersedes RAE-TR-70079; ARC-32340 (ARC-CP-1152; RAE-TR-70079; ARC-32340) Avail: NTIS; HMSO: 40p; PHS: $1.75

Recent wind tunnel tests revealed the existence of a powerful ground effect on the rolling derivatives of a slender wing model. Analog computer studies were made which show the consequences of this phenomenon on the lateral behavior of a large slender aircraft during landing approaches in the presence of side gusts. The ground effect is shown to exert a powerful constraint on bank angle disturbances for this class of aircraft, almost eliminating the effects of lateral turbulence as a control problem. Other possible consequences of this ground effect on various lateral control problems are briefly discussed.

Author (ESRO)

N72-11962# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

WIND TUNNEL TESTS AT TRANSONIC AND SUPERSONIC SPEEDS TO INVESTIGATE THE LONGITUDINAL STABILITY OF A MODEL OF THE AVRO 720 AIRCRAFT

E. Huntley London Aeron. Res. Council 1971 49 p refs Supersedes RAE-TN-AERO-2685; ARC-22430 (ARC-CP-1140; RAE-TN-AERO-2685; ARC-22430) Avail: NTIS; HMSO: 40 p; BIS: $1.60

Tests were made in a 3ft x 3ft wind tunnel on a 1/30 scale model of the AVRO 720 aircraft to investigate the longitudinal stability characteristics at Mach numbers between 0.70 and 2.00. Additional tests were made with airbrakes attached to the rear-fuselage and with notches cut in the leading edges of the wing at 66.7% semispan. The results show no doubtful features apart from a sharp but small transient pitch-up at lift coefficients around C sub L = 0.45 for M = 0.80 and C sub L = 0.60 for M = 0.96. The instability is appreciably reduced by the application of up-elevon and is almost completely eliminated by the leading edge notches. The notches, however, introduce some instability at M = 0.99 where none had occurred originally.

Author (ESRO)

N72-11963# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A FURTHER WIND TUNNEL INVESTIGATION OF UNDERWING JET INTERFERENCE

A. G. Kurn London Aeron. Res. Council 1971 52 p refs Supersedes Rae-TR-69090; ARC-31505 (ARC-CP-1156; RAE-TR-69090; ARC-31505) Avail: NTIS; HMSO: 70p; PHI: $2.95

Experiments, to investigate the interference of the jet stream issuing from a high bypass ratio engine mounted below a wing are described. Tests have been made with a two-dimensional wing, and two nozzle shapes representing engines with different fan cowl lengths. A jet blowing from these nozzles produced negligible interference on the wing upper surface. However, a change in the lower surface pressure distribution occurred which was dependent only on the wing and nozzle geometry. This interference was dominated by a high suction peak, which appeared to be related to a region in the jet where the alternate expansion and compression waves were not uniformly spaced.

Author (ESRO)

N72-11964# Royal Aircraft Establishment, Bedford (England). Aero Flight Div.

THEORETICAL ASSESSMENT OF A METHOD FOR THE FLIGHT MEASUREMENT OF NET ENGINE THRUST USING TOWED DRAG DEVICES

W. J. G. Pinsker 1971 27 p refs Supersedes RAE-TR-69281; ARC-32173

(ARC-CP-1169; RAE-TR-69281; ARC-32173) Avail: NTIS; HMSO: 40p; BIS $1.60

It is shown that in theory at least engine net-thrust can be determined from flight tests utilizing towed drag devices e.g. parachutes. The thrust evaluation is based on the measurement of the pull exerted by the device on the aircraft and the speed change it produces in level flight. A knowledge of the variation of thrust and drag with speed is required, however, and the accuracy of the technique is assessed to be at best 3 to 5 per cent. There are, moreover, flight conditions and configurations where the methods are of little practical value and these are indicated. A potential accuracy of near 1% is obtainable, if the technique is used to measure the increment of thrust obtained from change of throttle at a fixed speed. This could be useful as a check on thrust measurements by other methods. Apart from this particular application, the investigated method does not appear to offer a clear advantage in accuracy over existing procedures, but it might be used where simplicity is more important than high accuracy or where other methods are impracticable for some specific reasons. Author (ESRO)

N72-11965# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

AIRCRAFT CENTRE OF GRAVITY RESPONSE TO TWO-DIMENSIONAL SPECTRA OF TURBULENCE

I. W. Kaynes London Aeron. Res. Council 1971 37 p refs Supersedes RAE-TR-69271; ARC-32139

(ARC-R/M-3665; RAE-TR-69271; ARC-32139) Avail: NTIS; HMSO: 90p; BIS: $3.50

The energy spectrum of atmospheric turbulence is used to predict the normal acceleration response of a rigid aircraft. Particular reference is made to spanwise variations of gust velocity and this effect is described in terms of a general input spectrum which is applicable to any wing with a particular spanwise loading distribution operating under a wide range of conditions. Tables of the gust response factor and the number of zero crossings are presented for a range of parameters.

Author (ESRO)

N72-11966# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

FURTHER PILOTED SIMULATION STUDIES OF THE HANDLING CHARACTERISTICS OF A SLENDER-WING SUPERSONIC TRANSPORT AIRCRAFT DURING APPROACH AND LANDING

B. N. Tomlinson London Aeron. Res. Council 1971 54 p refs Supersedes RAE-TR-69003; ARC-31375

(ARC-R&M-3660) Avail: NTIS; HMSO: £1.40; PHI: $5.80

A simulated slender wing supersonic transport aircraft was flown by a number of airline and test pilots. Pilots, comments on the handling qualities of the simulated aircraft, problem areas, and touchdown, and the effect of autostabilizer failures were studied. The touchdown phase was of particular interest. Results were qualified by the inability of the simulation to provide all the cues, particularly visual ones, necessary for a successful landing. Cockpit motion in pitch and roll was used. Principal results were that 1) The handling qualities of the simulated aircraft in its fully autostabilized state were good; 2) Loss of the pitch damper provoked the strongest criticisms; and 3) Loss of autothrottle did not pose any great difficulty. Retaining the autothrottle in operation throughout the landing flare was desirable. Sidestep maneuvers were performed easily and good landings could be made in calm and turbulent conditions, in cross winds up to 25 kts. Author (ESRO)

N72-11967# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WIND-TUNNEL MEASUREMENTS OF SURFACE PRESSURE FLUCTUATIONS ON TWO SLENDER-WING MODELS

D. A. Lovel and T. B. Owen London Aeron. Res. Council 1971 43 p refs Supersedes RAE-TR-70168; ARC-32575

(ARC-CP-1154; RAE-TR-70168; ARC-32575) Avail: NTIS; HMSO: 60p; PHI: $2.65

Measurements of the amplitudes and spectra of surface pressure fluctuations have been made on the upper surfaces of two delta wings with 76 deg leading-edge sweep. The high frequency portion of each spectrum is found to conform to a universal scaling law based on two-dimensional boundary-layer data. It is also found that the high level of low-frequency pressure fluctuations is confined to an area on the upper surface of the wing under and outboard of the core of the leading-edge vortex sheet and that the amplitudes and spectrum shapes of the low-frequency portions of the spectra are not strongly dependent on the Reynolds number, and the nondimensional magnitude increases slowly with increasing angle of incidence. However, the high level of low-frequency fluctuations spreads inboard as the angle of incidence is increased and problems of wing buffet or panel vibration could arise on a large aircraft. Author

N72-11968# Naval Air Development Center, Johnsville, Pa.

STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT Summary Report, 1 Jan. 1962 - 1 Jan. 1971

Thomas A. DeFiore 1 May 1971 108 p ref

(AD-725840; NADC-ST-7108) Avail: NTIS CSCL 01/3

The report is a specialized summary of normal acceleration data recorded by counting accelerometers. Data are separated by calendar time and mission category. Only data reported in the counting accelerometer program are included. Author (GRA)

N72-11969# North American Rockwell Corp., Los Angeles, Calif.

AERODYNAMIC STABILITY AND CONTROL/WIND TUNNEL DATA CORRELATION Final Technical Report, 15 Oct. 1966 - 31 Aug. 1970

G. R. Casteel May 1971 220 p refs

(Contract AF 33(615)-5323; AF Proj. 698 BT)

(AD-726103; NA-70-327-2; AFFDL-TR-71-3) Avail: NTIS CSCL 01/3

The general objective was to collect and analyze aerodynamic stability and control data for the XV-4B, XV-5A, and P-1127 VTOL configurations. Correlation and analysis of existing model data were made to investigate hover and transition characteristics. Particular emphasis was placed on the aerodynamic power effects, sometimes referred to as interference effects. Other areas of investigation were sometimes referred to as interference effects. Other areas of investigation were nondimensional coefficients used to present VTOL data and wind tunnel test techniques. Wind tunnel tests were conducted using an inlet only model and a jet only model to investigate special test and analysis problems for these components. The agreement between different sets of XV-4B model data was, in general, found to be poor. However, the nondimensional coefficients used by Lockheed to reduce to XV-4B model data appear to be valid parameters for this category of VTOL airplane. The jet entrainment flow was shown by experiment to be the primary cause of the XV-4B power effects, and the XV-4B jet path was experimentally and theoretically determined. Author (GRA)

N72-11970# Army Foreign Science and Technology Center, Charlottesville, Va.

TOLERANCE PLUS OR MINUS 5: HOW TO UNDERSTAND IT

N. Chernykh, B. A. Andreeva, and V. Lysova 21 Jul. 1971 11 p Transl. into ENGLISH from Aviatsiya i Kosmonavtika

(Moscow)
(AD-728656; FSTC-HT-23-741-71) Avail: NTIS CSCL 01/3
Statistical evaluation of regular periodic service of aircraft as a function of accrued flying time is presented. GRA

N72-11971# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
THEORY OF AN AIR CUSHION LANDING SYSTEM FOR AIRCRAFT Technical Report, Aug. 1968 - Jun. 1971
Kennerly H. Digges Jun. 1971 327 p refs
(AF Proj. 1369)
(AD-728647; AFFDL-TR-71-50) Avail: NTIS HC $6.00/MF $0.95 CSCL 01/3
The Air Cushion Landing System is a scheme to replace the wheeled landing gear on aircraft by a peripheral jet air cushion. The concept employs a flexible elastic membrane or 'trunk' which is attached to the bottom of the aircraft fuselage. During flight, the trunk shrinks elastically and hugs the bottom of the fuselage like a de-icing boot. When a flow of air is applied to tye inside of the trunk, the elastic material stretches and forms an elongated doughnut-shaped protrusion on the underside of the aircraft. The air flow is ducted by the trunk to the fuselage periphery and exhausted through a large number of holes or slots. As a result, a pressure builds up under the aircraft when the ground is approached. The pressure is sufficient to support the aircraft and absorb its vertical landing velocity. The study develops analytical relationships between the variables associated with the Air Cushion Landing System. Included are the following: The derivation of a theory which predicts the static characteristics of the system; Analytical methods for predicting flow, jet height and power requirements; Curves which illustrate the inter-relationships among the design variables; Computer programs for predicting the cross-sectional area and shape of the elastic trunk; The development and test of an analytical model which predicts the dynamic response of the system to landing impact; A discussion of the design considerations for the system.
Author (GRA)

N72-11972# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
INTERNAL/EXTERNAL NOISE Final Report
10 Jun. 1971 12 p refs
(AMCR Proj. 310-6)
(AD-728454; MTP-7-3-5) Avail: NTIS CSCL 01/3
Procedures are given to be used to determine that Army aircraft, equipment, auxiliary systems and air traffic control facilities are in accord with the internal/external noise limitations stated in Materiel Needs and the suitability of these items for Army use. Author (GRA)

N72-11973# California Univ., Los Angeles. School of Engineering and Applied Science.
ON THE PREDICTION AND OPTIMALITY OF AIRCRAFT MANEUVERS ASSOCIATED WITH APPROACH AND LANDING
Glenn Dexter Buell, Jr. Jun. 1971 161 p refs
(Contract F04701-70-C-0240; Grant AF-AFOSR-0699-67; AF Proj. 9749)
(AD-728325; UCLA-ENG-7126; AFOSR-71-2266TR; Task-61102f; Task-681304) Avail: NTIS CSCL 01/3
The report analyzes in detail two of the critical aircraft maneuvers associated with approach and landing; the go-around maneuver and the flare maneuver. Optimal solutions that include state and control variable constraints are obtained for both problems. Two algorithms are given for computation of the minimum and maximum altitude loss associated with the pilot controlled go-around maneuver. A matrix operator is obtained that can be used for inflight computation of the altitude loss on a small general purpose digital computer. The flare optimization presented is for a cost functional that includes both the longitudinal touchdown dispersion and the normal acceleration. A closed loop mechanization is given that approximates the optimal trajectory. A second matrix operator which can be used for prediction of the longitudinal touch down point is obtained. Uncertainties are also obtained for the purpose of establishing a prediction confidence level. It is proposed that these prediction techniques should be incorporated into a decision making performance monitor. This monitor could provide the pilot with a continuous assessment of the approach and could generate a pre-flare decision on whether or not to commit the aircraft to the flare maneuver. Author (GRA)

N72-11974# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 3: AVIONICS ANALYSIS AND SYSTEM SYNTHESIS Final Report, 30 Jun. 1969 - 1 Dec. 1970
O. Herbert Lindquist, Arthur L. Jones, and James W. Wingert Jul. 1971 331 p refs
(Contract N00014-69-C-0460; NR Proj. 213-072)
(AD-728043; Rept-12609-FR1-Vol-3; JANAIR-701221-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 06/7
The analysis and synthesis of an avionics system for a search and rescue mission must take into account the constraints imposed by the aircraft along with the requirements imposed by the mission and the avionic equipment available as described in Volume II. For this purpose an estimate of the helicopter size and operational characteristics required for the 1972-1974 SAR missions was made. These characteristics are presented. In the study the crew workload analyses and the system synthesis were cycled through twice, once for a baseline system and once for a revised system. Prior to the start of the second crew workload analysis, the number of crew members was reduced from five to four, necessitating a redistribution of functions among the crew. Furthermore, the results of the first analyses indicated that a detailed investigation of the flight control system was required to define the required modes and associated workloads.
Author (GRA)

N72-11975# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 1: SUMMARY Final Report, 30 Jun. 1969 - 1 Dec. 1970
O. Herbert Lindquist, Arthur L. Jones, and James W. Wingert Jul. 1971 44 p
(Contract N00014-69-C-0460; NR Proj. 213-072)
(AD-728041; HONEYWELL-12609-FR1-Vol-1; JANAIR-701219) Avail: NTIS CSCL 06/7
An analytical synthesis and evaluation of an avionic system and its airborne displays and controls was performed for a hypothetical Search and Rescue helicopter of the 1972-1974 era. The requirements for the system were based on composite mission and operational requirements obtained from four services: U.S. Navy, U.S. Air Force, U.S. Army and U.S. Coast Guard. The candidate systems evaluated were selected from equipment that was state of the art now or readily could be by 1972. The evaluations of the candidate systems were based on the functional performance of the equipment and on the crew-equipment interface suitability as measured by crew workload. The configuration recommended met most, but not all, of the composite mission requirements. Additional development was suggested in areas where the equipment or the crew-equipment interface evaluations indicated a deficiency in performance. Author (GRA)

N72-11976# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 2: SAR REQUIREMENTS AND TECHNOLOGY SURVEY Final Report, 30 Jun. 1969 - 1 Dec. 1970

O. Herbert Lindquist, Arthur L. Jones, and James W. Wingert Jul. 1971 183 p refs

(Contract N00014-69-C-0460; NR Proj. 213-072)

(AD-728042; HONEYWELL-12601-FRI-Vol-2; JANAIR-701220) Avail: NTIS CSCL 06/7

The volume covers the initial work tasks of this multiservice (USN, USA, USAF, USCG) research effort which pertains to airborne displays and controls for search and rescue vehicles for the 1972-1974 time frame. The work tasks include collection of SAR mission objectives from the four services, description of flight mission profiles by mission segments, identification of functional requirements to be met and technology surveys of industry to determine applicable avionics capabilities.

Author (GRA)

N72-11979# Royal Aircraft Establishment, Farnborough (England).

COMPARATIVE ASSESSMENT OF TWO FORMS OF CYCLOCONVERTER

A. Bainbridge May 1970 47 p refs

(RAE-TR-70092; EP-547; UDC-621.314.26) Avail: NTIS

The operation of two forms of cycloconverter, using natural and forced commutation, is described and analysed mathematically, with particular reference to equivalent circuit parameters, effective power factor and harmonic content. It has been claimed that the differences between these alternatives will have significant elfects on the performance and engineering arrangement of variable speed constant frequency (VSCF) aircraft generating systems, and the analysis confirms that forced commutation has theoretical advantages which could result in simplified circuitry and reduced size of alternator. The results presented which admittedly apply to ideal situations, will help in the assessment of the two systems and indicate further avenues of research.

Author

N72-12037# California Univ., Los Angeles. School of Engineering and Applied Science.

THE EFFECTS OF AIRCRAFT DYNAMICS AND PILOT PERFORMANCE ON TACTICAL WEAPON DELIVERY ACCURACY

Robert R. Rankine, Jr. Nov. 1970 226 p refs

(Grant AF-AFOSR-0699-67)

(AD-728324; UCLA-ENG-7085; AFOSR-71-2262TR) Avail: NTIS CSCL 05/10

An adequate model of piloted weapon delivery is needed in order to relate pilot tracking performance, and the aircraft dynamics which limit that performance, to the overall accuracy of tactical weapon delivery. By modeling the entire pilot-aircraft system xor the air-to-ground weapon delivery task, an understanding of the interaction and relative importance of the various elements of the system can be obtained. With this insight the designer is able to treat the correction or improvement of system deficiencies in a logical order of their importance to a specific measure of system performance. A complete model of the piloted weapon delivery task is now possible through the application of mathematical models of the human operator's performance characteristics to the dynamic description of the combined control-display-vehicle system. The approach taken is to derpve a linear expression for projectile impact error in terms of the task variables which are directly under the pilot's control. A statistical model of the propagation of these pilot-induced errors into impact error is then developed by considering each of the pilot inputs to be a random variable. A method for including the effect of pilot compensation of an observed error in one of the variables with an intentional deviation in another is also introduceb. An analytical model of the human pilot is used to estimate the tracking error from the controlled-element dynamics and the turbulence environment. Author (GRA)

N72-12064# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Advanced Systems Div.

A SYSTEMS APPROACH TO C-130E AIRCREW TRANSITIONAL TRAINING Final Report

Horace H. Valverde and Bob P. Burkett (Tactical Air Command, Little Rock AFB, Ark.) Mar. 1971 72 p refs

(AF Proj. 1710)

(AD-727055; AFHRL-TR-71-4) Avail: NTIS CSCL 05/9

The report describes the development and evaluation of a Tactical Air Command (TAC) C-130E transitional aircrew training program based on a systems approach. The systems approach to training emphasizes the importance of specifying objectives derived from a task analysis of the aircrew member's job. A training program was prepared to develop proficiency in the ypecific duties required of the C-130E pilot, co-pilot, and the flight engineer. The training program was designed to be highly job relevamt and included multimedia and self-instructional materials. Training objectives were derived from a task analysis of the C-130E aircrew members' job requirements. Aircrew flight training course materials and various training media were prepared based on the specific end-of-course objectives. The training program was evaluated over a six-month period, revised as needed, and implemented by TAC in the USAF formal school for C-130E transitional training for all military services. The results were as follows: students in the new course achieved all training objectives; classroom instruction was reduced about 50%; flying hours were reduced from 45 to 35 hours; length of training was reduced 37% per trainee; pilots and co-pilots, graduates of the new course, were rated significantly higher by their supervisors than were graduates of the old course; there was no significant difference in ratings received by the two flight engineer groups; and verified annual savings of about five million dollars was realized. Author (GRA)

N72-12080* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

POSITION LOCATION SYSTEM AND METHOD Patent

Charles R. Laughlin and Roger C. Hollenbaugh, inventors (to NASA) Issued 20 Jul. 1971 11 p Filed 28 Nov. 1969 Continuation-in-part of US Patent Appl. SN-701744, filed 30 Jan. 1968

(NASA-Case-GSC-10087-3; US-Patent-3,594,790; US-Patent-Appl-SN-880885; US-Patent-Class-343-6.8R; US-Patent-Class-325-4; US-Patent-Class-343-6.5R) Avail: US Patent Office CSCL 17B

A system and method for position locating for air traffic control are described. This includes communication via voice and digital signals between remote aircraft, especially supersonic transports, and a central station, as well as peripheral ground station(s), through a synchronous satellite relay station. Side tone ranging patterns and the voice and digital signals are modulated on a carrier transmitted from the central station and received on all of the aircraft. Each aircraft communicates with the ground station via a different frequency multiplexed spectrum. Aircraft position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the airplanes, with a plurality of different side tone techniques, and relayed back to the transports. Common to all the side tone techniques is Doppler compensation for the supersonic transport velocity.

Official Gazette of the U.S. Patent Office

N72-12086*# ESL, Inc., Sunnyvale, Calif. Electromagnetic Systems Labs.

COMMUNICATION PERFORMANCE OVER THE TDRS MULTIPATH/INTERFERENCE CHANNEL

J. Jenny, D. Gaushell, and P. Shaft 19 Aug. 1971 99 p refs

(Contract NAS5-20228)

(NASA-CR-122295; ESL-TM239) Avail: NTIS CSCL 17B

Previously developed models are used to predict communication system performance for two cases: and aircraft/TDRS and a

weather satellite/TDRS relay. The magnitude of multipath, differential time delay, Doppler shift, time and Doppler spread, and interference expected to be encountered are reviewed and applied to the two cases of interest. Author

N72-12087# National Aviation Facilities Experimental Center, Atlantic City, N.J.
VHF/UHF GROUND-AIR-GROUND COMMUNICATIONS SITING CRITERIA Final Report, Jul. 1967 - Dec. 1970
James G. Dong Nov. 1971 289 p refs
(FAA Proj. 221-110-17X)
(FAA-RD-71-76; FAA-NA-71-7) Avail: NTIS

Results are presented of tests accomplished at the National Aviation Facilities Experimental Center and selected Federal Aviation Administration field facilities to determine radio frequency communication problems and equipment performance under remote transmitter receiver and remote center air-ground configurations. Performance characteristics of antennas, *transmitters, receivers, transmission lines, and ancillary equipment* were investigated to determine the parameters that affect mutual interference when these equipments are combined in FAA system configurations. The results of the investigation were limited to equipment in current use at field sites and equipment recently developed. The data are incorporated in a field manual which was prepared to provide reference and guidance to installation and maintenance personnel on interference aspects in correcting similar problems at existing sites and the application of these principles in establishing new sites. Author

N72-12112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GRAPHIC DISPLAYS FOR LARGE AERODYNAMIC TEST FACILITIES
Daniel L. Whipple Nov. 1971 13 p refs
(NASA-TM-X-67968; E-6474) Avail: NTIS CSCL 09B

A combination of software and hardware for a time-sharing computer is described which allows the user to obtain an on-line data display in the control room of a large research facility. Display and hard copy of alphanumeric data as well as graphical data can be obtained as desired by the user. In addition, a number of utility programs provide for on-line graphic editing, program control, data manipulation, and off-line microfilm processing. Author

N72-12182*# McDonnell Aircraft Corp., St. Louis, Mo.
AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES. VOLUME 1: WIND TUNNELS
C. J. Pirrello, R. D. Hardin, M. V. Heckart, and K. R. Brown Washington NASA Nov. 1971 314 p
(Contract NAS2-5458)
(NASA-CR-1874) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

A survey of wind tunnel research facilities in the United States is presented. The inventory includes all subsonic, transonic, and hypersonic wind tunnels operated by governmental and private organizations. Each wind tunnel is described with respect to size, mechanical operation, construction, testing capabilities, and operating costs. Facility performance data are presented in charts and tables. Author

N72-12183*# McDonnell Aircraft Corp., St. Louis, Mo.
AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES. VOLUME 3: STRUCTURAL
C. J. Pirrello, R. D. Hardin, M. V. Heckart, and K. R. Brown Washington NASA Nov. 1971 271 p
(Contract NAS2-5458)
(NASA-CR-1876) Avail: NTIS CSCL 14B

An inventory of test facilities for conducting acceleration, environmental, impact, structural shock, load, heat, vibration, and noise tests is presented. The facility is identified with a description of the equipment, the testing capabilities, and cost of operation. Performance data for the facility are presented in charts and tables. Author

N72-12198# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
FLOW UNSTEADINESS AND MODEL VIBRATION IN WIND TUNNELS AT SUBSONIC AND TRANSONIC SPEEDS
D. G. Mabey London Aeron. Res. Council 1971 101 p refs Supersedes RAE-TR-70184; ARC-32716
(ARC-CP-1155; RAE-TR-70184; ARC-32716) Avail: NTIS; HMSO: £1.30; BIS: $4.95

Flow unsteadiness and model vibration in the 3 ft x 3 ft tunnel have impeded static and dynamic measurements at subsonic and transonic speeds. The unsteadiness was measured with pressure transducers both in the 3 ft x 3 ft tunnel and a 1/9 scale model of this tunnel, and good agreement was obtained. For the closed 3 ft x 3 ft tunnel, successive modifications to the balance section and diffuser derived from tests of the model have reduced the unsteadiness at subsonic speeds to an acceptable level for dynamic tests. The unsteadiness in the slotted tunnels operated by diffuser suction originated in the extraction region was reduced in the tunnel by covering the slots with perforated screens. The perforated and closed working sections of the model tunnel had nearly the same unsteadiness, and a similar result was achieved with the perforated working for the 3 ft x 3 ft tunnel in the frequency range of 20 to 900 Hz. Edge-tones generated at low unit Reynolds number were eliminated by a modification to the hole geometry.
Author (ESRO)

N72-12211*# Michigan State Univ., East Lansing. Div. of Engineering Research.
A STUDY OF THE ROUND JET/PLANE WALL FLOW FIELD Annual Report
John F. Foss and Stanley J. Kleis 8 Oct. 1971 203 p refs
(Grant NGR-23-004-068)
(NASA-CR-124604; AR-1) Avail: NTIS CSCL 20D

Impingement angles, between the axisymmetric jet axis and the plane wall, from zero to 15 degrees have been examined for nozzle heights of 0.75, 1.0, 1.5 and 2.0 diameters and for: (1) a fully developed pipe flow, and (2) a relatively uniform exit velocity condition. Velocity measurements have been used to define isotach contours and to determine mass, momentum and energy flux values for the near field (within five diameters) of the jet. Surface pressure measurements have been used to define surface pressure forces and jet centerline trajectories. The geometric and flow conditions examined and the interpretation of the results have been motivated by the externally blown flap STOL aircraft application. Author

N72-12223*# General Electric Co., Schenectady, N.Y. Research and Development Center
THE THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON MULTIPLE PURE TONE NOISE, PART 1
R. A. Kantola and M. Kurosaka Nov. 1971 157 p refs
(Contract NASw-1922)
(NASA-CR-1831) Avail: NTIS CSCL 21E

A theoretical and experimental investigation is described on multiple pure tone noise. Based on a two-dimensional and inviscid flow model, an analysis is developed to predict the generation and subsequent evolution of multiple pure tone noise from prescribed blade-to-blade nonuniformities in the rotor geometry. The results show that even small nonuniformities within manufacturing tolerances can cause a significant amount of multiple pure tone noise. Among the different kinds of

nonuniformities investigated, errors in blade spacings are a weaker generator of multiple pure tone noise than errors in blade stagger or blade contours. Experimental investigations of the effects of the rotor relative Mach number, incidence angle and length of the inlet duct on the evolution of the multiple pure tone noise are conducted with a known distribution of rotor nonuniformities. The model fan is operated, in Freon 12, in a closed loop acoustical facility. Author

N72-12241# Harry Diamond Labs., Washington, D.C.
FLUIDIC GENERATOR SYSTEM TO FIRE AIRCRAFT ROCKETS ENVIRONMENTALLY
Carl J. Campagnuolo, Clinton J. Sewell, and Clayton D. McKindra Jun. 1971 21 p refs Sponsored by NOL
(HDL Proj. 34734)
(AD-728105; HDL-TM-70-30) Avail: NTIS CSCL 13/7

A fluidic generator system for firing aircraft rockets has been developed to eliminate accidental firings of rockets while the aircraft is on the ground or on a carrier deck. The system increases safety of these rockets by denying a power supply to the squibs until specified flight conditions are met. Sufficient power to fire the rocket motors is provided by the fluidic generator only when the aircraft is airborne and has reached a speed of 200 knots. Flight tests of the system in the altitude range between 500 and 31,000 ft indicated that firing voltage (50 V dc) was reached in the velocity range between 210 to 260-knots indicated airspeed. This agreed well with laboratory results. No output voltage was recorded during an acoustic test conducted to determine the susceptibility of the generator to aircraft noise. Author (GRA)

N72-12392# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
LOW-SPEED WIND-TUNNEL CALIBRATIONS OF THE PITOT AND STATIC PRESSURE SENSORS AND WIND VANES ON THE SHORT SC AIRCRAFT
K. P. King and E. N. Rowthorn London Aeron. Res. Council 1971 32 p refs supersedes RAE-TR-70133; ARC-32780
(ARC-CP-1162; RAE-TR-70133; ARC-32780) Avail: NTIS; HMSO: 45p; PHI: $1.95

The pressure sensors tested consisted of a perforated sphere static, a twin venturi pitot arrangement, designed to permit the derivation of dynamic pressure in both forward and backward flight, and a Mk.8T pitot-static head. It was found that only the Mk.8T pitot-static head gave satisfactory results over the range of sideslip angles likely to be met in flight. This pitot-static head was then calibrated over a range of incidence and sideslip angles and error contours were plotted to facilitate the correction of the indicated static and dynamic pressures recorded in flight. The wind vanes measuring sideslip and incidence were also calibrated over the same range and error contours plotted for the correction of their indications. Finally the dynamic response of the wind vanes was investigated to determine their natural frequency and damping and hence their amplitude ratio and phase lag when recording aircraft oscillations. Author (ESRO)

N72-12413*# General Motors Corp., Indianapolis, Ind. Allison Div.
DESIGN OF AIRCRAFT TURBINE FAN DRIVE GEAR TRANSMISSION SYSTEM
E. Dent, R. A. Hirsch, and V. W. Peterson Washington NASA Mar. 1970 88 p
(Contract NAS3-12417)
(NASA-CR-72735) Avail: NTIS CSCL 13I

The following basic types of gear reduction concepts were studied as being feasible power train systems for a low-bypass-ratio, single-spool, geared turbofan engine for general aircraft use: (1) single-stage external-internal reduction, (2) gears (offset shafting), (3) multiple compound idler gear system (concentric shafting), and (4) star gear planetary system with internal ring gear final output member (concentric shafting-counterrotation). In addition, studies were made of taking the accessories drive power off both the high-speed and low-speed shafting, using either face gears or spiral bevel gears. Both antifriction and sleeve-type bearings were considered for the external-internal and star-planet reduction concepts. Author

N72-12419*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN STUDY OF SHAFT FACE SEAL WITH SELF-ACTING LIFT AUGMENTATION. 5: PERFORMANCE IN SIMULATED GAS TURBINE ENGINE OPERATION
Lawrence P. Ludwig and Robert L. Johnson Washington Dec. 1971 20 p refs
(NASA-TN-D-6563; E-6312) Avail: NTIS CSCL 11A

The feasibility and the noncontact operation of the self-acting seal was demonstrated over a range of simulated gas turbine engine conditions from 200 to 500 ft/sec sliding speed. Sealed pressure differentials were 50 to 300 psi and sealed temperatures were 150 to 1200 F. Low leakage (about 1/10 that of conventional labyrinth seals) was exhibited in two endurance runs (200 and 338 hr) at 400 ft/sec, 200 psi and 1000 F (gas temperature). For these endurance runs, the self-acting pad wear was less than 3.8 micrometers (0.00015 in.); this low wear was attributed to the noncontact operation of the primary seal. Operating problems identified were fretting wear of the secondary seal and erosion of the primary seal by hard particles. Author

N72-12420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTOHYDRODYNAMIC FILM THICKNESS MEASUREMENTS WITH ADVANCED ESTER, FLUOROCARBON, AND POLYPHENYL ETHER LUBRICANTS TO 589 K (600 F)
Richard J. Parker and Jerrold W. Kannel Washington Dec. 1971 25 p refs
(NASA-TN-D-6608; E-6440) Avail: NTIS CSCL 11H

Elastohydrodynamic (EHD) film thicknesses have been measured, by means of an X-ray technique, under conditions that closely simulate the ball-race contact in advanced turbine engine thrust bearings. The experiments were conducted with a rolling-disk machine using disks which yield a contact zone similar to that in the actual bearing. Both the rolling and spinning motions of the ball relative to the race were simulated by the apparatus. Four lubricants were evaluated at temperatures to 600 F and maximum Hertz stresses to 350,000 psi. The X-ray film thickness data correlated well with observations of surface distress (or lack thereof) in full-scale bearing tests with the same lubricants under similar conditions of temperature and load. The predicted variation of film thickness with speed and viscosity as verified, although the magnitude of measured film thickness was generally one-half to one-third of predicted values. An effect of stress greater than predicted was consistently observed in the higher stress range. Author

N72-12425# Bendix Corp., Southfield, Mich. Research Labs.
INVESTIGATION OF ROTARY ACTUATION TECHNIQUE Final Report, Jan. 1966 - Jul. 1970
Kenneth W. Verge, Ronald G. Read, and Norbert L. Sikora Wright-Patterson AFB, Ohio AFAPL Sep. 1970 319 p refs
(Contract AF 33(615)-3431)
(AD-875752; Rept-5273; AFAPL-TR-70-52) Avail: NTIS HC $6.00/MF $0.95 CSCL 13/7

A unique, high-torque rotary actuation technique applicable to aircraft vehicle control is described. This device, the dynavector actuator, incorporates an integrated captive vane orbital hydraulic motor with a high ratio epicyclic transmission. The demonstration of this rotary actuator technology has been accomplished by the design, fabrication and evaluation testing of a 100,000 in-lb torque capacity drive. Author (GRA)

N72-12427# Biotechnology, Inc., Falls Church, Va.
DEVELOPMENT OF INFORMATION MEASUREMENT TECHNIQUES FOR QUALITY ASSURANCE OF NAVY AIRCRAFT MAINTENANCE JOB AIDS. PART 1: RESEARCH AND DEVELOPMENT EFFORT Final Report, Jun. 1970 - Jun. 1971
Harold E. Price, Theodore J. Post, and Gretchen Kolsrud Jun. 1971 154 p refs
(Contract N62269-70-C-0395)
(AD-725814) Avail: NTIS CSCL 05/2

The purpose of the study was to develop paper-and-pencil tests to support in-process review of aviation maintenance job aids. Two types of tests were developed, editorial and information content. Application of the tests would result in early detection of inadequacies and corrective feedback to technical writers. Author (GRA)

N72-12428# Biotechnology, Inc., Falls Church, Va.
DEVELOPMENT OF INFORMATION MEASUREMENT TECHNIQUES FOR QUALITY ASSURANCE OF NAVY AIRCRAFT MAINTENANCE JOB AIDS. PART 2: IN-PROCESS REVIEW TEST DESCRIPTIONS AND PROCEDURES Final Report, Jun. 1970 - Jun. 1971
Harold E. Price, Theodore J. Post, and Gretchen Kolsrud Jun. 1971 105 p
(Contract N62269-70-C-0395)
(AD-725815) Avail: NTIS CSCL 05/2

The purpose of this study was to develop paper-and-pencil tests to support in-process review of aviation maintenance job aids. This volume was specifically prepared for use by publications review specialists. To this extent, it concentrates on test descriptions and procedures. The tests were prepared as part of an advanced development effort and are intended strictly to be supportive materials for the publications review specialist. The tests possess an added value, too. Since they can also be used as guidelines for the preparation of manuscripts, it is hoped that contractors preparing technical publications will find them to be helpful in that way. GRA

N72-12429# Biotechnology, Inc., Falls Church, Va.
DEVELOPMENT OF INFORMATION MEASUREMENT TECHNIQUES FOR QUALITY ASSURANCE OF NAVY AIRCRAFT MAINTENANCE JOB AIDS. PART 3: IN-PROCESS REVIEW TEST FORMS Final Report, Jun. 1970 - Jun. 1971
Harold E. Price, Theodore J. Post, and Gretchen Kolsrud Jun. 1971 52 p
(Contract N62269-70-C-0395)
(AD-725816) Avail: NTIS CSCL 05/2

The purpose of the study was to develop paper-and-pencil tests to support in-process review of aviation maintenance job aids. Six types of tests were developed. Four of these tests concern editorial quality of draft manuscripts; the remaining two tests address the adequacy of information content appearing in the manuscript to be evaluated. To facilitate test administration, a set of forms has been developed for each of the six tests. Part II of this report (AD-725815) describes each of these tests and presents detailed instructions for completing the test forms. After the reviewer is familiar with the test procedures, a more truncated version of the test procedures is appropriate for field use. This part presents that truncated version. Only the test forms and key guidelines for their use are included. GRA

N72-12437# Bendix Corp., South Bend, Ind. Energy Control Div.
COMPONENT IMPROVEMENT PROGRAM FOR AIRCRAFT BRAKE PISTON SEALS Final Report, Dec. 1969 - May 1971
Richard F. Horner Wright-Patterson AFB, Ohio ASD Aug. 1971 39 p refs
(Contract F33657-70-C-0508; WM Proj. 9-163-2605)
(AD-728216; ASD-TR-71-43) Avail: NTIS CSCL 13/7

Hydraulic fluid leakage in aircraft brakes has long been a problem for the Air Force. This leakage commonly occurs when the equipment is operated in a low temperature environment. In some cases, the leakage problem was resolved by using special nonstandard 'O' ring seals at a higher cost. Consequently, it is desirable to determine if a revision to the standard gland dimensions will improve cold temperature performance of MS-28775 series 'O' ring seals. The primary purpose of this investigation was to determine optimum gland dimensions for use with existing MS-28775 'O' ring packings for aircraft brake dynamic seals. A secondary objective was to evaluate new materials for seals. Author (GRA)

N72-12448# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
RESEARCH AND DEVELOPMENT PROGRAMS Quarterly Report, 1 Oct. - 31 Dec. 1970
C. F. Noyes, R. E. Walker, R. K. Frazer, N. Rubenstein, and R. W. Allen 31 Dec. 1970 42 p refs
(Contract N00017-62-C-0604)
(AD-726202; APL-U-RQR/70-4) Avail: NTIS CSCL 20/5

A record of the activities of the Applied Physics Laboratory in the field of Research and Development is issued in three volumes. In this volume results are reported on work in the following categories: Microelectronics Laboratory status and improvements; chemical laser systems, fast flow chemical laser experiment; limitations of current radomes; structural elastic studies; compact transpiration cooling studies; heat flux calorimeter development; turbulent transport with blowing and suction; turbulent boundary layer analysis; a wideband array antenna system; gaseous jet penetration experiments; Scramjet propulsion research; a Harpoon inlet model structural design; radar observations of land breeze fronts at Wallops Island, Va.; and guiding center motion of a charged particle in an inhomogeneous magnetic field. Author (GRA)

N72-12518# Naval Ordnance Lab., White Oak, Md.
REHARDENING OF EC-2273 POTTING COMPOUND IN F-4 AIRCRAFT ELECTRICAL COMPONENTS Final report, 1 Jul. 1969 - 31 Dec. 1970
Joseph M. Augl and Porter W. Erickson 14 May 1971 23 p refs
(NOLTR Proj. 341/AIR-520C0)
(AD-726180; NOLTR-71-53) Avail: NTIS CSCL 11/9

The useful lifetimes for electrical connectors potted with EC-2273 can be doubled by skin-hardening the surface of the potting compound with a 25% solution of hexamethylene diisocyanate in hexane or with a mixture of hexamethylene diisocyanate, butylisocyanate and hexane. These treatments are applicable to partially deteriorated as well as to the nondeteriorated potting compound. The treatments are carried out simply by immersion of the electrical component in the hardening solution for a period of three days. Author (GRA)

N72-12520# Monsanto Research Corp., Dayton, Ohio.
A THERMOPLASTIC TRANSPARENT ADHESIVE FOR BONDING POLYCARBONATE TO GLASS Final Report, 26 Aug. 1970 - 25 Apr. 1971
George L. Ball, III, Philip H. Wilken, Charles J. North, and Ival O. Salyer Jul. 1971 52 p refs
(Contract DAAG46-71-C-0007; DA Proj. 1f1-62205-aa-52)
(AD-728174; MRC-DA-296; AMMRC-CR-71-10) Avail: NTIS CSCL 11/1

The extent of the usefulness of glass and polycarbonate in armored windows depends both on the properties of these two

materials, as well as the availability of transparent adhesives for bonding the polycarbonate to glass and to itself. Until now, no completely suitable transparent adhesive of the thermoplastic type has been available. Accordingly, ethylene terpolymers varying in molecular weight, hydroxyl content, and degree of partial crosslinking were investigated. The primary requisities for the adhesive were that it be thermoplastic, optically clear, hydrolytically stable, and maintain the integrity of a glass-polycarbonate laminate when exposed to either thermal cycling from -65 up to &165F or ballistic impact. An ethylene terpolymer material identified as ETA no. 138150 was made available which more than fulfilled the performance requirements. Author (GRA)

N72-12523# Naval Air Engineering Center, Philadelphia, Pa. Aero Materials Dept.

EVALUATION OF DRY-TO-THE-TOUCH ULTRA THIN FILM, WATER DISPLACING, CORROSION PREVENTIVE COMPOUNDS

W. E. Knight 31 Jul. 1971 14 p refs

(F Proj. 00-543-202)

(AD-728779; NADC-MA-7145) Avail: NTIS CSCL 11/3

The report covers the evaluation of a material which is ultra thin, has good water displacing properties, and possesses corrosion preventive properties, and which is dry-to-the-touch when used on land-based aircraft in dusty areas. Author (GRA)

N72-12550*# Techtran Corp., Glen Burnie, Md.

THE PHYSICS OF EXHAUST CONDENSATES IN THE WAKE OF AIRPLANES

H. J. aufmKampe Washington NASA Dec. 1971 11 p Transl. into ENGLISH from Luftwissen, v. 10, no. 6, 1943 p 171-173

(Contract NASw-2037)

(NASA-TT-F-14047) Avail: NTIS CSCL 01A

The cause of vapor trails which form behind piston engine aircraft is discussed and vapor trail experiments carried out with a Henschel 126 aircraft at altitudes of approximately 10,000 meters are described. Author

N72-12553# Royal Aircraft Establishment, Bedford (England). Aero Flight Div.

ON LARGE AND RAPID WIND FLUCTUATIONS WHICH OCCUR WHEN THE WIND HAD PREVIOUSLY BEEN RELATIVELY LIGHT

J. Burnham and M. J. Colmer London Aeron. Res. Council 1971 24 p refs Supersedes RAE-TR-69261; ARC-32205

(ARC-CP-1158; RAE-TR-69261; ARC-32205) Avail: NTIS; HMSO: 35p; PHI: $1.55

Examination of anemometer records obtained at Bedford Airfield for the years 1962-1966 shows that, on about 40 occasions per year, large and rapid changes in windspeed and direction occur in relatively light wind conditions. Such events are associated with convection and do not follow the usual relationship between the size of fluctuations and the mean windspeed. Author (ESRO)

N72-12554# Royal Aircraft Establishment, Bedford (England). Aero Flight Div.

RESULTS OF A SERIES OF FLIGHTS IN THE STRATOSPHERE OVER MOUNTAINOUS TERRAIN IN THE WESTERN USA DURING FEBRUARY 1967

A. McPherson and J. M. Nicholls (Meteorol. Office, Bracknell, Engl.) London Aeron. Res. Council 1971 110 p refs Supersedes RAE-TR-70034; ARC-32579

(ARC-CP-1159; RAE-TR-70034; ARC-32579) Avail: NTIS; HMSO: 1.40; PHI: $5.80

Flights were planned on the basis of tropospheric lee wave forecasts and were usually made along wind at heights from the tropopause to about 50,000 ft over California and Nevada. Mountain waves, deduced from an analysis of the temperature along the flight track, were moderate or strong on four flights. Moderate or severe turbulence and marked temperature changes were encountered on three flights. The results give an insight into the severity of the stratospheric environment and the meteorological conditions in which the severe disturbances occur. Author (ESRO)

N72-12578# National Aviation Facilities Experimental Center, Atlantic City, N.J.

MODELING AND ANALYSIS OF AIR TRAFFIC CONTROL VOICE COMMUNICATION CHANNEL LOADING Interim Report, May 1969 - May 1971

Allen C. Busch Nov. 1971 55 p

(FAA Proj. 012-604-01X)

(FAA-RD-71-78; FAA-NA-71-42) Avail: NTIS

An effort to analyze and model by means of a nonreal-time simulation programming language, in this case GPSS, some of the characteristics of an air traffic control (ATC) air/ground/air voice communications channel is described. The functional entities or parameters of the model and the statistical characteristics of these parameters are presented. Furthermore, a comparison is made between the modeling outputs and real field derived measures of system output or performance. The conclusions are that this type of modeling and analysis can be a powerful and efficient tool for ATC simulation and system analysis provided that the model parameters adequately coincide with real system parameters and that real operational data are used to quantify the dependent variables in the model. Author

N72-12580*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

ON OPTIMAL SCHEDULING AND AIR TRAFFIC CONTROL IN THE NEAR TERMINAL AREA M.S. Thesis

Alexander Hippocrates Sarris Sep. 1971 170 p refs

(Grants NGL-22-009-124; AF-AFOSR-1941-70)

(NASA-CR-124640; ESL-R-459) Avail: NTIS CSCL 01E

A scheme is proposed for automated air traffic control of landing aircraft in the vicinity of the airport. Each aircraft is put under the control of an airport-based computer as soon as it enters the near-terminal area (NTA). Scheduling is done immediately thereafter. The aircraft is given a flight plan which, if followed precisely, will lead it to the runway at a prespecified time. The geometry of the airspace in the NTA is chosen so that delays are executed far from the outer marker, and violations of minimum altitude and lateral separations are avoided. Finally, a solution to the velocity mix problem is proposed. Author

N72-12583# National Bureau of Standards, Washington, D.C. Optical Radiation Section.

DEVELOPMENT, TESTING, AND EVALUATION OF VISUAL LANDING AIDS Consolidated Progress Report, 1 Apr. - 30 Jun. 1971

1 Sep. 1971 19 p refs

(NBS Proj. 2211511; NBS Proj. 2211514; NBS Proj. 2211680; NBS Proj. 2211681)

(NBS-10606) Avail: NTIS

The developments during this period are reported, and include the work in developing visibility meters and their application, airfield lighting and marking, and carrier lighting and marking. A list of publications and specifications reviewed is also included. F.O.S.

N72-12586# National Bureau of Standards, Washington, D.C. Engineering Mechanics Section.
STATIC TESTS OF L-837 AIRPORT MARKER LIGHT BASES
George F. Sushinsky Jul. 1971 21 p ref
(NBS Proj. 2211680)
(NBS-10453) Avail: NTIS

Static compressive load tests were performed on L-837 airport marker light bases. The bases were proof-loaded to 1000.000 lbf in assembly with currently used airport landing light fixtures of two different designs to determine compatibility of each piece in the assembled units. The bases, without landing light fixtures, were then over-loaded to determine load carrying capabilities and failure characteristics. Failures in the base flange and in the base sidewall were separately generated. Local yielding in the flange area was the more significant factor in strength considerations of these light bases. Author

N72-12587# Federal Aviation Administration, Washington, D.C.
SYSTEM DESIGN FOR AN ALL WEATHER AIRPORT SURFACE TRAFFIC SYSTEM
26 Apr. 1971 135 p refs
(RD-620:63965) Avail: NTIS

The design requirements and development plan for an all weather system for controlling airport surface traffic are presented. The stages in progressing from the current system for controlling airport surface traffic to an all weather system are described and include: existing system, visual signalling, detection, alarm/priority logic, computer processing, and reduced visibility guidance and control. F.O.S.

N72-12588# Federal Aviation Administration, Washington, D.C. Systems Analysis Div.
ESTIMATED INSTANTANEOUS AIRBORNE TRAFFIC IN THE PACIFIC
Chester E. Dunmire May 1970 14 p refs
(Proj. 197-622-02R)
Avail: NTIS

Estimates of the maximum number of aircraft likely to be airborne simultaneously over the Pacific are developed for use in planning operational satellite services. The operational satellite coverage area is assumed to extend from 40 S to 60 N and 120 W to 120 E, excluding Manila and land masses near New Guinea. The annual instantaneous airborne count estimates for busy day periods in the Pacific are given for the period 1969 to 1979. F.O.S.

N72-12590# Royal Aircraft Establishment, Farnborough (England).
A SYSTEM FOR AIRBORNE RECORDING AND ANALYSIS OF ILS LOCALISER AND GLIDE PATH INSTALLATIONS
T. R. G. Lampard Nov. 1970 60 p refs
(RAE-TR-70222) Avail: NTIS

A new measuring technique was developed for beam bending classification in instrument landing system localizers, by recording the audio output of the localizer receiver during the landing phase by means of an onboard portable magnetic tape recorder. The tape so obtained is later replayed through a specially developed analyzer, the results from which are processed on an ultraviolet recorder to give a visual record. The study shows that a measure of the order of severity of beam bends can be obtained by filtering the guidance signal in a low frequency band-pass filter (to exclude the very low frequency terms due to aircraft movement), and then integrating the mean square output of the filter over approach time. ESRO

N72-12593# Civil Aeronautics Board, Washington, D.C.
CONGRESSIONAL AIRPORT CONGESTION STUDY, PART 2
J. C. Constantz, R. J. Pellicoro, W. R. Williamson, R. J. Hilgert, W. A. Bingham, C. Hintze, R. L. Autl, W. E. Dougherty, P. S. Kozlek, and S. M. Tracy Dec. 1970 290 p
(AD-726061) Avail: NTIS CSCL 01/2

The report was prepared to provide information on principal airport congestion and its cause and effect. The study is a consolidation of information obtained from various data sources, including government and industry from which a comprehensive analysis was made to determine the probable cause and degree of air carrier delay in operations at major airports. Included in the study is an analysis of load factors and composition of passenger loads, a detailed analysis of peak period delay data and a summary of operations and delay data for the airports studied for the study timeframe. The study summarizes the probable causes of air carrier delay in operations at the major airports and recommendations to alleviate the source of delay. Author (GRA)

N72-12604*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRBREATHING NUCLEAR PROPULSION: A NEW LOOK
Frank E. Rom Washington Dec. 1971 26 p refs
(NASA-TM-X-2425; E-6316) Avail: NTIS CSCL 21F

Nuclear-powered air-cushion vehicles using lightweight aircraft-type nuclear powerplants show promise of carrying transoceanic cargo at cost-per-metric-ton-kilometer (cost-per-ton-n mi) rates comparable to railroad rates. These rates are independent of the distance traveled. Cargo rates for nonstop distances of 4000 n mi are expected to be less than one-half those for similar fossil-fueled air-cushion vehicles. For 6000-n mi nonstop distances, the rates are expected to be less than one-sixth as much. There are no fundamental technical reasons why subsonic nuclear aircraft cannot be made to fly successfully if the gross weight is over 1 million lb. Public safety of airborne nuclear powerplants is receiving the greatest attention in low-level experimental and analytical investigations. Idealized model containment vessels which have been impacted on reinforced concrete showed no leaks after impact at velocities to 400 mph. The experiments indicate feasibility of impacting at speeds over 600 mph with no leaks. Author

N72-12779*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATIONAL PROCEDURE FOR COMPUTER PROGRAM FOR DESIGN POINT CHARACTERISTICS OF A COMPRESSED-AIR GENERATOR WITH THROUGH-FLOW COMBUSTOR FOR V/STOL APPLICATIONS
Richard P. Krebs Washington Nov. 1971 36 p refs
(NASA-TM-X-2422; E-6563) Avail: NTIS CSCL 21E

The computer program described in this report calculates the design-point characteristics of a compressed-air generator for use in V/STOL applications such as systems with a tip-turbine-driven lift fan. The program computes the dimensions and mass, as well as the thermodynamic performance of a model air generator configuration which involves a straight through-flow combustor. Physical and thermodynamic characteristics of the air generator components are also given. The program was written in FORTRAN IV language. Provision has been made so that the program will accept input values in either SI units or U.S. customary units. Each air generator design-point calculation requires about 1.5 seconds of 7094 computer time for execution. Author

N72-12780*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF NORMAL-SHOCK POSITION IN A MIXED COMPRESSION SUPERSONIC INLET
Miles O. Dustin, Gary L. Cole, and Robert E. Wallhagen

Washington Nov. 1971 20 p refs
(NASA-TM-X-2397; E-6373) Avail: NTIS CSCL 20D

Methods of determining inlet normal shock position from wall static pressure profiles were investigated. By using methods investigated in this report, it should be possible to control an inlet with less stability margin. Variation in inlet angle-of-attack caused drastic changes in pressure profile shape and wide variations in the angle of the shock plane with respect to the inlet axis. Thus, four sensors located around the circumference may be required to handle angle-of-attack and sideslip variations. One criterion would determine the shock position by comparing individual statics to a properly selected reference pressure.

Author

N72-12783*# *National Aeronautics and Space Administration.* Lewis Research Center, Cleveland, Ohio.
SUPERSONIC TURBINE DESIGN AND PERFORMANCE
Louise J. Goldman [1971] 13 p refs Proposed for presentation at Joint Conf. of the Gas Turbine Div. and the Fluids Eng. Div., San Francisco, 26-30 Mar. 1962; sponsored by ASME
(NASA-TM-X-67961; E-6671) Avail: NTIS CSCL 21E

Methods for designing supersonic stator and rotor blading corrected for boundary layer displacement thickness are summarized. Computer programs based on these methods have been reported in NASA publications. Analytical blade losses for blading of this type are presented and design limitations resulting from consideration of flow separation and supersonic starting are discussed. In addition, a summary of the experimental performance of a single-stage turbine designed by these methods is given.

Author

N72-12785*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMPIRICAL EXPRESSIONS FOR ESTIMATING LENGTH AND WEIGHT OF AXIAL-FLOW COMPONENTS OF VTOL POWERPLANTS
David A. Sagerser, Seymour Lieblein, and Richard P. Krebs Washington Dec. 1971 39 p refs
(NASA-TM-X-2406; E-6191) Avail: NTIS CSCL 21E

Simplified equations are presented for estimating the length and weight of major powerplant components of VTOL aircraft. The equations were developed from correlations of lift and cruise engine data. Components involved include fan, fan duct, compressor, combustor, turbine, structure, and accessories. Comparisons of actual and calculated total engine weights are included for several representative engines.

Author

N72-12795# Curtiss-Wright Corp., Wood-Ridge, N.J.
SINGLE-STAGE AXIAL COMPRESSOR STATOR REDESIGN INVESTIGATION Final Report
C. Muller Ft. Eustis, Va. Army Aviation Materiel Labs. Oct. 1970 98 p refs
(Contract DAAJ02-69-C-0085)
(AD-877209; USAAVLABS-TR-70-56; CW-WR-69-072.F; Task-1C162203D14413) Avail: NTIS CSCL 21/5

A program is described to redesign the exit stators of a 2.8:1 pressure ratio supersonic axial compressor, and to fabricate and test the redesigned stators to evaluate the effect of the redesign on the overall stage performance. This compressor is intended to serve as a boost stage in axial centrifugal compressors with overall pressure ratios of 16.1 for small gas turbine engines. The redesign was undertaken to provide an essentially cylindrical flow path aft of the rotor. The measured performance showed no improvement over the original design, and indicated a two-point degradation in efficiency.

Author (GRA)

N72-12796# Pratt and Whitney Aircraft, West Palm Beach, Fla.
TURBINE BLADE/DISK FABRICATION INVESTIGATION Final Report
George W. Kelch and Richard W. Nelson Ft. Eustis, Va. Army Aviation Materiel Labs. Sep. 1970 176 p refs
(Contract DAAJ02-68-C-0071)
(AD-877170; USAAVLABS-TR-70-53; PWA-FR-3827; Task-1G162203D14413) Avail: NTIS CSCL 21/5

An investigation of blade/disk attachment methods for small gas turbine engines is reported. The investigation included analytical and experimental evaluations of selected attachment methods potentially suitable for a 2 lb/sec axial flow turbine with 2500 F turbine inlet temperature. A literature survey of attachments for small axial flow turbines yielded six candidate methods for further analytical study. The three most promising approaches were evaluated experimentally to determine the superior attachment technique.

Author (GRA)

N72-12798# Cincinnati Univ., Ohio.
SIMULATION OF ENVIRONMENTAL SOLID-PARTICLES TRAJECTORIES AND VELOCITIES THROUGH AN AXIAL FLOW COMPRESSOR STAGE, AND THE PRESSURE DISTRIBUTION ON BLADES
W. Tabakoff, A. Hamed, and M. F. Hussein 1971 34 p refs Presented at 10th Natl. Conf. on Environ. Effects on Aircraft and Propulsion Systems, Trenton, 18-20 May 1971
(Contract DAHC04-69-C-0016; DA Proj. 2T0-14501-B-81-B)
(AD-725596; AROD-T-4-31-E; Rept-71-5) Avail: NTIS CSCL 13/7

An experimental investigation is reported of the trajectories and velocities of solid particles suspended in a fluid passing through an axial flow compressor stage. Such investigation is of importance to the study of erosion damage sustained by the blade. Two test facilities were used for this study: a subsonic cascade wind tunnel for compressible flow and a water table for incompressible flow. From the test technique it would appear that the present existing theoretical analysis for particle trajectories through a compressor stage is questionable. The wind tunnel test simulation is preferred for predicting particle trajectories.

Author (GRA)

N72-12800# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATION AND OSCILLATION OF AVIATION ENGINE ROTORS
M. E. Levit and V. P. Roizman 14 Jun. 1971 239 p refs Transl. into ENGLISH of the book "Vibratsiya i Uravnoveshivanie Rotorov Aviadvigatelei" Moscow, Izd-vo Mashinostroyeniye, 1970 p 1-172
(AF Proj. 604010)
(AD-728121; FTD-MT-24-6-71; DIA-Task-T65-04-18A; UR/0000-70-000-000) Avail: NTIS CSCL 21/5

The book represents a survey of the contemporary methods of balancing the rotors of aircraft engines and lists the factors which influence the level of vibrations of engines. It is noted that one of the basic reasons for vibrations is the imbalance of elastically deformable rotors during operation at rpm's close to critical. Simplified methods of balancing are given, producing a considerable effect when using equipment existing in plants. Much attention is given to the complex method of the research of the dynamics of aircraft engines such as the stage preceding the selection of the means of rotor balancing. The results of research on vibrations of full scale gas-turbine aircraft engines and of their compressors and turbines are illuminated. Given is a fundamental solution of the questions connected with automation of the processes of balancing and development of new means of balancing; apparatus and equipment have been described. Basic problems in the area of the further development of the theory and practical methods of balancing of rotary systems of aircraft engines have been formulated. Author (GRA)

N72-12812# Los Alamos Scientific Lab., N.Mex.
RESULTS OF POLARIZATION OBSERVATIONS OF THE OUTER CORONA FROM A JET AIRCRAFT
C. F. Keller Jun. 1971 11 p refs Presented at the 14th COSPAR Meeting, Seattle, 17 Jun. 1971 Sponsored by AEC
(LA-DC-12495; Conf-710615-1) Avail: NTIS

Observations were made from an NC-135 aircraft at 36,380 ft over the Gulf of Mexico just off the coast of Mexico. White-light photographs were taken from a stabilized camera; four each were made for six exposure times ranging from 1.0 to 10.0 seconds; three each were made through plane Polaroid filters whose orientation was varied at 60 deg intervals. One streamer was recorded at 13 solar radii and six others could be seen beyond 7 solar radii. NSA

N72-12820# National Research Council of Canada, Ottawa (Ontario).
DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin
30 Sep. 1971 94 p refs
(DME/NAE-1971(3)) Avail: NTIS

Projects conducted by the Mechanical Engineering and National Aeronautical Establishment of Canada are discussed. Three topics concerning water pollution, an electric heater, and lubrication under cold weather conditions are presented in detail. Research projects are briefly described which encompass the following subjects: (1) industrial control problems, (2) human factors engineering, (3) ducted fan aerodynamics, (4) locomotive Diesel engines, (5) aircraft instruments, (6) atmospheric turbulence, (7) V/STOL propulsion, (8) gas dynamics, and (9) low speed aerodynamics. Author

N72-12908*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION OF FLIGHT MANEUVER-LOAD DISTRIBUTIONS BY UTILIZING STATIONARY, NON-GAUSSIAN RANDOM LOAD HISTORIES
Herbert A. Leybold Washington Nov. 1971 26 p refs
(NASA-TN-D-6570; L-7810) Avail: NTIS CSCL 01A

Random numbers were generated with the aid of a digital computer and transformed such that the probability density function of a discrete random load history composed of these random numbers had one of the following non-Gaussian distributions: Poisson, binomial, log-normal, Weibull, and exponential. The resulting random load histories were analyzed to determine their peak statistics and were compared with cumulative peak maneuver-load distributions for fighter and transport aircraft in flight. Author

N72-12925# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
PARAMETER ESTIMATION FOR THE LOG-NORMAL PARENT POPULATION OF FATIGUE FAILURES FROM A SAMPLE CONTAINING BOTH FAILED AND NON-FAILED MEMBERS
A. M. Stagg London Aeron. Res. Council 1971 48 p refs Supersedes RAE-TR-70145; ARC-32594
(ARC-CP-1144; RAE-TR-70145; ARC-32594) Avail: NTIS; HMSO: 65p; PHI: $2.75

A maximum likelihood technique was applied to provide estimates of the mean and standard deviation of the parent (log-normal) population of a sample of fatigue test results, for the case when the sample consists of some specimens that have not broken as well as specimens that have failed. The estimates produced by this method of analysis are compared with those given the application of a technique developed by Gupta and with those resulting from a graphical procedure. The samples used for these comparisons were fictitious, being obtained from an assumed parent population by a Monte Carlo technique, and, although limited in number and scope, they indicate that the maximum likelihood technique gives reasonable approximations to the population parameters. Use of the most suitable of the methods of analysis mentioned in order to correlate early service failures with a test failure should enable a check to be made on the validity of the fatigue monitoring process being applied to the service aircraft. Author (ESRO)

N72-12928# Naval Air Development Center, Johnsville, Pa. Aero Structure Dept.
STRESSES AND STRAINS AROUND OPEN AND FILLED HOLES IN AN ALUMINUM SHEET DURING CYCLIC LOADING Final Report
Ralph E. Vining 6 Jan. 1971 90 p refs
(Proj. I.R. TR-4-01)
(AD-726164; NADC-ST-7009) Avail: NTIS CSCL 01/3

The stress and strain history at a point of stress concentration were studied in an effort to resolve conflicts regarding the effects of spectrum block size in fatigue testing. Fatigue tests were performed using as specimens large sheets of 7075-T6 aluminum alloy with a central hole. Plastic deformation was induced at the edge of the hole, although the gross area stress in the sheet remained in the elastic range. It was found that the strains at the stress concentrator varied during subsequent constant-amplitude fatigue cycling. Relaxation of the mean stress and strain hardening were qualitatively detected. Author (GRA)

N72-12942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYTICAL STUDY OF THE EFFECT OF COOLANT FLOW VARIABLES ON THE KINETIC ENERGY OUTPUT OF A COOLED TURBINE BLADE FLOW
Herman W. Prust, Jr. [1971] 18 p refs Proposed for Presentation at the 10th Aerospace Meeting, San Diego, Calif., 17-19 Jan. 1972; sponsored by AIAA
(NASA-TM-X-67960; E-6667) Avail: NTIS CSCL 20M

The results of an analytical study to determine the effect of changes in the amount, velocity, injection location, injection angle, and temperature of coolant flow on blade row performance are presented. The results show that the change in output of a cooled turbine blade row relative to the specific output of the uncooled blade row can be positive, negative, or zero. Comparisons between the analytical results and experimental results for four different cases of coolant discharge, all at a coolant temperature ratio of unity, show good agreement for three cases and rather poor agreement for the other. To further test the validity of the method, more experimental data is needed, particularly at different coolant temperature ratios.
Author

N72-12947*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF HEAT-TRANSFER TESTS OF AN IMPINGEMENT-CONVECTION- AND FILM-COOLED VANE IN A CASCADE
Herbert J. Gladden, Daniel J. Gauntner, and John N. B. Livingood Washington Dec. 1971 46 p refs
(NASA-TM-X-2376; E-6230) Avail: NTIS CSCL 20M

Experimental flow and heat transfer data obtained for an air-cooled turbine vane tested in a static cascade at gas temperatures and pressures to 1644 K (2500 F) and 31 N/cm2 (45 psia), respectively, are presented. Average and local vane temperatures were correlated in several ways. Calculated and measured coolant flows and vane temperatures are compared. Potential allowable increases in gas temperature are also discussed. Author

N72-12949*# Silverstein (Calvin C.), Baltimore, Md.
A FEASIBILITY STUDY OF HEAT-PIPE-COOLED LEADING EDGES FOR HYPERSONIC CRUISE AIRCRAFT
Calvin C. Silverstein Washington NASA Nov. 1971 148 p refs
(Contract NAS1-9872)
(NASA-CR-1857; SIL-106) Avail: NTIS CSCL 20M

A theoretical study of the use of heat pipe structures for cooling the leading edges of hypersonic cruise aircraft was carried out over a Mach number range of 6 to 12. Preliminary design studies showed that a heat pipe cooling structure with a 33-in. chordwise length could maintain the maximum temperature of a 65 deg sweepback wing with a 0.5-in. leading edge radius below 1600 F during cruise at Mach 8. A few relatively minor changes in the steady-state design of the structure were found necessary to insure satisfactory cooling during the climb to cruise speed and altitude. It was concluded that heat pipe cooling is an attractive, feasible technique for limiting leading edge temperatures of hypersonic cruise aircraft. Author

N72-12968# Federal Aviation Administration, Washington, D.C.
FAA STATISTICAL HANDBOOK OF AVIATION
1970 310 p refs
(ZMS-348G; FAS-1; FFS-1; FFS-2; FFS-3; FFS-5; FFS-7; FAT-O(Minimum)) Avail: SOD $2.75 Stock No. 5007-0166

A handbook of aviation historical data is presented to assist in evaluating progress, determine trends, and estimating future aeronautical activity. Data on major civil aviation activities for the 11-year period ending 31 December 1969 are reported, and include the following areas: (1) FAA and its functions, (2) workload of FAA air traffic facilities, (3) airport activity statistics, (4) U.S. civil air carrier operating data, (5) general aviation aircraft, and (6) aircraft accidents. F.O.S.

N72-12969# Federal Aviation Administration, Washington, D.C.
THIRD ANNUAL NATIONAL AVIATION SYSTEM PLANNING REVIEW CONFERENCE
1971 74 p refs Conf. held 26-29 Apr. 1971
(WRCNM-2; FOF-O(Minimum)) Avail: NTIS

Summaries of the lectures presented at the annual forum are presented along with summaries of the group discussions. The sessions reported include: plenary session, capital equipment priorities and investments, man in the system, systems engineering management, research and development, and short haul transportation. F.O.S.

N72-12971# Aeronautical Research Council (Gt. Brit.).
PUBLISHED REPORTS AND MEMORANDA OF THE AERONAUTICAL RESEARCH COUNCIL (NOS. 3551 TO 3650)
1971 13 p refs
(ARC-R and M-3650) Avail: NTIS

One hundred titles which have been published in the R/M Series of the Aeronautical Research Council are listed. They include reports on aerodynamics, aircraft, wind tunnel tests, etc. Author (ESRO)

N72-12972# Office of Naval Research, London (England).
AERONAUTICAL ENGINEERING AT TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY
Richard D. Mathieu 4 Jun. 1971 23 p refs
(AD-726162; ONRL-R-15-71) Avail: NTIS CSCL 05/9

The shortage of engineers in Israel and the role that the Technion - Israel Institute of Technology plays in the education of engineers is discussed. Emphasis is placed on the academic program, research, and related activities in the Department of Aeronautical Engineering. Author (GRA)

N72-12974# Weapons Research Establishment, Salisbury (Australia).
DIGITAL COMPUTER CALCULATIONS OF THE EFFECTS OF VARIATION OF MASS AND INERTIA PARAMETERS ON THE SPIN OF A 60 DEG DELTA-WING FIGHTER AIRCRAFT
R. Wilson Jul. 1971 46 p refs
(WRE-TN-453-(WR/D); COSATI-0103; COSATI-2004; RD73) Avail: NTIS

Spinning motions of a 60 deg delta-wing fighter aircraft were obtained by numerically integrating the six degrees of freedom equations of motion on a digital computer. The effects of variation of mass and inertia parameters were studied by comparing perturbed parameter spins with a datum spin while the aerodynamic properties were kept constant. Large and small parameter variations were considered separately, with the small variations being compatible with practical uncertainties in estimates of aircraft mass and inertias, and the large variations being compatible with the carriage of external stores. The effects on computed spins of small parameter variations were not significant. Of the large parameter variations, increasing the rolling moment of inertia was found to be the most practical means of improving spin recovery characteristics. Author

N72-12975*# National Aeronautics and Space Administration. Lewis Researvh Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR DESIGN OF TWO-DIMENSIONAL SUPERSONIC TURBINE ROTOR BLADES WITH BOUNDARY-LAYER CORRECTION
Louis J. Goldman and Vincent J. Scullin Washington Dec. 1971 58 p refs
(NASA-TM-X-2434; E-6494) Avail: NTIS CSCL 20D

A FORTRAN 4 computer program for the design of two-dimensional supersonic rotor blade sections corrected for boundary-layer displacement thickness is presented. The ideal rotor is designed by the method of characteristics to produce vortex flow within the blade passage. The boundary-layer parameters are calculated by Cohen and Reshotoko's method for laminar flow and Sasman and Cresci's method for turbulent flow. The program input consists essentially of the blade surface Mach number distribution and total flow conditions. The primary output is the corrected blade profile and the boundary-layer parameters. Author

N72-12978# Advisory Group for Aerospace Research and Development, Paris (France).
AERODYNAMIC TESTING AT HIGH REYNOLDS NUMBERS AND TRANSONIC SPEEDS
D. Kuechemann (Roy. Aircraft Estab., Farnborough, Engl.) Nov. 1971 9 p refs Presented at NATO Defence Res. Group Seminar on Gen. Probl. Relating to Aerodyn. Testing Facilities, St. Louis, France, 4-7 May 1971
(AGARD-R-588-71) Avail: NTIS

As a contribution to a NATO seminar on aerodynamic testing facilities held at the ISL from 4 to 7 May 1971, a brief report is given on the outcome of a specialists' meeting organized by the fluid dynamics panel of AGARD and held at Gottingen from 26 to 28 April 1971. Various AGARD activities, leading up to this meeting, are also briefly described. The best technical advice available within AGARD leads to the conclusion that one or several large new wind tunnels would contribute immensely to the effectiveness of a large number of aerospace systems now planned or contemplated within the NATO nations. Author

N72-12979*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TOLERANCE OF MACH 2.50 AXISYMMETRIC MIXED-COMPRESSION INLETS TO UPSTREAM FLOW VARIA-

TIONS
David A. Choby Washington Jan. 1972 52 p refs
(NASA-TM-X-2433; E-6452) Avail: NTIS CSCL 20D

An investigation of the tolerances of two Mach 2.50 axisymmetric mixed-compression inlets to upstream flow variations was conducted. Tolerances of each inlet to angle of attack as a function of decreasing free-stream Mach number were obtained. A local region of overcompression was formed on the leeward side of the inlet at maximum angle of attack before unstart. This region of overcompression corresponded to local subsonic flow conditions ahead of the geometric throat. A uniform Mach number gradient of 0.10 at the cowl lip plane did not affect the inlet's pressure recovery, mass flow ratio, or diffuser exit total-pressure distortion. Author

N72-12981# National Aerospace Lab., Tokyo (Japan).
FREE FLIGHT TESTS ON LONGITUDINAL DYNAMIC CHARACTERISTICS OF FFM-10 MODEL
Toshio Kawasaki, Taketoshi Hanawa, Hideo Saito, Kazuaki Takashima, and Iwao Kawamoto Jul. 1971 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-237) Avail: NTIS

The free flight model simulates a supersonic aircraft with delta wing. It is propelled by a rocket motor installed in the fuselage. Longitudinal short period motion is produced by two side jets ignited in sequence. Measurements of acceleration in the direction of pitching motion permit the determination of longitudinal static and dynamic aerodynamic derivatives. The results are compared with theoretical estimates and show fairly good agreement. Author

N72-12982*# Scientific Translation Service, Santa Barbara, Calif.
CALCULATION PROCEDURES FOR THREE DIMENSIONAL AERODYNAMICS IN PERFECT FLUIDS
P. Perrier and W. Vitte Washington NASA Dec. 1971 33 p refs Transl. into ENGLISH from Proceedings of 7th Aerodyn. Colloq., Assoc. Franc. des Ingr. et Technicians de l'Aeron. et de l'Espace, (Modane and Ecully), 4-6 Nov. 1970 39 p
(Contract NASw-2035)
(NASA-TT-F-14074) Avail: NTIS CSCL 01A

The three-dimensional problem of vortex interaction and its effect on lift, drag and other aerodynamic properties of various wing and aircraft configurations is treated by a new analytical method. The aerodynamic surfaces are replaced by equivalent surface elements. The data are displayed on an IBM terminal. Author

N72-12983*# Scientific Translation Service, Santa Barbara, Calif.
THE HIGH LIFT WING: REMARKS ON THE PREDICTION OF CHARACTERISTICS
Y. Semezis and J. Gombert Washington NASA Dec. 1971 69 p refs Transl. into ENGLISH of "L' Aile aux Portances Elevees. Remarques sur la Prevision des Caracteristiques" Chatillon, Soc. Natl. Ind., Aerospatiale, 1971 85 p Presented at 7th Appl. Aerodyn. Colloq., Modane and Ecully, France, 4-6 Nov. 1971
(Contract NASw-2035)
(NASA-TT-F-14073) Avail: NTIS CSCL 01A

Problems encountered in predicting the characteristics of high lift wings, with or without additional high lift devices, are examined. Existing means of controlling lift or distributing the load on a wing by detachment are considered. Particular emphasis is placed on the processes of prediction of maximum lift coefficient and its increase by means of high lift devices. These are compared for the case of a moderately long and moderately swept-back wing equipped with conventional high lift devices. It is considered that improvement in prediction is related to a better understanding of detechment phenomena. Results of current studies are briefly reviewed, and various procedures to increase lift by blowing are described. Author

N72-12984# Joint Publications Research Service, Washington, D.C.
ON UTILIZING THE KINETIC ENERGY OF THE JET OF A TURBOJET ENGINE TO PROVIDE AN ADDITIONAL LIFTING FORCE ON THE WINGS OF THE AIRCRAFT
V. A. Kosterin and V. M. Yermolayev 23 Dec. 1971 12 p refs Transl. into ENGLISH from Tr. Kaz. Aviats. Inst. (USSR), no. 88, 1965 p 92-103
(JPRS-54785) Avail: NTIS

The thrust efficiency of turbojet engines in modern jet aircraft is considerably less than unity as shown in the design dependence of a turbojet engine on Mach number. It is evident from the curve that at subsonic flight speeds only 40-50% of the kinetic energy of gases passing through the engine are spent usefully, i.e. for performing the work of flight. The remaining 50-60% are lost. Transmission of the kinetic gas energy after the engine to the larger amounts of air passing around the airfoils of an aircraft raises the propulsive qualities of a turbojet engine. A simplified procedure has been developed for determining the aerodynamic characteristics of thin profiles when a gas jet is directed at a tangent to a profile's upper surface. Author

N72-12985# Grumman Aerospace Corp., Bethpage, N.Y.
THREE DIMENSIONAL SUPERSONIC FLOW OVER A SMOOTH BODY WITH SHOCK-PRODUCING PROTUBERANCE
Richard A. Scheuing May 1971 183 p refs
(AD-728501; RE-406) Avail: NTIS CSCL 01/1

The investigation is directed primarily at the second order solution of the three dimensional, supersonic flow field around an arbitrarily-shaped body which, although otherwise of smooth contour, has a protuberance that generates a shock wave and substantially disturbs the flow downstream. Such configurations occur for example, in fuselage-canopy combinations. The calculation of the flow field about a body with no local protuberance is considered first, the solution being based on the so-called method of near-characteristics. Typical numerical results are presented for circular and elliptic cones, tangent ogives of circular and elliptic cross section, and a representative non-axisymmetric compression surface. Comparisons with results from conical flow theories and with experimental data are made wherever possible. The theoretical analysis and computational procedure evolved for the primary body is then extended to permit the addition of the shock-producing protuberance. This approach enable the flow upstream of the secondary shock to be considered uniform. GRA

N72-12986# Naval Ship Research and Development Center, Washington, D.C. Aviation and Surface Effects Dept.
METHOD FOR PREDICTING THE STATIC AERODYNAMIC CHARACTERISTICS OF TYPICAL MISSILE CONFIGURATIONS FOR ANGLES OF ATTACK TO 180 DEGREES
Research and Development Report
Bernard F. Saffell, Jr., Millard L. Howard, and Eugene N. Brooks, Jr. Mar. 1971 44 p refs
(WW Proj. 16-25)
(AD-729009; AERO-1168; NSRDC-3645) Avail: NTIS CSCL 16/4

A method for predicting the static, longitudinal aerodynamic characteristics of typical missile configurations at zero roll angle (i.e., in a plus configuration) has been developed and programmed for use on the IBM 7090 digital computer. It can be applied throughout the subsonic, transonic, and supersonic speed regimes to slender bodies of revolution or to nose-cylinder body combinations with low aspect-ratio lifting surfaces. The

aerodynamic characteristics can be computed for missile configurations operating at angles of attack up to 180 degrees. The effect of control surface deflections for all modes of aerodynamic control are taken into account by this method. The method is based on well-known linear, nonlinear crossflbw and slender body theories with empirical modifications to provide the high angle of attack capability. Comparisons of the theory with experimental data are presented to demonstrate the accuracy of the method. Author (GRA)

N72-12987# National Aviation Facilities Experimental Center, Atlantic City, N.J.

FIRE EXTINGUISHING METHODS FOR NEW PASSENGER/CARGO AIRCRAFT Final Report, Jul. 1969 - Feb. 1971

Julius J. Gassmann and Richard G. Hill Nov. 1971 39 p refs (Proj. 502-201-02X)

(FAA-NA-71-23; FAA-RD-71-68) Avail: NTIS

Full-scale fire tests were conducted to determine the degree to which fire in large cargo compartments may be controlled by the use of bromotrifluoromethane as an extinguishing method in conjunction with ventilation shutoff. Results of the tests, using a 10-percent load, indicated that temperature can be kept below 500F and that a flash fire can be averted for at least 2 hours by the use of as little as 3 percent by volume of bromotrifluoromethane. The rate of agent application was about 3 1/2 pounds per second. During these tests, the normal leakage that occurs while in flight configuration was simulated by providing an airflow of 75 cubic feet per minute. Two tests were conducted to determine the effectiveness of liquid nitrogen as an extinguishing agent. The weights of agent used were 175 pounds and 284 pounds, respectively. The use of liquid nitrogen proved very effective in extinguishing the initial flames, but with the 75 CFM simulated leakage, when the oxygen concentration rose to 12 percent, a flash fire occurred. In both cases the protection lasted just over 30 minutes. The rate of application of application of the liquid nitrogen was as high as 10 pounds per second. Author

N72-12988*# Wyle Labs., Inc., Hampton, Va.

AN EVALUATION OF METHODS FOR SCALING AIRCRAFT NOISE PERKEPTION

J. B. Ollerhead Washington NASA Oct. 1971 147 p refs (Contract NAS1-9257)

(NASA-CR-1883) Avail: NTIS CSCL 20A

One hundred and twenty recorded sounds, including jets, turboprops, piston engined aircraft and helicopters were rated by a panel of subjects in a paired comparison test. The results were analyzed to evaluate a number of noise rating procedures in terms of their ability to accurately estimate both relative and absolute perkeived noise levels. It was found that the complex procedures developed by Stevens, Zwicker and Kryter are superior to other scales. The main advantage of these methods over the more convenient weighted sound pressure level scales lies in their ability to cope with signals over a wide range of bandwidth. However, Stevens' loudness level scale and the perceived noise level scale both overestimate the growth of perceived level with intensity because of an apparent deficiency in the band level summation rule. A simple correction is proposed which will enable these scales to properly account for the experimental observations. Author

N72-12989# Royal Aircraft Establishment, Farnborough (England).

OPERATING LOADS ON THE MAIN UNDERCARRIAGES OF THE F-104 G AIRCRAFT

O. Buxbaum Jun. 1971 73 p refs Transl. into ENGLISH from Betriebskraefte an Hauptfahrwerken des Flugzeuges F-104 G, Lab. fuer Betriebsfestigkeit, Darmstadt, report FB-82, 1969

(RAE-Lib-Trans-1591; FB-82; UDC-533.6.048.3; UDC-629.13.015.11; UDC-629.13.074; BR26988) Avail: NTIS

At the main landing gears of two airplanes, vertical, lateral and drag loads have been recorded continuously during 50 flights and have been analyzed statistically. The report presents, for the loading conditions: landing, spring-back, taxi, transition, braking, engine run-up, turning and pivoting, cumulative frequency and extreme value distributions of the loads in the three axes, as well as information about the correlation between simultaneously occurring load components. Author

N72-12990*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUMMARY OF SPIN TECHNOLOGY AS RELATED TO LIGHT GENERAL-AVIATION AIRPLANES

James S. Bowman, Jr. Washington Dec. 1971 34 p refs (NASA-TN-D-6575; L-7952) Avail: NTIS CSCL 01A

A summary was made of all NASA (and NACA) research and experience related to the spin and recovery characteristics of light personal-owner-type general-aviation airplanes. Very little of the research deals with light general-aviation airplanes as such, but many of the airplanes and models tested before and during World War II were similar to present-day light general-aviation airplanes with regard to the factors that are important in spinning. The material is based mainly on the results of spin-tunnel tests of free-spinning dynamically scaled models of about 100 different airplane designs and, whenever possible, includes correlation with full-scale spin tests. The research results are discussed in terms of airplane design considerations and the proper use of controls for recovery. Author

N72-12991*# Michigan Univ., Ann Arbor. Tire and Suspension Systems Research Group.

AN EVALUATION OF STRING THEORY FOR THE PREDICTION OF DYNAMIC TIRE PROPERTIES USING SCALE MODEL AIRCRAFT TIRES

S. K. Clark, R. N. Dodge, and G. H. Nybakken Aug. 1971 52 p refs

(Grant NGL-23-005-010)

(NASA-CR-112007; Rept-056080-18-T; TR-12) **Avail: NTIS** CSCL 01A

A number of scale models were made, and their static elastic constants, as well as slow speed rolling constants, were determined. These data were used as input for a sequence of tire calculations which employed both point contact and finite contact patch length theory. Computations were carried out for the cases of a wheel under forced sinusoidal steer angle oscillation and a wheel under forced sinusoidal lateral displacement of the wheel hub center. The computations were compared with data obtained from the small-scale tires under dynamic tests on a 30-in. diameter small-scale road wheel. It was found that the critical ratio describing these motions was path dependent. The data also showed good linearity of force and moment characteristics with input steer or displacement amplitudes. In general the experimental data agreed well with calculations based on finite contact patch string theory. Author

N72-12992* Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

INVESTIGATION OF ROTOR BLADE TIP-VORTEX AERODYNAMICS Final Report, 1 Jun. 1968 - 30 Sep. 1971

W. S. Lewellen 30 Sep. 1971 4 p refs

(Grant NGR-22-009-303)

(NASA-CR-112009) Avail: NTIS CSCL 01A

Several aspects of the aerodynamics of rotor blade tip vortices are examined. Two particular categories are dealt with; (1) dynamic loads on a blade passing close to or intersecting a trailing vortex, and (2) the response of the trailing vortex core to changes in the flow. Results for both categories are in reasonable agreement with existing data, although lower pressure gradients

were obtained than anticipated for category one. A correlation between trailing edge sweep angle at the tip and vortex core size was noted for category two. E.H.W.

N72-12993# General Applied Science Labs., Inc., Westbury, N.Y.
SONIC BOOM MINIMIZATION THROUGH AIR STREAM ALTERATION Final Report
F. W. Lipfert Jul. 1971 138 p refs
(Contract DOT-FA70WA-2320)
(TR-760; FAA-RD-71-90) Avail: NTIS

The potential of modifying supersonic aircraft sonic boom signatures by means of altering the flow field in the vicinity of the aircraft was investigated theoretically. A specific airplane, the NASA SCAT-15F, was selected as a basis, and a cruise flight condition of Mach 2.7, 62,000 feet was chosen. Signatures were computed using real (1962) atmospheric properties. Finite rise times, reduced overpressures, and reduced shock pressure rises were among the signature improvements investigated. Flow field alteration mechanisms considered included free combustion, boundary layer mass addition, force fields, and laser-generated heat fields. Weight penalties of the order of the baseline aircraft gross weight were found for all attempts to modify the complete baseline aircraft signature. If this additional weight were borne by the baseline aircraft, an additional overpressure would result which would, in many cases, negate the effect of the signature improvement. Considerably smaller weight penalties (by factors of 4-5) were found to be required to create a precursor signal that would warn of the impending sonic boom. Author

N72-12994*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
BOUNDARY LAYER TRANSITION DETECTION ON THE X-15 VERTICAL FIN USING SURFACE-PRESSURE-FLUCTUATION MEASUREMENTS
Thomas L. Lewis and Richard D. Banner Washington Dec. 1971 17 p refs
(NASA-TM-X-2466; H-660) Avail: NTIS CSCL 01A

A flush-mounted microphone on the vertical fin of an X-15 airplane was used to investigate boundary layer transition phenomenon during flights to peak altitudes of approximately 70,000 meters. The flight results were compared with those from wind tunnel studies, skin temperature measurements, and empirical prediction data. The Reynolds numbers determined for the end of transition were consistent with those obtained from wind tunnel studies. Maximum surface-pressure-fluctuation coefficients in the transition region were about an order of magnitude greater than those for fully developed turbulent flow. This was also consistent with wind tunnel data. It was also noted that the power-spectral-density estimates of the surface-pressure fluctuations were characterized by a shift in power from high frequencies to low frequencies as the boundary layer changed from turbulent to laminar flow. Large changes in power at the lowest frequencies appeared to mark the beginning of transition. Author

N72-12995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VEHICLE TECHNOLOGY FOR CIVIL AVIATION: THE SEVENTIES AND BEYOND Conference Proceedings
Washington 1971 452 p refs Conf. held at Langley Sta., Va., 2-4 Nov. 1971
(NASA-SP-292) Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Technological concepts for the development of future advanced transport aircraft in civil aviation are developed. Highlighted are promising avenues of research that offer the potential of improving both current and future civil aircraft in the fields of aerodynamics, propulsion, structures and materials, operational aspects, and technology application.

N72-12996*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VEHICLE TECHNOLOGY FOR CIVIL AVIATION: THE SEVENTIES AND BEYOND. KEYNOTE ADDRESS
E. M. Cortright *In its* Vehicle Technol. for Civil Aviation 1971 p 1-14
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Future trends and opportunities in civil aviation are considered in technological forecasting of transport vehicle developments for the next decade. Vehicle technology is assessed in the framework of total air transportation systems and projected economic growth. Improved aircraft type developments involve the design of STOL transports with augmented lift concepts, control systems, and cross-wind landing gear; advanced helicopter and tilt-rotor vehicles for short-haul and long-haul commerce; and the possibility of hypersonic transports. While most of the technology for second generation SST up to Mach 3 is within reach, still faster transportation will require dramatic technical advances. Author

N72-12997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH-LIFT AERODYNAMICS c01
Alexander D. Hammond *In its* Vehicle Technol. for Civil Aviation 1971 p 15-26 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

There is a continuing interest in the development of high-lift devices for improving the take-off and landing performance of civil transport aircraft. Some of the important aspects of the development of high-lift systems were presented. The high-lift devices to be discussed include both powered- and unpowered-lift concepts. The landing performance that can be attained with the use of present-day state-of-the-art lifting systems as well as the predicted improvements in performance are related to some of the limitatiofs imposed by operational constraints, particularly tye limitations imposed on the usable lift of powered-lift concepts. Author

N72-12998*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC AND TRANSONIC AERODYNAMIC RESEARCH c01
Edward C. Polhamus *In its* Vehicle Technol. for Civil Aviation 1971 p 27-44 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

Results of some subsonic and transonic aerodynamic research applicable to the design of civil aircraft in the 1970's and beyond are presented, and some of the needs for future research are outlined. Advances in technology afforded by the supercritical aerodynamic concepts and the combination of control-configured vehicle and variable-wing-sweep concepts are discussed, and both progress and needs in aerodynamic theory in the area of component interference, mixed flow, and leading-edge vortex flow are reviewed. Author

N72-12999*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC TECHNOLOGY c01
Harry W. Carlson *In its* Vehicle Technol. for Civil Aviation 1971 p 45-61 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

Supersonic aerodynamic design technology, which has advanced dramatically within the past decade, is expected to undergo continual refinement. Maximum liftdrag ratios in excess of 10 can be anticipated for large SST aerodynamic designs which have a reasonable promise for development into practical aircraft. Much progress has been made in exploration of the

sonic-boom-minimization problem; however, there is not yet any development that promises sonic-boom reduction to such an extent as to permit unrestricted overland SST operations.
Author

N72-13000*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AIRPLANE AERODYNAMIC TECHNOLOGY **c01**
Dennis M. Bushnell *In its* Vehicle Technol. for Civil Aviation 1971 p 63-84 refs
Avail: NTIS HC $6.00/MF $ 0.95 CSCL 01A

The status of hypersonic aircraft aerodynamic technology is reviewed and critical research areas for the 1970's are determined. The outlook for numerical flow-field calculations and recent research in the problem areas of engine-airframe integration, slot injection as an active airframe cooling technique, lee-side vortex heating, and hypersonic boundary-layer transition are considered. It is concluded that with realistic progress in aerodynamic technology, an efficient hypersonic cruise aircraft can be developed. The most critical area for research is the integration of the air-breathing propulsion system with the lower surface of the aircraft, since the forebody compression surface acts as an inlet spike and the lower part of the vehicle afterbody acts as an exhaust nozzle for the propulsion modules. Also a significant gain in payload can accrue from the further development and application of active cooling technology for both external and internal cooling concepts. Author

N72-13001*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MATERIALS FOR JET ENGINES **c28**
John C. Freche *In its* Vehicle Technol. for Civil Aviation 1971 p 85-106 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

The key to improved turbojet engine performance lies in the development of suitable materials and the engineering techniques required to use these materials effectively. Discussed herein are the improvements that can be expected during the ensuing decade in the materials used for key engine components, such as the fan blades and early-stage compressor blades, the latter-stage compressor blades, the turbine disks, and the turbine stator vanes and blades. Some of the materials problems posed by the engine environment, particularly corrosion and thermal fatigue, are also discussed as are some of the more advanced protection systems designed to solve these problems. Author

N72-13002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUBSONIC AND SUPERSONIC PROPULSION **c28**
Milton A. Beheim, Robert L. Cummings, James F. Dugan, Jr., Charles E. Feiler, Jack S. Grobman, and Warner L. Stewart *In its* Vehicle Technol. for Civil Aviation 1971 p 107-156

Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

About a year ago a 3-day conference on propulsion was held at the NASA Lewis Research Center. The present paper is a broad overview of that material and an attempt is made to forecast trends. An outline lists various kinds of airplanes and the types of engines that seem right for them. A conventional-takeoff-and-landing transport of the future could be a near-sonic airplane. A short-takeoff-and-landing airplane might either use a very high bypass turbofan, if it had externally blown flaps, or a medium bypass turbofan, if it had an augmentor wing. Vertical and short takeoff-and-landing aircraft that are powered by integral lift fans or else by remote lift fans are also considered. In the latter case a separate engine supplies working fluid to the lift-fan unit. A future supersonic transport might use low-bypass turbofan engines. For general aviation, a geared turbofan could provide the right balance between performance and cost. Author

N72-13003*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AIR-BREATHING PROPULSION SYSTEMS **c28**
John R. Henry and H. Lee Beach *In its* Vehicle Technol. for Civil Aviation 1971 p 157-177 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 21A

An overview of the various possibilities for air-breathing propulsion systems for cruise applications is presented and an assessment of their present status and their future potential is gien. Clearly, there is a need for exploratory research and imaginative solutions in many areas in order to realize the apparent potential of air-breathing engine types. In this regard, several promising approaches to the design of the airframe-integrated scramjet (supersonic combustion ramjet) are described in some detail. Emphasis is placed on scramjet development because it has inherent qualities, such as high performance over wide ranges of flight speeds and geometric and mechanical simplicity, which make it a leading candidate for many hypersonic applications. Author

N72-13004*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURES TECHNOLOGY FOR HYPERSONIC VEHICLES
Melvin S. Anderson and H. Neale Kelly *In its* Vehicle Technol. for Civil Aviation 1971 p 179-192 refs

Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The technology base that has been established for the primary structural components of hypersonic aircraft is reviewed, and areas where additional research is required, if hypersonic cruise flight is to become a practical reality, are indicated.
Author

N72-13005*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MATERIALS APPLICATION TO CIVIL AIRCRAFT STRUCTURES IN THE SEVENTIES AND BEYOND
Richard A. Pride *In its* Vehicle Technol. for Civil Aviation 1971 p 193-207 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The current status and projections for materials usage for the 1970's and beyond in civil aircraft structures are considered. Metal structural alloys and composite materials, with most of the emphasis on composites, are discussed. Such drivers for future development as fracture toughness and corrosion resistance for metals and response to environment, maintainability, and costs for composites are projected. Programs which demonstrate the benefits to be realized, such as weight reduction, improved performance, and increased longevity, are presented. Author

N72-13006*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE AND FRACTURE **c32**
Herbert F. Hardrath *In its* Vehicle Technol. for Civil Aviation 1971 p 209-224 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The four major parameters that govern fatigue behavior are choice of materials (metals and composites), configuration, load experience, and environments (thermal and chemical). Emphasis is placed on choice of materials, configuration, and load experience in designing against fatigue and fracture for future aircraft. Also included is a description of a research program that should lead to improvements in the state of the art of fatigue analysis so that aircraft may be designed to have maximum efficiency consistent with high reliability. Author

N72-13007*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATED DESIGN METHODS IN STRUCTURAL TECHNOLOGY **c32**
Harvey G. McComb, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 225-243 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The impact of automation is considered for three areas: structural anlaysis, structural design, and integrated design. The term structural analysis simply refers to the determination of stresses or internal loads and deflections in a given structure under given loading conditions. Structural design, on the other hand, involves incorporation of the analysis into a resizing and reanalysis procedure in which structural allowables are taken into account and the process is cycled to a converged design. Finally, the term integrated design is used to refer to interdisciplinary approaches where modules from several disciplines are integrated into unified systems for analysis and design of aeronautical vehicles. Author

N72-13008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED ACTIVE CONTROLS TECHNOLOGY
A. Gerald Rainey *In its* Vehicle Technol. for Civil Aviation 1971 p 245-257 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Advanced active control concepts are described and their potential for providing improved characteristics for aircraft, along with an indication of the status of the technology in relation to its readiness for application, is given. The concepts considered are relaxed aerodynamic stability, maneuver load control, flutter suppression, fatigue damage reduction, and ride quality control. Author

N72-13009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE AIRPORT-AIRPLANE INTERFACE: THE SEVENTIES AND BEYOND
John P. Reeder *In its* Vehicle Technol. for Civil Aviation 1971 p 259-269 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

A projection of current technologies relating the airplane and the airport for an advanced transportation system is reported. It deals primarily with transport aircraft in high-density traffic. The order of discussion is as follows: (1) Air transportation situation; (2) Technical status of the operating system; and (3) Airport-airplane interface. Author

N72-13010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE PILOT-AIRCRAFT INTERFACE **c05**
George E. Cooper *In its* Vehicle Technol. for Civil Aviation 1971 p 271-286 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 05E

The pilot-aircraft interface centers in the cockpit but is specifically represented by the means through which the pilot receives his information and through which he, in turn, controls or communicates with the aircraft and the environment. In any aircraft each of the pilot's channels of sensory perception is utilized in one way or another. The predominate input channel is visual. First an attempt to define the nature of the problem is made; then the state of technology in this area is briefly considered. Next, the requirements for applying this technology as well as that for assessing promising technology for application to the pilot-aircraft interface are examined. Then a review is made of the most important elements of technology which should be used during the 1970's and which will have a significant impact on the civil transport cockpit of the 1980's. Author

N72-13011*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED AVIONIC SYSTEMS
G. Barry Graves, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 287-300
Avaiw: NTIS HC $6.00/MF $0.95 CSCL 01B

The development of avionics is illustrated by stability augmentation systems (SAS) and automatic landing equipment incorporated in the latest series of transports to obtain the desired handling qualities and to improve operations during approach and landing. Area navigation equipment is available to provide flexiblity in using the existing network of ground-based navigation stations. Also, a new microwave landing system which will greatly improve the accuracy of landing guidance signals and permit maneuvering during approach is projected. Expected future developments include the following three items: computer-centered digital systems for both flight management and advanced control applications; automated communications; and systems for wide-area navigation and surveillance. Author

N72-13012*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRENDS IN AIRCRAFT NOISE ALLEVIATION
Yomer G. Morgan *In its* Vehicle Technol. for Civil Aviation 1971 p 301-315 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 20A

The principal sources of aircraft noise are engines, rotors and propellers, boundary layers, and the sonic boom. Elimination or reduction of noise at the source is the most obvious approach to moise abatement. New operational procedures, such as the steep approach, reduce engine noise by operating at reduced power while also lengthening transmission paths of the noise through the atmosphere so that less noise reaches airport communities. Flight or ground structures can also be used to shield passengers or the public from direct impingement by the noise that cannot be eliminated at the source. In any event, a problem exists when noise reaching a receiver causes annoyance (people) or degraded performance (people or structures). The effects of noise on people and structures and noise reduction from rotary-wing vehicles are discussed. Author

N72-13013*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
GENERAL AVIATION: THE SEVENTIES AND BEYOND
M. R. Barber and Jack Fischel *In its* Vehicle Technol. for Civil Aviation 1971 p 317-332 refs
Avaiw: NTIS HC $6.00/MF $0.95 CSCL 01C

The possible advancements in general aviation through the applications of technology during the next decade are discussed in terms of aircraft performance, utility, safety, and public acceptance. Author

N72-13014*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIRECT-LIFT JET V/STOL CONCEPTS
Curt A. Holzhauser *In its* Vehicle Technol. for Civil Aviation 1971 p 333-343 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Direct-lift jet-powered V/STOL concepts have the greatest potential for future short-haul transportation. Such aircraft can be produced with current technology; however, they would be deficient in weight, noise, and operational characteristics. It is

shown how advanced technology can improve direct-lift jet V/STOL transports. Anticipated improvements in structures, propulsion, and aerodynamics and their effects on advanced V/STOL transport designs are noted. In addition, low-speed control and operation is also considered because of the unique performance capability of V/STOL aircraft. Recent flight experience with direct-lift jet V/STOL aircraft is used as a basis of the control and operational considerations. Author

N72-13015*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ROTORCRAFT APPLICATIONS AND TECHNOLOGY
Robert J. Tapscott *In its* Vehicle Technol. for Civil Aviation 1971 p 345-358
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The helicopter, because of its inherent advantage of lifting capability at hover or low speeds for long periods of time, is finding increased usage even without special attention to the development of economical and operationally suitable vehicles for this kind of applications. The principle targets for the application of technology to improve the helicopter are propulsion systems, noise abatement, vibration and structural integrity, and instrument flight capability. Aeroelastic analysis, structural concepts, and rotor geometry are discussed and some of the technologies relating to instrument flight for helicopters are indicated. Author

N72-13016*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF ADVANCED TECHNOLOGY ON STOL TRANSPORT AIRCRAFT
Woodrow L. Cook *In its* Vehicle Technol. for Civil Aviation 1971 p 359-373 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The objectives of this study are as follows: (1) application of specific technology advances to commercial STOL transportation; (2) total effect of technology advances on STOL transport aircraft gross weight, direct operating cost, and acceptance; and (3) assessment of advanced technology progress for STOL transportation in the 1980's. Author

N72-13017*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC-TRANSONIC TRANSPORT AIRCRAFT PROJECTIONS
William J. Alford, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 375-388 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The application of advanced technologies to subsonic-transonic conventional take-off and landing (CTOL) transport aircraft and their characteristics in the 1980's are discussed. The goals to be demanded of aircraft of this time period are reductions of the effects of noise and pollutant emissions on the environment, and the maintenance of competitive superiority in the world's aircraft market. The discussion deals primarily with long-haul aircraft; however, brief consideration are given to the outlook for the short/medium-haul class. The material presented is based on results from NASA in-house programs and from contracted advanced transport technology studies. Author

N72-13018*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROPERTIES OF OBLIQUE-WING/BODY COMBINATIONS FOR LOW SUPERSONIC SPEEDS c01
Robert T. Jones *In its* Vehicle Technol. for Civil Aviation 1971 p 389-407 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

In theory, antisymmetric arrangements of wings and bodies can have smaller wave drag than corresponding mirror-symmetric arrangements. Thus, a long narrow oblique wing which presents tye same aspect for two opposite directions of flight is pozentially more efficient than a corresponding (that is, structurally equivalent) swept wing. The single continuous wing panel also adapts itself more readily to varying angles of obliquity and hence to varying flight speeds. Work on the aerodynamics and flight stability of oblique-wing combinations is reviewed and a possible mode of application to transport aircraft operating at moderate supersonic speeds is suggested. Author

N72-13019*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE SECOND-GENERATION SUPERSONIC TRANSPORT
Mark R. Nichols, Arvid L. Keith, Jr., and Willard E. Foss, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 409-428 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The impact on the second-generation supersonic transport of technology advances forecast for the 1975 to 1985 time period is considered. A number of areas are identified which offer the potential of major improvements in capabilities compared with the characteristics of the first-generation supersonic transports. When considered together, it is evident that the technical prognosis is good for the development of a well balanced second-generation aircraft that should be able to more than hold its own in the intercontinental air-transportation market of the 1980's. Author

N72-13020*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC TRANSPORTS
John V. Becker and Frank S. Kirkham *In its* Vehicle Technol. for Civil Aviation 1971 p 429-445 refs
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Refinements for vehicle types which have already enjoyed massive developments are considered in large-scale support of hypersonic aircraft. An attempt is made to assess the implications of these disciplinary advances for the hypersonic aircraft. In projecting some 20 years into the future, it is obviously appropriate that these assessments be uninhibited. Author

N72-13021# Federal Aviation Administration, Washington, D.C. Aviation Forecast Div.
LARGE AND MEDIUM HUB AVIATION ACTIVITY FORECAST, 1966 - 1982
Jul. 1971 43 p
(EC-200) Avail: NTIS

The forecasts of the large and medium hubs were summarized on two bases. The first is an alphabetical listing of large hubs followed by a similar listing for the medium hubs. Each of the five forecast series is shown separately. In addition, summaries and brief analyses of the rational used to develop individual air carrier forecasts were made for each FAA region showing the sum of large and medium hub activity by data series. Annual growth rates are shown along with each region's share of the national large and medium hub passenger enplanements and air carrier operations. Each region's projected share of national population and personal income is also shown based on data published by the National Planning Association. Author

N72-13022# Technology, Inc., Dayton, Ohio. Information Systems Div.
AIRLINE OPERATIONAL DATA FROM UNUSUAL EVENTS

RECORDING SYSTEMS IN 707, 727, AND 737 AIRCRAFT
Interim Report, Jul. 1968 - Jun. 1971
Larry E. Clay, Robert C. DeLong, and Ronald I. Rockafellow Sep. 1971 151 p refs
(Contract dot-FA68WA-1906)
(FAA-RD-71-69; TI-273-71-4) Avail: NTIS CSCL 03C

To monitor the interaction between aircraft motion and pilot control inputs during such unusual happenings as upsets caused by turbulence and collision-avoidance type of maneuvers, unusual event recording systems (UERS) were installed in three jet transports: Boeing 707, 727, and 737 operated by two major airlines in scheduled passenger-carrying flights. The resultant 2088 hours of usable data demonstrated the adequacy of the UERS for extended monitoring of commercial aircraft flight parameters and revealed the potential of such data for providing statistical information. In addition to the usable operational data, data from 163 approaches recorded during 727 training flights were processed and presented. Data results indicated: that the three aircraft flew a little faster on landing approaches than the target speeds, that the airspeeds during flap extension and retraction frequently exceeded the limits with the frequency of exceedance varying with aircraft type, that the c.g. accelerations recorded in this program correlated well with those recorded on various aircraft types in a previous NASA program, that the 737 had a greater percentage of time in turbulence than the 707 and 727 in this program and twin-engine jet transports in the NASA program, and that sideslip angles with reverse rudder deflections usually occurred only at the lower airspeeds. Author

N72-13024# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL
Technical Supplement to Final Report
William A. Jessiman and Donald E. Ward Dec. 1970 479 p refs
(Contract DOT-T8-542)
(PB-200470; T8-542-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

A supplement is presented for the intercity transportation effectiveness model. Author (GRA)

N72-13025# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 1: COMPUTER PROGRAM ORGANIZATION AND DESIGN SPECIFICATION
William A. Jessiman and Robert B. Cody Dec. 1970 368 p
(Contract DOT-T8-542)
(PB-200471; T8-542-3-Vol-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

The intercity transportation effectiveness computer programs are composed of a data base system, system executive, and the ITE model programs. The data base programs are used to create, update, and print the data base. The system executive is used to control the flow of inprocess data between the various programs of the ITE Model and to save intermediate and final results. The model programs are structured in five modules, namely, Passenger Demand, Cargo Demand, Routes, Network Assignment, and Timetable Building. The system is programmed in extended Fortran 4 for execution on a CDC 6600 computer. A summary description of each module of the ITE model is given, together with general descriptions of the programs comprising each module. Brief descriptions of the suprograms comprising each program are also included. Author (GRA)

N72-13026# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 1: SECTIONS 1-25
William A. Jessiman and Robert B. Cody Dec. 1970 452 p
(Contract DOT-T8-542)
(PB-200472; T8-542-3-Vol-2-BK-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed descriptions of the programs contained in each module are given. These descriptions are composed of detailed writeups of the subprograms comprising each program. Operating system control cards and program tape organization are also discussed. Author (GRA)

N72-13027# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 2: SECTIONS 26-28
William A. Jessiman and Robert B. Cody Dec. 1970 405 p
(Contjact DOT-T8-542)
(PB-200473; T8-542-3-Vol-2-Bk-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups of the routines which generate air routes and routings for use by the network assignment module are given. The route selection procedure and the routing generator program are described. Author (GRA)

N72-13028# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 3: SECTIONS 29-32
William A. Jessiman and Robert B. Cody Dec. 1970 498 p
(Contract DOT-T8-542)
(PB-200474; T8-542-3-Vol-2-Bk-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups of the programs used to assign aircraft and selected routes to satisfy passenger and cargo demand at minimum social and economic cost are given. The airport access program which is used to evaluate the access characteristics of existing or proposed terminals and the daily traffic assignment model which determines the optimal allocation of aircraft and routings are described. The integer seeking program which converts fractional aircraft output of the DTAM to integer quantities and the route retrieval program which matches the routing output of integer seeking with the routes generated by the route selection program are considered. The cargo assignment program which assigns cargo demand to previously scheduled passenger flights is also described. Author (GRA)

N72-13029# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 4: SECTIONS 33-39
William A. Jessiman and Robert B. Cody Dec. 1970 334 p
(Contract DOT-T8-542)
(PB-200475; T8-542-3-Vol-2-Bk-4) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

The subprogram design specification for the intercity transportation effectiveness model is given. GRA

N72-13030# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 3: ACCEPTANCE TEST SPECIFICATIONS
William A. Jessiman and Robert B. Cody Dec. 1970 57 p
(Contract DOT-T8-542)
(PB-200476; T8-542-3-Vol-3) Avail: NTIS CSCL 01B

A description of the acceptance tests used to validate the capability of the programs to operate on real world airline networks is presented. The tests include running an 81-node network and performing 19 sensitivity tests on a subnetwork of approximately 25 nodes. Author (GRA)

N72-13031# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 6: CODING SPECIFICATIONS. BOOK 1: SECTIONS 1, 2
William A. Jessiman and Robert B. Cody Dec. 1970 15 p
(Contract DOT-T8-542)
(PB-200477; T8-542-3-Vol-6-Bk-1) Avail: NTIS CSCL 01B

Computer subprogram listings, load maps, and flow charts are presented for the intercity air transportation model.
Author (GRA)

N72-13032# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 7: COMPUTER OPERATOR'S MANUAL
William A. Jessiman and Robert B. Cody Dec. 1970 55 p
(Contract DOT-T8-542)
(PB-200478; T8-542-3-Vol-7) Avail: NTIS CSCL 01B

Computer operator instructions and a list of program stops encountered in each program are presented for an intercity air transportation effectiveness model. Author (GRA)

N72-13033# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 1: SECTIONS 1-25
William A. Jessiman and Robert B. Cody Dec. 1970 450 p
(Contract DOT-T8-542)
(PB-200479; T8-542-3-Vol-8-Bk-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed descriptions are given of the programs contained in each module of the intercity air transportation model. These are composed of writeups of the subprograms comprising each program. The writeup contains an abstract, input data and format specification, logic flow, output description, programming notes, and a listing bf program tables and variables. Operating system control cards and program tape organization are also discussed. Author (GRA)

N72-13034# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 2: SECTIONS 26-28
William A. Jessiman and Robert B. Cody Dec. 1970 404 p
(Contract DOT-T8-542)
(PB-200480; T8-542-3-Vol-8-BK-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups of the routines which generate air routes and routings for use by the network assignment module are presented. The route selection procedure, and the routing generator program are also described. Author (GRA)

N72-13035# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 3: SECTIONS 29-32
William A. Jessiman and Robert B. Cody Dec. 1970 498 p
(Contract DOT-T8-542)
(PB-200481; T8-542-3-Vol-8-BK-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups are presented of the programs used to assign aircraft and selected routes to satisfy passenger and cargo demand at minimum social and economic cost. The airport access program which is used to evaluate the access characteristics of existing or proposed terminals is described. The daily traffic assignment model (DTAM) which determines the optimal allocation of aircraft and routings and the integer seeking program which converts fractional aircraft output of the DTAM to integer quantities are discussed. The route retrieval program which matches the routing output of the integer seeking with the routes generated by the route selection program and the cargo assignment program which assigns cargo demand to previously scheduled passenger flights are reviewed. Author (GRA)

N72-13036# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 4: SECTIONS 33-39
William A. Jessiman and Robert B. Cody Dec. 1970 333 p refs See also Vol. 8, Book 3, PB-200481
(Contract DOT-T8-542)
(PB-200482; T8-542-3-Vol-8-Bk-4) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Seven sections of the computer programmer's manual for the intercity transportation effectiveness model are presented.
GRA

N72-13037# Watervliet Arsenal, N.Y.
THE TRANSIENT AEROELASTIC RESPONSE OF ROTOR
Eugene J. Brunelle and Struan R. Robertson Jun. 1971 46 p refs
(DA Proj. 1F0-61102-A-35-D)
(AD-728818; WVT-7141; AMCMS-CODE-501B.11.35D00.01) Avail: NTIS CSCL 01/3

The theorems of variational mechanics are employed to derive the equations of transient motion of a helicopter rotor in axial flight. Bending, torsion, and flapping motions are permitted. The resulting equations are solved approximately by means of a modified Galerkin technique and yield frequencies and damping ratios for given rotor parameters and a given rotor angular velocity. A parametric study of the variables is made and the results are discussed with particular reference to the damping ratios dependence on the rotor parameters. Author (GRA)

N72-13038# Navy Electronics Lab., San Diego, Calif.
NOISE LEVELS ON AIRCRAFT-CARRIER FLIGHT DECKS, AND THEIR EFFECTS Research and Development Report, 1 Jul. - 31 Dec. 1970
J. C. Webster 30 Apr. 1971 48 p
(NZLC Proj. B505; SF Proj. 14-224-001)
(AD-729067; NELC-TR-1762) Avail: NTIS CSCL 20/1

Measurements were made of noise levels produced by four aircraft during pilot qualification exercises aboard the flight deck of USS KITTY HAWK. These measurements, on both the A- and C- frequency weighting networks, were augmented by calculations of speech-interference levels made later from tape recordings. These data were compared to similar measurements made at the Naval Air Test Center at Patuxent River, Md., and interpreted in terms bf deafness risk and interference with speech communications. The levels measured on the carrier showed large amounts of low-frequency energy (at octaves centered at 62 and 125 Hz) not present in the data taken ashore; this variation is ascribed to the presence of blast deflectors on the carrier and to the effects of strong wind across the deck and the measuring microphone in its wind-screen. The noise levels measured are shown to severely degrade speech communications and to present a risk of deafness to personnel. Author (GRA)

N72-13039# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A GRAPHITE HORIZONTAL STABILIZER Semiannual Interim Technical Report, 1 Nov. 1970 - 30 Apr. 1971
George M. Lehman, A. V. Hawley, F. C. Allen, and P. T. Mikkelson Jul. 1971 215 p refs
(Contract N00156-70-C-1321)
(AD-729050; MDC-J5169) Avail: NTIS CSCL 01/3

Testing of the graphite composite I-beam and box-beam components was completed and the test results were interpreted to indicate design modifications needed in the graphite stabilizers. Theoretical bending and torsional deflections of the box-beam compared favorably with test results. Allowable stresses in compression, shear, tension, and bearing were measured and deduced from test results and used to re-assess margins-of-safety in the stabilizer design. Margins-of-safety in compression and shear were judged adequate throughout the stabilizer. Negative margins-of-safety in combined tension and shear were determined in two localized areas of the upper skin panel near station X = 9.000 at the bolted attachments bf the front and rear-spars. Pin-bearing strengths were adequate to transmit ultimate loads, but the fiberglass grid element appeared susceptible to bearing damage at somewhat lower loads, especially under fatigue conditions. Design modification optiofs to eliminate the negative margins-of-safety involved the local reinforcing of the upper skin panel (with attendent changes to substructure components and tooling) or the use of bonding in addition to bolting for attachment of the upper panel. After evaluation of the two design options, the use of bolting and bonding was selected on the basis of reduced weight, increased strength and reliability, and minimum impact on detail design, tooling, schedule, and costs. Author (GRA)

N72-13040# Tactical Air Command, Langley AFB, Va. Office of Operations Analysis.
STOL TRANSPORT PARAMETERS (MILITARY AND COMMERCIAL) WITH SPECIAL EMPHASIS ON NOISE
George W. Stickle and Bobby G. Batten May 1971 149 p refs
(AD-729184; TAC-OA-TR-70-17) Avail: NTIS CSCL 01/3

A short handbook approach relating physical and environmental selection parameters to STOL transport capability is provided. It reviews existing laws and regulations on transport noise abatement. It reviews the noise from turbofan powered transports and discusses the future research and development trends and needs. It provides an indepth analysis of free turbine turbopropeller noise abatement providing engineering formulas, examples, and experimental data. Author (GRA)

N72-13041# McDonnell Aircraft Corp., St. Louis, Mo.
SURVIVABLE FLIGHT CONTROL SYSTEM. STUDIES, ANALYSES, AND APPROACH. SUPPLEMENT FOR CONTROL LAW DEVELOPMENT STUDIES Interim Report, Jul. 1969 - May 1971
Robert Kisslinger and George J. Vetsch Wright-Patterson AFB, Ohio. AFFDL May 1971 379 p refs
(Contract F33615-69-C-1827; AF Proj. 680J)
(AD-729207; AFFDL-TR-71-20-Suppl-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01/3

The Survivable Flight Control System (SFCS) Program is an advanced development program of which the principal objective is the development and flight test demonstration of an SFCS utilizing Fly-By-Wire and Integrated Actuator Package techniques. The studies and analyses conducted to date have sufficiently defined the system requirements to provide a definition of an approach to the implementation of the SFCS. The results of these studies and the definition of the approach are presented in the basic report. The details of the Control Criteria, and Hydraulic Power and Actuation studies are presented in report supplements 1 and 3, respectively. The results of the Control Law Development studies are presented in this supplement 2. Author (GRA)

N72-13233*# McDonnell Aircraft Corp., St. Louis, Mo.
AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES. VOLUME 2: AIR BREATHING ENGINE TEST FACILITIES
C. J. Pirrello, R. D. Hardin, M. V. Heckart, and K. R. Brown Washington NASA Nov. 1971 127 p
(Contract NAS2-5458)
(NASA-CR-1875) Avail: NTIS CSCL 14B

The inventory covers free jet and direct connect altitude cells, sea level static thrust stands, sea level test cells with ram air, and propulsion wind tunnels. Free jet altitude cells and propulsion wind tunnels are used for evaluation of complete inlet-engine-exhaust nozzle propulsion systems under simulated flight conditions. These facilities are similar in principal of operation and differ primarily in test section concept. The propulsion wind tunnel provides a closed test section and restrains the flow around the test specimen while the free jet is allowed to expand freely. A chamber of large diameter about the free jet is provided in which desired operating pressure levels may be maintained. Sea level test cells with ram air provide controlled, conditioned air directly to the engine face for performance evaluation at low altitude flight conditions. Direct connect altitude cells provide a means of performance evaluation at simulated conditions of Mach number and altitude with air supplied to the flight altitude conditions. Sea level static thrust stands simply provide an instrumented engine mounting for measuring thrust at zero airspeed. While all of these facilities are used for integrated engine testing, a few provide engine component test capability. Author

N72-13246# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL Final Report
William A. Jessiman and Donald E. Ward Dec. 1970 121 p refs For Tech. Suppl. see PB-200470
(Contract DOT-T8-542)
(PB-200469; T8-542-1) Avail: NTIS CSCL 01B

The intercity transportation effectiveness model approximates the mix of aircraft, routes, schedules, and terminal facilities that satisfy intercity air-carrier passenger and cargo demand at minimum social time and economic cost. The model comprises a set of integrated computer modules including: a passenger and cargo demand module, a route module, a network assignment module, and a timetable building module. The daily traffic assignment model is a decomposed linear program in which a method is used to solve the subproblem in greatly reduced running time. The model is useful in solving problems involving such issues as airline mergers, route awards, new terminals, traffic congestions and new aircraft technology. It was applied successfully to real-world airline networks. Author (GRA)

N72-13249# Naval Postgraduate School, Monterey, Calif.
PERFORMANCE ANALYSIS OF A TURBO-TYPE ENERGY ABSORBER FOR AN AIRCRAFT CARRIER ARRESTING GEAR M.S. Thesis
Leo Stanley Rolek, Jr. Jun. 1971 132 p refs
(AD-728682) Avail: NTIS CSCL 13/9

The increasing weight and speed of carrier based aircraft are taxing the limit of conventional piston type energy absorbers which are used for arresting gear. Turbo-type absorbers have been proposed as an alternative. This study investigates a turbo-type energy absorber for an aircraft arresting gear under development by the Naval Air Engineering Center. A mathematical analysis, computer simulation and performance prediction are given for each mode of operation. It was initially expected that the absorber could operate in just two modes, forward and reverse, but the analysis shows that four distinct modes are possible, since not only shaft rotation but the path of fluid flow kan be reversed. Theoretical performance predictions are also compared with test data from an existing smaller scale version of the absorber. The agreement is excellent. An approximation of scaling effects on power absorption is also presented. It is concluded that the turbo-type absorber is basically adequate to meet the demands of carrier operation for the forseeable future. Author (GRA)

N72-13266# Cambridge Univ. (England). Dept. of Engineering.
EFFECTS OF FREE STREAM TURBULENCE ON BLADE PERFORMANCE IN A COMPRESSOR CASCADE
B. J. Evans 1971 48 p refs
(CUED/A-Turbo/TR-26) Avail: NTIS

Boundary layer behavior on the stator blades of an axial flow compressor were studied under the effects of free stream turbulence generated by the passage of upstream rotor blades across the flow field, at low Reynolds' numbers. These conditions were simulated in a specially designed two-dimensional linear cascade. A detailed study of the boundary layer behavior was made up to turbulence levels of 4% using flow visualization and hot wire anemometry techniques. Reliable data on separation bubble length and on natural attached transition length and position is presented in a directly applicable form, and the necessity of considering the turbulence structure is demonstrated by an experimental investigation into the isolated effects of scale upon transition. Author

N72-13269# National Research Council of Canada, Ottawa (Ontario).
ANALYSIS OF THE FLOW PAST A SHOCKLESS LIFTING AIRFOIL IN DESIGN AND OFF-DESIGN CONDITIONS
J. J. Kacprzynski, L. H. Ohman, P. R. Garabedian, and D. G. Korn Nov. 1971 88 p refs Presented at the 4th AIAA Fluid and Plasma Dynamics Conf., Palo Alto, Calif., 21-23 Jun. 1971
(Grant NGR-33-016-167)
(NRC-12315; LR-554) Avail: NTIS CSCL 20D

An airfoil designed for shockless inviscid flow at M sub infinity = 0.75 with C sub L = 0.63 was tested at high Reynolds numbers up to 27,000,000-in conditions. The experimental results are compared to theoretical ones, showing good agreement in general. Author

N72-13271*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPUTER PROGRAM FOR CALCULATING SUPERSONIC FLOW ON THE WINDWARD SIDE CONICAL DELTA WINGS BY THE METHOD OF LINES
E. B. Klunker, Jerry C. South, Jr., and Ruby M. Davis Washington Jan. 1972 58 p refs
(NASA-TM-X-2438; L-7950) Avail: NTIS CSCL 20D

A user's manual is presented for a program that calculates the supersonic flow on the windward side of conical delta wings with shock attached at the sharp leading edge by the method of lines. The program also has a limited capability for computing the flow about circular and elliptic cones at incidence. It provides information including the shock shape, flow field, isentropic surface-flow properties, and force coefficients. A description of the program operation, a sample computation, and a FORTRAN 4 program listing are included. Author

N72-13272# National Aerospace Lab., Tokyo (Japan). Second Aerodynamics Div.
A METHOD FOR THE CALCULATION OF LIFTING POTENTIAL FLOW PROBLEMS. 1: THEORETICAL BASIS
Masao Ebihara Jul. 1971 27 p refs
(NAL-TR-240T) Avail: NTIS

A formulation of lifting potential flow problems is worked out in terms of a doublet distribution over the body surface and the trailing vortex sheet. In the course of analysis, it is shown that the velocity field due to a surface distribution of doublets is equivalent to that due to a surface distribution of vortices. This fact is utilized to derive a non-singular expression of surface derivatives of potential due to a doublet distribution. In view of the significance of the Kutta's condition in controlling the lifting flow field, the behavior of the potential and its derivatives is examined in tye neighbourhood of the trailing-edge of a wing. Conditions on the strength of doublets are thus obtained with which the flow velocity remains finite at the trailing-edge. These conditions are incorporated in the final formulation of the lifting potential flow field. Author

N72-13331# Northern Research and Engineering Corp., Cambridge, Mass.
STUDIES OF TURBULENT MIXING AND COMBUSTION IN SUPERSONIC HETEROGENEOUS FLOWS Final Scientific Report
Kenneth N. C. Bray, Ronald S. Fletcher, Richard J. Murad, and D. B. Spalding Apr. 1971 45 p refs
(Contract F44620-70-C-0041; AF Proj. 9711)
(AD-728675; NREC-1157-1; AFOSR-71-1915TR; Task-61102F; Task-681308) Avail: NTIS CSCL 21/2

The objective of the program was the development of analytical models of various flow configurations which can be used in the design of supersonic air-breathing propulsion systems. The work described in the report represents an extension of earlier studies in the program to conditions that exist in air-augmented rocket systems. These conditions vary according to the nature of the rocket propellant, as liquid propellants usually produce only gaseous fuel-rich combustion products whereas solid propellant rockets emit heterogeneous products which contain small combustible particles. The inclusion of particles produces significant effects upon reacting turbulent flows, particularly when the particles themselves continue to burn. Some predictions of their behavior in a reacting flow field are presented. A series of systematic tests has been planned by which the experimental conditions proceed stepwise through conditions of increasing primary stream (rocket exhaust) complexity starting with a cold nonreactive gas and ending with a hot, reactive, heterogeneous mixture. The method permits the effects of temperature, of gaseous combustion and solid combustion upon a supersonic, reacting flow field to be isolated. Results obtained from the experimental tests are presented, and some conclusions are drawn from the data. Author (GRA)

N72-13351*# Transportation Systems Center, Cambridge, Mass.
LABORATORY EVALUATION OF FECKER AND LORAL OPTICAL IR PWI SYSTEMS
Mark Gorstein, James N. Hallock, Maurice Houten, and Ian G. McWilliams Feb. 1971 83 p ref
(NASA Order-R1022)
(NASA-CR-124721; DOT-TSC-NASA-71-5) Avail: NTIS CSCL 14B

A previous flight test of two electro-optical pilot warning indicators, using a flashing xenon strobe and silicon detectors as cooperative elements, pointed out several design deficiencies. The present laboratory evaluation program corrected these faults and calibrated the sensitivity of both systems in azimuth elevation and range. The laboratory tests were performed on an optical bench and consisted of three basic components: (1) a xenon strobe lamp whose output is monitored at the indicator detector to give pulse to pulse information on energy content at the receiver; (2) a strobe light attenuating optical system which is calibrated photometrically to provide simulated range; and (3) a positioning table on which the indicator system under study is mounted and which provides spatial location coordinates for all data points. The test results for both systems are tabulated. D.L.G.

N72-13360# Japan Broadcasting Corp., Tokyo. Technical Research Labs.
THE NHK HELICOPTER COLOR CAMERA
Sakae Shigeta, Kotaro Wakui, Masao Sugimoto, and Heiichiro Ando Mar. 1971 15 p
(NHK-Labs-Note-142) Avail: NTIS

A description is given of a helicopter color camera system. This system can be used not only on a helicopter, but automobiles, too, with easy operation and a good quality color picture. Its distinctive features include a wireless color camera

system with newly designed equipment such as a 3 plumbicon-tube color camera, digital control equipment, an 800MHz video transmitter and receiver, and a vibration isolator.
Author

N72-13429# Vought Aeronautics, Dallas, Tex.
DEVELOPMENT OF FASTENER COUNTERSINK CORROSION PROTECTION SEALS Final Report, 24 Jan. 1970 - 24 Apr. 1971
G. W. Kelly Apr. 1971 72 p refs
(Contract N00019-70-C-0244)
(AD-728039; VAC-2-53110/IR-2916) Avail: NTIS CSCL 11/1

The objects of the program were to modify coating materials for use with specialized application equipment, to study application techniques applicable to production practices and to develop a color stable (non-yellowing) material suitable for this use. All objectives were oriented toward development of an elastomeric sealant system designed for use in sealing fastener-head countersinks in highly loaded aircraft skins that are susceptible to exfoliation corrosion. Materials were formulated that could be smoothly deposited on vertical surfaces to thicknesses of 5 to 7 mils per pass utilizing vapor-carrier type spray equipment; other materials formulated for use in conventional application equipment were easily applied to an aesthetically smooth finish with a minimum loss of coating build per pass. These coatings were manufactured in commercial facilites and test results obtained from these materials correlated with laboratory experimental data. Materials and application techniques developed as a result of this program have significantly reduced the costs of applying fastener-countersink seals to production aircraft. Author (GRA)

N72-13434# Illinois Univ., Chicago. Dept. of Materials Engineering.
PRINCIPLES OF INCREMENTAL FORGING, PHASE 2 Final Report
P. H. Abramowitz and J. A. Schey Jul. 1971 75 p refs
(Contract N00019-70-C-0077)
(AD-729012; Rept-71-7) Avail: NTIS CSCL 13/8

The first phase of this program, established the feasibility of forging thin web-tall rib configurations typical of many airframe components by an incremental technique. In the second phase of the program, described in the report, the process was further developed by assuring accurate movement of the simultaneously indenting vertical and side anvils, and by feeding the workpiece with a manipulator developed for this task. The effects of process variables such as anvil length, bite, penetration and friction were investigated and the influence of process geometry on material displacement in a single indentation was explored in detail. In its present state of development, the process is capable of producing a thin web tall rib configuration with any number of stiffening cross ribs; rib and web thicknesses of 1/8 in. were achieved on the aluminum used as the simulating material.
Author (GRA)

N72-13435# Kaman Aerospace Corp., Bloomfield, Conn.
A FULL-SCALE EXPERIMENTAL FEASIBILITY STUDY OF HELICOPTER ROTOR ISOLATION USING THE DYNAMIC ANTIRESONANT VIBRATION ISOLATOR Final Report
Robert Jones Jun. 1971 137 p refs
(Contract DAAJ02-68-C-0094)
(AD-729317; R-892; USAAVLABS-TR-71-17; Task-1F162204A14608) Avail: NTIS CSCL 13/9

The report contains the results of a full-scale experimental feasibility study of rotor isolation employing the Dynamic Antiresonant Vibration Isolator (DAVI). The full-scale experiments were performed on a UH-2 helicopter fuselage isolated from a simulated rotor and transmission. Tests were conducted for three directions of vibratory input at the hub on the nonisolated vehicle and then compared to results obtained for the isolated vehicles. Tests on the isolated helicopter were conducted for two-bladed, three-bladed, and four-bladed rotor configurations. These rotor configurations were simulated by proper tuning of the DAVI isolation system to the predominant excitation frequency of the rotor systems. Results of this experimental study on a 6500-pound helicopter show that rotor isolation is feasible. Excellent reduction of vibration throughout the fuselage was obtained at the predominant excitation frequency (n-per-rev). This was accomplished with low static deflection, minimum weight penalty, and small relative vibratory deflections between the rotor and fuselage. Author (GRA)

N72-13446# TRW Systems Group, Redondo Beach, Calif.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF STRESSES IN TURBINE BLADES USING HOLOGRAPHIC INTERFEROMETRY Final Report, 23 Jun. 1970 - 23 Jun. 1971
R. Aprahamian, K. R. Overoye, D. A. Evenson, and L. D. Hofmeister 23 Jul. 1971 149 p refs
(Contract N00019-70-C-0590)
(AD-728802; AM-71-5) Avail: NTIS CSCL 14/2

The applicability of laser holographic interferometry to the determination of stresses in turbine blades was investigated. Experiments included continuous wave holographic interferometry of a statically loaded blade at both room and elevated temperatures (1400F) and a vibrating blade at room temperature. A finite element computer model of the blade was used to calculate deflections, strains and stresses in the blade in response to the experiment loads. The holographically measured deflections were compared to the computed deflections and found to be in good agreement. Actual stresses were then taken to be those calculated by the computer program. The applicability of holographic techniques to the detection of flaws in hollow turbine blades was also investigated. The methods used did not reveal localized flaws but did reveal the presence of out of tolerance wall thicknesses. The feasibility of obtaining holograms of blades rotating at high speed was investigated analytically and experimentally. Analysis showed that certain optical arrangements or shortened laser pulses were required. Experiments were performed in which holograms were successfully recorded, confirming the analysis and demonstrating that high rates of rotation do not necessarily degrade holographic images.
Author (GRA)

N72-13468*# General Electric Co., Evendale, Ohio. Aircraft Engine Group.
DEVELOPMENT OF SUPERALLOYS BY POWDER METALLURGY FOR USE AT 1000 - 1400 F
C. D. Calhoun Nov. 1971 92 p refs
(Contract NAS3-13202)
(NASA-CR-72968; R71AEG248) Avail: NTIS CSCL 11F

Consolidated powders of four nickel-base superalloys were studied for potential application as compressor and turbine discs in jet engines. All of the alloys were based on the Rene' 95 chemistry. Three of these had variations in carbon and A1203 contents, and the fourth alloy was chemically modified to a higyer volume fraction. The A1203 was added by preoxidation of the powders prior to extrusion. Various levels of four experimental factors (1) alloy composition, (2) grain size, (3) thermomechanical processing, and (4) room temperature deformation plus final age were evaluated by tensile and stress rupture testing at 1200 F. Various levels of the four factors were assumed in order to construct the statistically-designed experiment, but the actual levels investigated were established in preliminary studies that preceded the statistical process development study. Author

N72-13505*# Stanford Univ., Calif. Information Systems Lab.
EQUICONTROLLABILITY AND THE MODEL FOLLOWING PROBLEM
Richard T. Curran Jul. 1971 112 p refs
(Grant NGL-05-020-007)

(NASA-CR-124768; SU-SEL-71-034; TR-6303-2) Avail: NTIS CSCL 12A

Equicontrollability and its application to the linear time-invariant model-following problem are discussed. The problem is presented in the form of two systems, the plant and the model. The requirement is to find a controller to apply to the plant so that the resultant compensated plant behaves, in an input-output sense, the same as the model. All systems are assumed to be linear and time-invariant. The basic approach is to find suitable equicontrollable realizations of the plant and model and to utilize feedback so as to produce a controller of minimal state dimension. The concept of equicontrollability is a generalization of control kanonical (phase variable) form applied to multivariable systems. It allows one to visualize clearly the effects of feedback and to pinpoint the parameters of a multivariable system which are invariant under feedback. The basic contributions are the development of equicontrollable form; solution of the model-following problem in an entirely algorithmic way, suitable for computer programming; and resolution of questions on system decoupling. Author

N72-13580*# Litchford Systems, Northport, N.Y.
BROADCAST CONTROL OF AIR TRAFFIC Quarterly Progress Report
G. Litchford Sep. 1971 67 p refs
(Contract NASw-2247)
(NASA-CR-124696; QPR-1) Avail: NTIS CSCL 17G

Concepts of increased pilot participation in air traffic control are presented. The design of an air traffic control system for pilot usage is considered. The operating and safety benefits of LF/VLF approaches in comparison to current nonprecision approach procedures and systems are discussed. With a good national system plan, flight testing and validation, and the use of local differential, or general diurnal, corrections, the LF/VLF system would provide service superior to that presently available. K.P.D

N72-13584# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
FEDERAL AVIATION RESEARCH AND DEVELOPMENT FOR THE 1970'S
John A. Weber Jun. 1971 24 p Presented at the Am. Soc. for Eng. Educ. Ann. Meeting, Annapolis, 21-24 Jun. 1971
(Event-118) Avail: NTIS

Air transportation forecasts indicate a two-fold traffic increase by 1980 and up to five-fold by 1995. Air traffic of this magnitude requires continuous and orderly development progress in the national air traffic handling capability. The Federal Aviation Administration (FAA) research and development program is directed to meeting the increased demands of the aviation industry by application of advanced technology, particularly automation, and at the same time permitting maximum independence of flight with the highest degree of safety. Selected examples of the FAA R & D technical program are referenced, including air traffic control automation, microwave instrument landing system, and automatic digital data link, among others. Author

N72-13586# National Aviation Facilities Experimental Center, Atlantic City, N.J.
ANALYTICAL STUDY OF THE ADEQUACY OF VOR/DME AND DME/ DME GUIDANCE SIGNALS FOR V/STOL AREA NAVIGATION IN THE LOS ANGELES AREA Interim Report, Jul. 1970 - Jun. 1971
Bernhart V. Dinerman Dec. 1971 152 p
(Contract Proj. 330-014-04X; Proj. 045-390-01X)
(FAA-RD-71-96; FAA-NA-71-45) Avail: NTIS

An analysis was performed to determine the adequacy of very high frequency omnirange/distance measuring equipment (VOR/DME) guidance signals for vertical/short takeoff and landing (V/STOL) aircraft area navigation (RNAV) in the Los Angeles (LAX) area. Guidance signals were derived from existing VOR/DME and converted VOR facilities. It was concluded that: (1) VOR/DME RNAV over seven approved routes was feasible when using the existing VOR/DME facilities, (2) DME/DME RNAV over the approved routes is feasible when using station-pair combinations from existing VOR/DME facilities and certain converted VOR stations, (3) RNAV using DME/DME was potentially more accurate than VOR/DME, and (4) the number of en route station changeovers for VOR/DME and DME/DME RNAV over the approved and direct routes was considered acceptable. Author

N72-13589# National Aerospace Lab., Tokyo (Japan).
PRELIMINARY EXPERIMENTS FOR AUTOMATIC LANDING. 1: ON THE PERFORMANCE TESTS OF RADIO ALTIMETERS
Kazuo Higuchi, Kazuo Higuchi, Yuso Horikawa, Mikihiko Mori, Koichi Ogawa, Mitsuyoshi Mayanagi, Akira Watanabe, and Takayuki Nagoshi Apr. 1971 56 p refs In JAPANESE; ENGLISH summary
(NAL-TR-235) Avail: NTIS

Tests on two radio altimeters, the pulse type and the frequency modulated type, are described. The tests were made using an automatic landing experimental ground tower for simulation tests and a Beechcraft Queen Air 65 aircraft for in-flight tests. Results indicate both altimeters are adequate for automatic landing, and that altimeter signals are not affected by aircraft attitude changes within 30 degrees bank angle. E.H.W.

N72-13590# Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris Div. Telecommunications.
MATERIALS FOR THE SCANNING BEAM-DOPPLER CONTROVERSY
P. Fombonne 5 Feb. 1970 23 p
(AT/DTRN/2-155) Avail: NTIS

A comparison was made between a scanning beam and Doppler array type of aircraft landing guidance system. It is shown that an analogy exists between the radiation patterns of a linear array and the signal spectrum received by the same array when the elements are sequentially excited. The transmitted and received spectra of various systems are reviewed including the time reference scanning beam system, the code reference scanning beam system, and the STL Doppler system. No definitive conclusion is reached. ESRO

N72-13595# Epsco, Inc., Westwood, Mass.
STOL AIRCRAFT INSTRUMENT LANDING SYSTEM Final Report
Robert S. Hills Feb. 1971 67 p
(Contract DOT-FA69WA-2098)
(AD-725705; FAA-RD-71-17) Avail: NTIS CSCL 17/7

The development of a microwave scanning beam in instrument landing system for STOL aircraft and airports is discussed. It is a flexible system meeting or exceeding category 1 requirements with a growth potential for handling all types of aircraft in categories two and three by modular additions. In azimuth it provides plus or minus 0.5 degree accuracy with pilot selected course width between plus or minus 2 degrees and plus or minus 10 degrees within a 60 degree course sector. A left or right skew course, as well as a centerline course is selectable. In elevation it provides plus or minus 0.1 degree accuracy of a pilot selected glide slope between 3 degrees and 12 degrees and path width of plus or minus 1 to plus or minus 5 degrees. Integral DME functions are provided with an accuracy of plus or minus 0.01 nautical miles. The ground station is entirely dualistic except for antennas. Switch-over from main to standby equipment is controlled by integral dual monitor units operating in parallel. Author

N72-13614# Southampton Univ. (England). Inst. of Sound and Vibration Research.
[ACTIVITIES OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH] Annual Report, Apr. 1970 - Mar. 1971
1971 139 p refs
Avail: NTIS

The research activities of the following groups during 1970 are briefly described: (1) acoustics, (2) automotive engineering, (3) fluid dynamics and instrumentation, (4) operational acoustics and audiology, (5) structural dynamics, (6) random data analysis, and (7) the Wolfson Unit for noise and vibration control. Academic awards, courses, and publications of the Institute for 1970/71 are also included. ESRO

N72-13615# Southampton Univ. (England). Inst. of Sound and Vibration Research.
[ACTIVITIES OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH] Annual Report, Apr. 1969 - Mar. 1970
1970 143 p refs
Avail: NTIS

The research activities of the following groups during 1969 are briefly described: (1) acoustics, (2) automotive engineering, (3) fluid dynamics and instrumentation, (4) operational acoustics and audiology, (5) structural dynamics, (6) random data analysis, and (7) the Wolfson Unit for noise and vibration control. Academic awards, courses, and publications of the institute for 1969/70 are also included. ESRO

N72-13668# Air Force Academy, Colo.
NEUTRON DOSE TRANSMISSION FACTORS THROUGH AN F-102 AIRCRAFT
Jerald N. Jensen and Joseph F. Janni May 1971 51 p refs
(AD-728198; USAFA-RR-71-5) Avail: NTIS CSCL 18/8

The authors measured dose transmission factors for the F-102 aircraft using a Pu-Be source neutron flux incident from several directions around the cockpit. Neutron dose measurements were made with an Eberline PRN-4 neutron dosimeter, while the gamma radiation induced by the neutron interactions in the aircraft was measured using a Geiger-Mueller tube. Transmission factors for cockpit exposure doses and body depth doses (approximated by using a paraffin shield) were measured and tabulated. The cockpit exposure dose transmission factors ranged from .36 to 1.17 with most values greater than .8. The depth dose transmission factors varied from .16 to .8 with most values near .5. Author (GRA)

N72-13747# National Aerospace Lab., Tokyo (Japan).
DYNAMIC CHARACTERISTICS OF LIFT JET ENGINE JR 100 H
Kenji Nishio, Masanori Endo, Nanahisa Sugiyama, Takeshi Koshinuma, and Toshimi Ohata May 1971 31 p refs In JAPANESE; ENGLISH summary
(NAL-TR-238) Avail: NTIS

A numerical method is presented for obtaining the engine transfer function when the static performance and geometrical dimensions of the engine are known. The engine transfer functions of the JR-100 H engine were calculated experimentally by three methods: transient response, frequency response, and random signal. The results of the numerical and experimental methods were compared, and a comparative discussion of the experimental methods is presented. The effects of each component's performance on the transfer function were determined, and it was concluded that the random signal method is the most practical and accurate. Author

N72-13884*# Lockheed-Georgia Co., Marietta.
C-130: RESULTS OF CENTER WING RESIDUAL STRENGTH AND CRACK PROPAGATION TEST PROGRAM
F. L. Reeder, W. J. Dirkin, and H. L. Snider 15 Oct. 1971 297 p refs
(Contract NAS1-9485)
(NASA-CR-112008; ER-11178; LSR-7221-70-012A) Avail: NTIS CSCL 20K

Fourteen C-130 airplane center wings which had experienced from approximately 4,000 to 13,000 hours of flight service and its associated fatigue damage were tested to destruction, seven in upbending and seven in downbending. Six wings were tested directly for static residual strength in the fatigue-damaged condition as received from field service. The other eight wings were tested in crack propagation cyclic testing at a prescribed stress level for a maximum of 10,000 cycles. Then the stress level was reduced and testing was continued up to a maximum of 20,000 total cycles. Cyclic testing was performed with constant-amplitude stresses at a stress ratio of +0.1. Maximum cyclic skin stresses were approximately 18,000 psi. At the conclusion of cyclic testing, a static test to destruction was conducted to determine the residual strength of each fatigue-damaged specimen. Author

N72-13887*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATED PRELIMINARY DESIGN OF SIMPLIFIED WING STRUCTURES TO SATISFY STRENGTH AND FLUTTER REQUIREMENTS
W. Jefferson Stroud, Cornelia B. Dexter, and Manuel Stein Washington Jan. 1972 138 p refs
(NASA-TN-D-6534; L-7876) Avail: NTIS CSCL 20K

A simple structural model of an aircraft wing is used to show the effects of strength (stress) and flutter requirements on the design of minimum-weight aircraft-wing structures. The wing is idealized as an isotropic sandwich plate with a variable cover thickness distribution and a variable depth between covers. Plate theory is used for the structural analysis, and piston theory is used for the unsteady aerodynamics in the flutter analysis. Mathematical programming techniques are used to find the minimum-weight cover thickness distribution which satisfies flutter, strength, and minimum-gage constraints. The method of solution, some sample results, and the computer program used to obtain these results are presented. The results indicate that the cover thickness distribution obtained when designing for the strength requirement alone may be quite different from the cover thickness distribution obtained when designing for either the flutter requirement alone or for both the strength and flutter requirements concurrently. This conclusion emphasizes the need for designing for both flutter and strength from the outset.
Author

N72-13888# National Aerospace Lab., Tokyo (Japan).
FULL-SCALE FATIGUE TEST OF YS-11A-500/600 TURBOPROP TRANSPORT WING. 1: SAFE-LIFE FATIGUE TEST LOADS AND TEST METHOD
Kazuyuki Takeuchi, Toshio Nohara, and Hiroo Asada Jul. 1971 23 p refs In JAPANESE; ENGLISH summary
(NAL-TR-241) Avail: NTIS

Full scale fatigue tests of the YS-11-500/600 transport aircraft wing are discussed. Tests were required because of increase in maximum takeoff weight by 2.2 tons more than original design considerations. The fatigue loads and program sequence of the tests were: (1) gust loads, maneuver loads, and ground-air-ground loads were taken into consideration as fatigue test loads and (2) flight loads corresponding to 100 flights were applied in an ascending-descending sequence in which ground-air-ground loads were inserted. Author

N72-13909*# General Electric Co., Schenectady, N.Y. Research and Development Center.
SHARP FLAT PLATE HEAT TRANSFER IN HELIUM AT

MACH NUMBERS OF 22.8 TO 86.8 AND IN CORNER FLOW WITH AIR AT MACH NUMBER OF 19 Final Report
H. T. Nagamatsu and R. E. Sheer, Jr. 26 Aug. 1971 63 p refs
(Contract NASw-1785)
(NASA-CR-124695) Avail: NTIS CSCL 20M

Surface heat transfer rates were measured on a sharp flat plate at zero angle of attack in a hypersonic shock tunnel. The density and leading edge Knudsen number were varied to span the continuum to near free molecule regimes. The strong interaction parameter varied from 11 to 16,000 with Knudsen numbers from 0.56 to 17.1 respectively. Local heat transfer rates in the corner flow region produced by the intersection of two perpendicular flat plates with sharp leading edges were determined for various flow densities. The strength of the shock wave from the vertical plate was varied by adjusting the angle of attack from 0 to 5 deg. The unit Reynolds number varied from 1,000 to 17,200 and the Knudsen numbers from 1.6 to 27. The strong interaction parameter varied from 14 to 500. Author

N72-13913# Aeronautical Research Labs., Melbourne (Australia).
NATURAL CONVECTION: STATE OF THE ART
G. D. Mallinson Apr. 1971 40 p refs
(ARL/SM-Rept-330; ISBN-642-97684-8) Avail: NTIS

The characteristics of heat transfer within the cavities of aircraft structures are described. Various mathematical approaches for calculating convective heat transfer are presented. The cavities are identified as horizontal layer or vertical layer. The flow classification is described as steady, time dependent, transient, and stable. Mathematical models for various conditions of convectie heat transfer are included. Author

N72-13922# Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.
THRUST EFFECTS ON MISSILE AERODYNAMICS
R. A. Deep, J. H. Henderson, and C. E. Brazzel 25 May 1971 40 p refs
(Contract DA Proj. 1M2-62303-A-214)
(AD-728155; RD-TR-71-9; AMCMS-Code-522C.11.21405)
Avail: NTIS CSCL 21/2

Problems arising from rocket plume effects on missile aerodynamics are generally discussed. The approach taken to investigate these problems is outlined, and preliminary results are presented. Author (GRA)

N72-13927# Committee on Public Works (U. S. Senate).
APPALACHIAN AIRPORTS
Washington GPO 1971 45 p ref Hearing before Comm. on Public Works, 92d Congr., 1st Sess., 2 Mar. 1971
Avail: Comm. on Public Works

A hearing before the Committee on Public Works of the United States Senate concerning the development of regional airports for improving transportation and passenger safety in the Appalachian area is presented. The airports which require improvement in terminal facilities and the types of navigation aids recommended for the airports are described. Cost estimates for completion of the safety improvement program are included. P.N.F.

N72-13931# Department of Transportation, Washington, D.C.
EXECUTIVE BRANCH CRITERIA FOR DOMESTIC AIRLINE MERGER PROPOSALS
31 Aug. 1971 8 p
Avail: NTIS

Airline merger agreements should take into account the following criteria: A merger should not result in either the elimination of effective competition, or an excessive market share for the surviving firm; undue concentration within the air carrier industry; defense merger proposals by competitive carriers; substantial foreclosure of competition for interchange traffic or other excessive injury to other carriers; substantial operational, service, or organizational benefits for the surviving firm; and corrective benefits of the surviving firm towards the original difficulty of the weaker merger partner. Author

N72-13933# Committee on Post Office and Civil Service (U. S. House).
CAREER PROGRAM FOR AIR TRAFFIC CONTROLLERS
Washington GPO 1971 174 p refs Hearings on H.R. 8083 and similar bills before Comm. on Post Office and Civil Serv., 92d Congr., 1st Sess., 8, 9, and 22 Jun. 1971
Avail: Comm. on Post Office and Civil Serv.

The minutes of an initial hearing on a career program for air traffic controllers are presented. A bill was proposed for maximum entrance and retention ages, training, and early retirement aspects. K.P.D.

N72-13937# Department of Transportation, Washington, D.C. Assistant Secretary for Safety and Consumer Affairs.
GENERAL AVIATION SAFETY, VOLUME 1 Report to the Secretary
15 Sep. 1971 33 p refs
Avail: NTIS

The factors contributing to general aviation safety, with the expressed purpose of finding ways to reduce current accident rates, are examined. Data include consideration of existing regulatory policies and practices required by the FAA, organizational matters, and other matters relating to general aviation, primarily with respect to the operation of small ajrplanes. Also considered were qualifications for the general aviation pilot and flight instructor, pilot proficiency requirements, and ground support operations. Recommendations are included. E.H.W.

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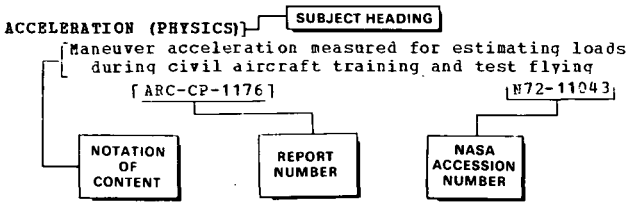

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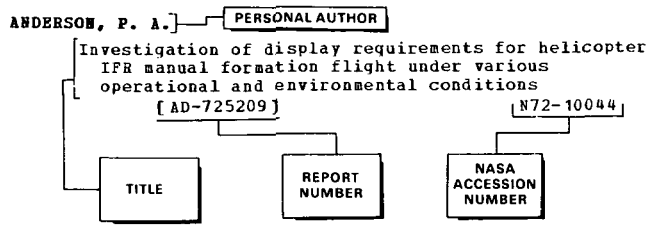

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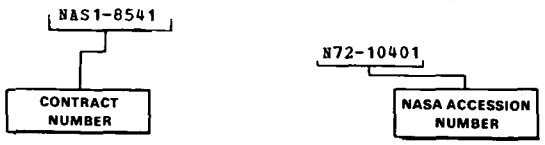

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15. Supplementary Notes

16. Abstract

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