NASA SP-7037 (26)

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 26

JANUARY 1973

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (26)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 26

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 December 1972 in

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

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JANUARY 1973
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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 448 reports, journal articles, and other documents originally announced in December 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 in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* 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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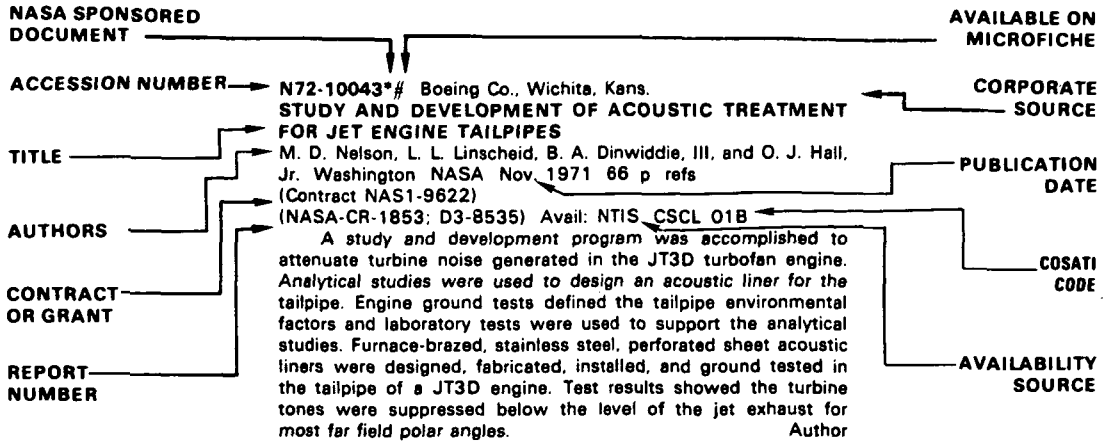

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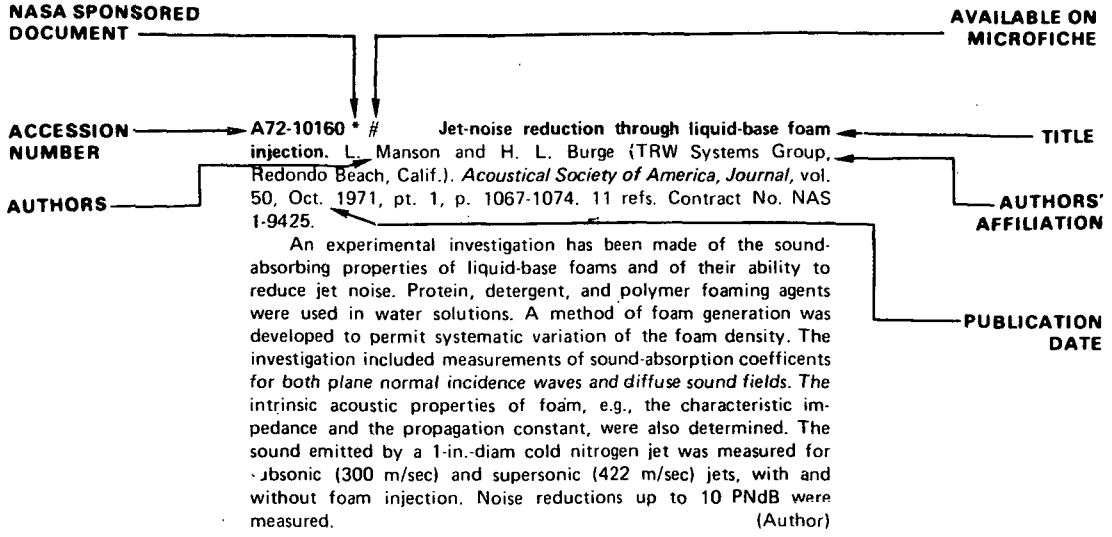

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 26) JANUARY 1973

IAA ENTRIES

A72-43244 **Air transport planning without plan.** W.-D. zu Castell (Münchner Flughafen, Munich, West Germany). *Airport Forum,* Sept. 1972, p. 4-6, 8 (3ff.). In English and German.

Issue is taken by the Munich airport director with the opinions of two Frankfurt airport executives expressed in an article by Mücke (1971) and another by Apfel (1972), deploring the absence of a Federal German overall 'air traffic concept' that would encompass an integrated transport system and suggesting the future need in Western Europe for only three major intercontinental airport terminals: London, Paris, and Frankfurt. Their position is rejected on the grounds that air transport should be direct, the German transport system is not comparable to those of France and England, the Frankfurt space is overcrowded, and a major intercontinental airport terminal in southern Germany is a necessity. M.V.E.

A72-43245 **The first jumbo freighter on the airport.** J. Doetsch (Deutsche Lufthansa AG, Hamburg, West Germany). *Airport Forum,* Sept. 1972, p. 23, 25-28, 30-34. In English and German.

The onboard freight facilities of the Boeing 747F cargo carrier, that Lufthansa uses on the Frankfurt-New York run since April 1972, are described, along with the freight-handling ground facilities used. Air transportation of commercial cargoes involves demands upon aircraft design that cannot be met at all by derivatives from military airfreight carriers and only imperfectly by design derivatives from commercial passenger aircraft. The 747F is shown to exemplify how much closer an optimum cargo carrier design can be approximated when it is derived from a bigger parent commercial aircraft design. Special attention is given to the discussion of the containerized cargo handling and of the loading facilities and equipment. M.V.E.

A72-43246 **Air freight distribution in the future.** R. F. Stoessel (Management Enterprises, Inc., Oklahoma City, Okla.). *Airport Forum,* Sept. 1972, p. 38-40, 42-50, 52, 53. In English and German.

Discussion of present air freight distribution patterns and trends, and forecast of future developments. Following an analysis of present air freight handling and transportation techniques and a review of present trends guiding efficiency improvement efforts, future air freight distributions systems and methods are discussed. The latter include: (1) mergers of multiple airport cargo facilities into centralized cargo-only airport terminals; (2) use of off-port air cargo receiving and shipment or distribution readying facilities; (3) increased use of containers for door-to-door transportation of prepacked goods furthered by an appropriate freight-rate and container-lease tariff structures; (4) increase in air cargo shipments by sender-owned and chartered aircraft; and (5) increased use of multimode transportation for pickup and delivery. M.V.E.

A72-43247 **The Central Terminal - Frankfurt's visiting card.** E. Becker (Flughafen Frankfurt/Main AG, Frankfurt am Main, West Germany). *Airport Forum,* Sept. 1972, p. 57-59, 61 (13ff.). In English and German.

Description of the new Central Terminal at Frankfurt airport that has been in operation for six months. It has put an end to all the temporary arrangements that had to be provided previously in order to keep abreast of the steep traffic growth rate. The new building is felt to be one of the most widely acclaimed airport projects in the world. It is described along with the circumstances that have motivated the choices underlying its design. The testing troubles encountered in its initial operation phase are discussed, and the need for better cooperation between airport and airline administrations is pointed out. Three brief reports by station managers of major airlines complement the review. M.V.E.

A72-43248 **Dala - Sweden's new regional airport.** O. Wiman (Dala Airport AB, Dala Airport, Sweden). *Airport Forum,* Sept. 1972, p. 102-106. In English and German.

Description of Sweden's new Dala airport that serves the two cities of Borlange and Falun, with a total population of 100,000. Following a review of the financing and planning phases, that were handled with a prudent and imaginative business sense, the terminal, its approach lighting, and IIS system are discussed, along with the provisions for future tourist and industrial development. This airport is situated in a region where the Swedish government is prepared to grant subsidies and loans to stimulate employment opportunities. M.V.E.

A72-43327 * # **Aeroelastic optimization of a panel in high Mach number supersonic flow.** T. A. Weisshaar (Maryland, University, College Park, Md.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 611-617. 9 refs. Grant No. NGL-05-020-243.

Solution for a least-weight skin thickness distribution for a panel with a flutter parameter constraint. This panel weighs less than any similar constant thickness panel, but has the same critical supersonic panel flutter parameter. The panel rests on simple supports and is of sandwich construction. The span to chord ratio is large enough that the inertial, elastic, and aerodynamic behavior is one-dimensional. The Mach number is great enough that the aerodynamic forces acting on the upper panel surface may be accurately described by quasi-steady, linearized, supersonic aerodynamic theory. The final optimum design is obtained from theoretical and numerical methods adapted from optimal control theory. The results of this investigation show that the optimal panel thickness distribution is symmetric about the panel chord midpoint. Compared to a reference panel with constant thickness, optimum panels are found to be nearly 12% lighter. (Author)

A72-43328 # **Calculation of separation points in incompressible turbulent flows.** T. Cebeci, G. J. Mosinskis, and A. M. O. Smith (Douglas Aircraft Co., Long Beach, Calif.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 618-624. 19 refs. Contract No. N00014-70-0099.

The purpose of this paper is to evaluate the accuracy with which the location of turbulent separation can be predicted on two-dimensional and axisymmetric bodies. The evaluation was made by studying a considerable number of flows that had separation. Calculated separation points were compared with the experimentally measured location. Four methods of predicting separation in turbulent flow were evaluated. They were Goldschmied's method, Stratford's method, Head's method, and the Cebeci-Smith method. It was concluded from the study that the last three listed methods predict separation points with the reliability and accuracy needed for aerodynamic design purposes. (Author)

A72-43329 # **An improved solution of the two-dimensional jet-flapped airfoil problem.** R. G. Leamon (U.S. Navy, Naval Ordnance Laboratory, White Oak, Md.) and A. Plotkin (Maryland, University, College Park, Md.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 631-635. 14 refs.

A method of solution is developed for a two-dimensional jet-flapped airfoil in potential flow. Numerical solutions are obtained which contain the proper singularities and which properly satisfy the boundary conditions on the airfoil and jet surfaces along their actual positions. A discussion of previous work is given. Comparisons of the method with previous work and experimental measurements are made. For momentum coefficients up to 1.0 and initial jet deflection angles of up to 60.0 deg the present method gives values of the sectional lift and pitching moment coefficients which differ from previous methods - those using the shallow jet approximation - by up to 16% but which lie within the range of experimental results. (Author)

A72-43330 # **Analytical method for combining the interaction of inlet distortion and turbulence.** R. L. Panton (Oklahoma State University, Stillwater, Okla.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 636-641. 13 refs.

The basic assumption of the work is that the compressor rotor blades are stalling and that the flow history of the blades should be analyzed. The interaction of distortion and turbulence to produce the rotor blade flow history is shown to be essentially nonlinear. Examples are given which demonstrate that distortion factors computed on an instantaneous basis frequently do not reflect the actual blade histories. Instantaneous distortion factors can be either too high or too low depending upon the nature of the turbulence. Equations and methods are given whereby experimental data taken with a fixed rake system can be converted into a coordinate system rotating with the blades. Then it is possible to analyze the blade history for the duration and magnitude of the pressure defect. Equations are also given to compute the Fourier coefficients or the power spectral density as it would be observed by the rotor blades. (Author)

A72-43331 # **Analysis and correlation of data on pressure fluctuations in separated flow.** D. G. Mabey (Royal Aircraft Establishment, Bedford, Hants., England). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 642-645. 27 refs.

The surface pressure fluctuations caused by bubbles at subsonic speeds are described and related with the mean pressure within the bubble and the development of the mixing layer. The pressure fluctuations caused by bubbles increase gradually from the separation line, reach a maximum near the reattachment line and then decrease gradually downstream of the reattachment line. Spectra of the pressure fluctuations near the reattachment line are similar for bubbles caused by leading-edge separation on wings, by forward facing steps, by rearward facing steps, by sudden enlargements in pipes and by cavities, if all the spectra are expressed in terms of a frequency parameter based on the bubble length. These observations should give a fairly good preliminary design method for evaluating fluctuating pressures. (Author)

A72-43332 # **A stability analysis for tethered aerodynamically shaped balloons.** J. D. DeLaurier (G.T. Schjeldahl Co., Northfield, Minn.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 646-651. 13 refs.

This work investigates the dynamic stability of tethered, aerodynamically shaped balloons by considering the system to pose essentially a cable problem, with the balloon's dynamics giving end and auxiliary conditions. This physical model gives a first-order problem in a sequence of partial differential wave equations with nonhomogeneous boundary conditions. Further, these equations uncouple to give a 'lateral' problem and a 'longitudinal' problem - as in first-order airplane dynamics. The solution of either problem takes the form of a transcendental characteristic equation for the stability roots, from which these roots are extracted by using an electronic computer and a roots locus plot. Further, this theory was applied toward the development of a high-performance tethered balloon design, and the results showed that good stability was attainable by the use of large and aerodynamically efficient fins. (Author)

A72-43333 # **Effect of air injection on the torque produced by a trailing vortex.** R. S. Snedeker (Aeronautical Research Associates of Princeton, Inc., Princeton, N.J.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 682-684. 5 refs. Contract No. F44620-69-C-0089.

An experiment is described which suggests that the value of a jet in modifying a vortex wake may be less than anticipated. The vortex was produced on the centerline of a vortex tube tunnel by a pair of airfoils of symmetric section which were set at equal but opposite angles of attack. Jet air was supplied from an external source through a tube inside one of the airfoils. It is shown that in spite of the modified tangential velocity profiles caused by the jet, the torque induced by the vortex on a typical wing changes very little in the near field. F.R.L.

A72-43334 # **Effect of several wing tip modifications on a trailing vortex.** J. F. Marchman, III (Virginia Polytechnic Institute and State University, Blacksburg, Va.) and J. N. Uzel (Martin Marietta Corp., Orlando, Fla.). *Journal of Aircraft,* vol. 9, Sept. 1972, p. 684-686. 6 refs.

An experimental investigation of the velocity field in the trailing vortex of a NACA 0012 wing with four different wing-tip modifications was conducted in a subsonic wind tunnel. Detailed measurements of the vortex were made using a yawhead pressure probe and a series of inclined manometers. It is shown that vortex dissipation effects similar to those produced by mass injection can be realized without either bleeding power from the engines or using auxiliary power. F.R.L.

A72-43419 # **Main results of nonlinear rotor theory (Osnovnye rezul'taty po nelineinoi teorii vinta).** M. M. Barshai (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol. 27, July-Aug. 1972, p. 98-101. 5 refs. In Russian.

Use of nonlinear vortex theory in an aerodynamic calculation of a helicopter rotor operating in a hovering and vertical takeoff regime. The proposed method is distinguished by the fact that it takes into account the variation of the induced-velocity field and the wake contraction. On the basis of an analysis of systematic calculations, conclusions are reached concerning the effect of various parameters on the aerodynamic characteristics of the rotor, and the conditions under which the classical methods give a result which is substantially in error are ascertained. A.B.K.

A72-43451 **From Hi-Shears to Hi-Loks - A decade of change.** V. L. Darby (Hi-Shear Corp., Reading, Pa.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 901.* 17 p.

The Hi-Lok fastening system development is traced from the factors of simplicity of design, weight saving and cost saving of the Hi-Shear rivet in 1941. These factors are shown graphically to give the comparison between the Hi-Shear rivet, conventional aluminum alloy rivets, and the AN bolt series that were prevalent in aircraft structure at that period of time. The Hi-Lok fastening system is compared to the features of the Hi-Shear rivet and the added feature of quiet assembly by the use of installation tools powered by air motors instead of vibratory rivet guns. A weight comparison is made between the tension type Hi-Lok and the 12 point MS21250 bolt series. Weight and strength comparisons are made between three types of countersunk head Hi-Loks and also show how fastener head height has afforded the designer the opportunity of saving weight by reducing flange widths and reducing chemically milled pad-up thicknesses for countersunk fasteners. (Author)

A72-43452 **Weight reduction with bimetallic fasteners.** W. B. Causey (Townsend Co., Santa Ana, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 902.* 11 p.

Description of a fastener which has a high-strength shank with a ductile tail and can be upset, thus providing the equivalent of a threaded fastener without the attendant difficulties. This type of fastener is now being produced under the trade name Cherrybuck and at present is available with 6AL-4V titanium shank and commercially pure tail. In addition to weight reduction by eliminating the need for nuts, there is a considerable cost savings which can be realized because of reduced stocking and simpler installation. (Author)

A72-43453 **S-3A weight control program.** F. Johnson (Lockheed-California Co., Burbank, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 906.* 18 p.

Detailed description and critique of the methods employed in the S-3A weight control program. The basic program requirements were an accurate measure of program weight status, complete visibility of the effect of pending changes and a rapid but orderly decision process which considered cost and total program effect. The primary tools employed were target weights controlled to the designer level, weight reduction reviews of each engineering job, vendor weight guarantee clauses, a hierarchy of weight control decision meetings, and cost recognition of each significant weight reduction proposal. Other significant program features were the use of a 'value of the pound,' mandatory weight engineering signature for drawing release, weekly weight and cost status reports, and short span highly intensified programs to cope with special problem areas. Avionics equipment weight was controlled by a program employing avionics engineers as weight specialists. (Author)

A72-43454 **A summary of the design synthesis process.** F. K. Ladner and A. J. Roch (LTV Aerospace Corp., Vought Aeronautics Div., Dallas, Tex.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 907.* 40 p.

This report provides an overview of computerized aircraft synthesis through a summary of Vought Aeronautics Company's Aircraft Synthesis Analysis Program, ASAP. This program is an aircraft synthesis computer model designed to size and optimize aircraft during design of potential aircraft systems. ASAP combines into one computer program analysis techniques and work procedures of the design process; automates a significant portion of the design process (i.e., initiation, analysis and optimization); and is applicable to all stages of the advanced design acquisition cycle. The ASAP development plan is presented with emphasis placed on ASAP's evolutionary and practical development approach and its modular construction. (Author)

A72-43455 **An aerodynamics model applicable to the synthesis of conventional fixed-wing aircraft.** R. S. Peyton (Lockheed-California Co., Burbank, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 908.* 15 p.

The ASSET computer program is comprised of many computer models or subroutines such as configuration generation, weights, aerodynamics, propulsion, and cost. Following input of the desired configuration variables, these subroutines combine together to perform and cost the matrix of desired aircraft. The aerodynamics model of ASSET defines the component lift and drag of each configuration variable and sums these components into the total flaps up airplane lift and drag. The sources of drag considered by the model include friction, profile, compressibility, wave, induced, protuberance, and drag of external stores. The model uses configuration data defining aircraft component size and shape and prediction techniques to generate the matrix of parametric aerodynamic data as a function of Mach number, altitude and lift coefficient. Experience gained through design application demonstrates that the model is flexible enough to accommodate a wide variety of fixed-wing aircraft configurations. The drag data provided by the model are applicable in the subsonic through supersonic flight regime for the moderate lift coefficients usually encountered over the mission profile. (Author)

A72-43456 **Performance methods for aircraft synthesis.** W. J. Moran (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 909.* 45 p.

The aircraft configuration synthesis process is described from the viewpoint of the performance engineer as a contribution to an interdisciplinary examination of the process. In addition, the performance engineer's task in the synthesis loop is described, as well as two computer programs being developed at the Fort Worth operation of Convair Aerospace. The first of these programs, MAPP (Mission Analysis and Performance Program), contains methods for computation of most types of performance data. The second, IMP (Interim Mission Program), is a general mission integration procedure. IMP is intended for eventual merger with MAPP to form the performance module of an integrated configuration synthesis system for conventional aircraft. (Author)

A72-43457 **Engine and airplane - Will it be a happy marriage.** W. L. McIntire and P. E. Beam, Jr. (General Motors Corp., Detroit Diesel Allison Div., Detroit, Mich.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 910.* 13 p.

In the past, new aircraft designs have generally been restricted to the use of off-the-shelf engines. As a rule, engine selection has been limited to two or three powerplants which are either in production or under development. In this study, all such restrictions have been removed, and the engine aerodynamic cycle, size, and configuration are dictated solely by the aircraft mission requirements. A matrix of engines was designed at various bypass ratios, pressure ratios, and turbine temperatures. The effect of these variables on engine performance and weight - and, thus, on the aircraft mission performance - is examined. Particular emphasis is given to the methods used to obtain the weight of each of the engines. (Author)

A72-43459 **The weight module - A keystone in the aircraft synthesis program.** R. L. Crossen (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 912.* 12 p.

The weight module of the aircraft synthesis program must meet the requirement of integrating all of the design parameters into a single parameter (weight or mass) of the real vehicle. This requirement forces the weight module to include consideration of aircraft design disciplines which are not separate modules of the total

synthesis program. The generalized component weight equation presented is useful for building the computational element of the module, while retaining total flexibility to tailor the module to each specific design problem. The generalized computational routine makes the engineer an integral part of the synthesis process by requiring him to define the weight equations for use in any specific application. Elimination of the need to continually develop new computational routines allows more time to be spent in the area of methods development. (Author)

A72-43460 Cost analysis as applied to aircraft synthesis. J. F. Fisher, S. T. Hitchcock, and R. H. Trelease (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 913.* 26 p. 5 refs.

Description of an improved method of estimating airframe manufacturing costs using a unique and fundamentally new approach. The computerized cost estimation method developed utilizes a technique for generating a detail parts list of a projected vehicle when only configuration concepts are available as input. The detail parts are then analyzed individually to determine their weight and the costs of material and manufacturing. Weights and costs of all detail parts are then summed, adding in the weight and costs of assembly elements, to determine the complete vehicle airframe weight and manufacturing cost. To this cost the engineering and tooling cost are added to complete the cost model. (Author)

A72-43461 Rotary wing head weight prediction. R. H. Swan (Boeing Co., Vertol Div., Philadelphia, Pa.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 914.* 17 p.

A semi-empirical rotary wing head weight prediction trend is presented, and its development is discussed. The method is tailored for use in the early preliminary design and parametric study phases of aircraft development. Major design loads and their sources are discussed. Parameters used in the correlation factor are defined, and the rationale for their selection is given. Rotary wing head composition is defined, and drawings of articulated, teetering, and hingeless designs are shown. A summary table lists the weights and parameters used to derive the trend curve. (Author)

A72-43462 PRD-49, a new composite material - Its characteristics and its application to the BO-105 helicopter. D. M. Hooker (Boeing Co., Vertol Div., Philadelphia, Pa.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 915.* 15 p.

A72-43463 A new approach to helicopter weight fractions. T. L. Hoffmann and A. R. Kampschafer (Bell Helicopter Co., Fort Worth, Tex.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 916.* 16 p.

A new means of expressing helicopter weight fractions is proposed in order to reach more equitable conclusions relative to comparative weight practices. Whereas the validity of contemporary weight ratios is dependent upon the dubious consistency of the contents and value of empty weight and gross weight, these new weight fractions are based upon values which effectively eliminate those elements which are more readily subject to interpretation and/or question. A single common denominator of rotor design - rotor thrust coefficient - is used as the basis for this method. Also developed and presented is a nondimensional method to approximate the effect of maneuver criteria on helicopter gross weight. (Author)

A72-43464 Experience on weighing the B 747 with loadcells, MEWS and OBAWS. G. Rosenkranz (Deutsche Lufthansa AG, Hamburg, West Germany). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 917.* 14 p.

A new weighing kit had to be designed in connection with the introduction of the B747 because of the great weight and the large dimensions of the new aircraft. The new device selected was a portable loadcell weighing kit consisting of six loadcells and a reading instrument with electronic digital indication. However, it was decided subsequently to purchase a platform scale weighing kit because of certain disadvantages inherent in the use of the first weighing device. The merits of the two weighing devices are compared. G.R.

A72-43465 Detection of structural deterioration and associated airline maintenance problems. H. D. Henniker (British European Airways Corp., Ruislip, Middx., England) and R. G. Mitchell (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 918.* 17 p.

A72-43466 Empty weight and cruise performance of very large subsonic jet transports. D. Howe (Cranfield Institute of Technology, Cranfield, Beds., England). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 919.* 14 p.

A72-43467 Self-validating weight and balance operations by moment sampling. A. J. Muhonen (Boeing Co., Seattle, Wash.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 920.* 19 p.

This paper presents a new concept for obtaining precise, self-validating measurement data in aircraft weighing operations. It is called the moment sampling concept whereby statistics are derived from numerous moment samplings that are converted into reliable weight measurement data via use of a desk computer. This procedure therefore, results in better weight measurement data than the prevalent procedure whereby the actual aircraft weight is compared with the predicted weight and the resultant weight measurement validity is based on the correlation between the two weights. The purpose of the moment sampling concept is to provide a many numbered sample space from which can be extracted a necessary and sufficient quantity of events for statistical processing by a desk computer. The computer program accepts the moment inputs and prints out: (1) the mean weight and the standard deviation and (2) the mean center of gravity and the standard deviation. (Author)

A72-43472 L-1011 computerized weight reporting system present and future capabilities. R. Jones and R. Jensen (Lockheed-California Co., Burbank, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 932.* 32 p.

A72-43473 A new weight data information system. G. A. Thompson and E. W. Traver (Douglas Aircraft Co., Long Beach, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 933.* 22 p. (Douglas Paper-6023)

The major features of a new weight record system, titled weight data information system are presented. The system objectives are discussed together with the rationale for their development. A description is given of the computer programs that are utilized to calculate and maintain mass properties data and to present these data in any desired format. The type of information stored in the data base and the output reports currently generated are defined. Related computer hardware and software are explained, and some consideration is given to future developments. (Author)

A72-43475 **Weight estimation of hydraulic secondary power system.** R. S. Kaneshiro (North American Rockwell Corp., Los Angeles, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 935.* 69 p. 8 refs. (NA-72-414)

The hydraulic secondary power system includes all components from the primary power source to the using functions. The system is sized by parameters such as aircraft size, system redundancy requirement, and system utility. Component data are given for loads and weights of linear hydraulic actuators, motor loads of ballscrew/jackscrew actuators, loads of landing gear systems and blowers, power supply, the reservoir, filters, and controls. The basic relationship of design requirements to weights is studied, as well as the effects of practical constraints and limits. Tables and curves are included. F.R.L.

A72-43476 **Post-design analysis for structural weight estimation.** D. P. Marsh (Douglas Aircraft Co., Long Beach, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 31st, Atlanta, Ga., May 22-25, 1972, Paper 936.* 19 p. (Douglas Paper-6021)

The methodology of post-design analysis (PDA) for determining structural weight penalties is presented. A process is described for determining these penalties through the study of production aircraft in order that real-life penalties may be extrapolated to a particular advanced design situation. (Author)

A72-43498 **A crack stopper concept for filamentary composite laminates.** J. M. McKinney (Lockheed-Georgia Co., Marietta, Ga.). *Journal of Composite Materials,* vol. 6, July 1972, p. 420-424.

Crack-stopper straps have been used as an effective means of stopping running cracks in a panelized wing and fuselage structure. These straps are usually fastened to the parent structure by a combination of adhesive bonding and mechanical fasteners. An investigation was conducted to discover an effective approach for introducing such straps into an advanced composite structure. Tests involving fourteen honeycomb sandwich panels were carried out. The tests showed that cracks in composite laminates can be arrested by a suitable reinforcement method. G.R.

A72-43585 # **Theory of a gyrohorizon compass with an azimuthally free casing of the sensitive element (Do teorii girogorizontkompasa z vil'noiu v azimuti obolonkoiu chutlivogo elementa).** S. M. Onishchenko (Akademiia Nauk Ukrains'koi RSR, Institut Matematiki, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Tekhnichni i Matematichni Nauki,* vol. 34, July 1972, p. 652-654. 5 refs. In Ukrainian.

A72-43608 **Output-feedback control law for randomly distributed multivariable system.** M. Healey (South Wales and Monmouthshire, University College, Cardiff, Wales). *Institution of Electrical Engineers, Proceedings,* vol. 119, Sept. 1972, p. 1372-1374. 6 refs.

A72-43637 # **Helicopter as flying cranes (Kranflüge mit Hubschraubern).** G. Krönert (Gesellschaft für internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 7, 1972, p. 299-308. In German.

In the German Democratic Republic the employment of cranes has become an important element in increasing the efficiency of operations in the field of construction engineering. Since the year 1961 INTERFLUG helicopters are used as cranes and for carrying external loads. About 12,000 external loads were carried in more than 550 operations. Two thirds of the operations involved a use of helicopters as cranes. It is recommended to consult an expert before making a decision concerning the employment of helicopters as cranes in a specific project. Data regarding the weights of the loads which can be carried under various conditions are discussed together with aspects of planning, length of time required for the operations, and details concerning the types of material carried. G.R.

A72-43638 # **Helicopter Ka-26 in operations in high mountains (Hubschrauber Ka-26 im Hochgebirgseinsatz).** A. Bubnov. *(Grazhdanskaia Aviatsiia,* no. 12, 1971.) *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 7, 1972, p. 309, 310, 323. In German. (Translation).

Test flights with the helicopter Ka-26 in the Caucasus have been successfully completed. The objective of the tests was the study of the flight characteristics of this helicopter type in a high-mountain environment. The requirements for flight operations in such an environment were also investigated. The landing fields used for the helicopter were at altitudes in the range from 400 to 3000 m. The flight operations involved altitudes up to 4750 m. The results obtained in the investigation are discussed. G.R.

A72-43639 # **The propulsion system NK-8-4 of the IL-62 (Das triebwerk NK-8-4 der IL-62).** R. Weinhold (Gesellschaft für internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 7, 1972, p. 311-317, 352. In German.

A two-stage low-pressure turbine and a one-stage high-pressure turbine are used. The components of the propulsion system, with the exception of the combustion chamber, the turbines, and the shafts, are made of a titanium alloy. The propulsion system can be equipped with thrust reversal devices. The main control system is based on hydromechanical principles. The design of the lubricating system is discussed together with the design of the starter system, the operational surveillance system, and aspects of the installation of the propulsion system. Questions of fuel consumption are considered along with maintenance operations, the occurrence of defects, and proposals for improvements in the maintenance operations. G.R.

A72-43640 # **Trends in the control of air-traffic flows in the air space (Tendenzen der Steuerung von Flugverkehrsströmen im Luftraum).** R. Küttner, G. Gäbel, J. Hölzer, and R.-J. Vilser (Gesellschaft für internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 7, 1972, p. 318-323. In German.

Principles of flight safety and air-traffic control are discussed together with requirements for the automatization of operations. The various activities of air traffic control are related to a preparatory phase involving planning and coordination and an operational control phase. The design of an installation for the automated processing of radar data is discussed. G.R.

A72-43641 # **Flight mechanics analysis of various flight conditions for conventional aircraft. V - Mechanical foundations /dynamics of rigid bodies/ (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. V - Mechanische Grundlagen /Dynamik des starren Körpers/).** F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 7, 1972, p. 324-333. In German.

A72-43653 # **Strength of a cylindrical shell of variable thickness located in a temperature field (Prochnosti' tsilindricheskoi obolochki peremennoi tolshchiny, nakhodiashcheisia v temperaturnom pole).** E. B. Brazhnikov and V. V. Ershov. *Aviatsionnaia Tekhnika,* vol. 15, no. 2, 1972, p. 22-26. In Russian.

A72-43654 # **Calculation of a thin-walled small-aspect-ratio wing beyond the limit of proportionality (K raschetu tonkostennogo kryla malogo udlineniia za predelami proportsional'nosti).** M. B. Vakhitov and A. S. Safonov. *Aviatsionnaia Tekhnika,* vol. 15, no. 2, 1972, p. 27-32. 7 refs. In Russian.

Equations (derived on the basis of Odinokov's /1948/ theory) for calculating thin-walled structures are applied to the calculation of a small-aspect-ratio wing beyond the proportional elastic limit. To enable a comparison, the calculations are performed by Beliaev's method of reduction coefficients and by Il'iushin's method of fictitious loads, each of which takes physical nonlinearities into account. A procedure for improving the convergence of the successive approximations is proposed. An algorithm for obtaining stress-strain curves with linear strengthening is constructed which minimizes the number of the required iterations. V.P.

A72-43663 # **Magnitude of the lateral force acting on a centrifugal-pump impeller (O velichine poperechnoi sily, deistvuiushchei na kryl'chatku tsentrobezhnykh nasosov).** N. K. Gladchenko. *Aviatsionnaia Tekhnika,* vol. 15, no. 2, 1972, p. 92-99. 7 refs. In Russian.

The deterioration of the shaft bearings of the electromotor driving an aircraft fuel pump is studied by measuring the radial and dynamic pressures about the pump impeller and determining the lateral force (created by the nonuniformity of the pressure distribution) which acts on the bearing. A method of calculating the magnitude and direction of this lateral force is proposed. V.P.

A72-43669 # **Parameter value averaging for a gas turbine engine in the process of measurements (Usrednenie znachenii parametrov GTD v protsesse izmerenii).** V. R. Toloknovskii, A. S. Tikhonov, and Z. Z. Bondareva. *Aviatsionnaia Tekhnika,* vol. 15, no. 2, 1972, p. 137-145. In Russian.

Description of a parameter averaging method applied to gas turbine performance measurements. The method is based on measurement error determination and results, for any prescribed error limits, in faster completion of the parameter averaging operation. M.V.E.

A72-43674 # **Basic dimensionless geometrical relations for the combustion chambers of aircraft gas turbine engines (Osnovnye bezrazmernye geometricheskie sootnosheniia dlia kamer sgoraniia aviatsionnykh gazoturbinnykh dvigatelei).** N. F. Dubovkin and A. P. Gorshenin. *Aviatsionnaia Tekhnika,* vol. 15, no. 2, 1972, p. 167-169. In Russian.

A72-43734 **The strength of cast gas turbine engine blades under alternating loads.** T. P. Zakharova and B. F. Balashov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR). *(Problemy Prochnosti,* vol. 3, July 1971, p. 55-61.) *Strength of Materials,* vol. 3, no. 7, Mar. 1972, p. 810-815. Translation.

The structural strength of blades cast from the ZhS6K heat-resistant alloy is analyzed on the basis of a series of fatigue data obtained for samples and actual turbine blades. Diagrams showing the ratio of the endurance limit to the breaking point for cylindrical samples and blades in fatigue tests in symmetrical bending are presented. V.P.

A72-43735 **Fatigue strength of model active gas turbine blades subjected to programmed temperature changes close to operating temperatures.** B. N. Sinaiskii (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *(Problemy Prochnosti,* vol. 3, July 1971, p. 62-68.) *Strength of Materials,* vol. 3, no. 7, Mar. 1972, p. 816-822. 12 refs. Translation.

Fatigue tests performed with cylindrical samples and actual turbine blades prepared from the ZhS6K heat-resistant alloy under two versions of programmed temperature variations are described. It is shown that an increase in temperature from 800 to 1000 C leads to an abrupt decrease in fatigue strength. The fatigue data obtained at constant and variable temperatures differ only slightly for smooth cylindrical samples and blades. V.P.

A72-43736 **Some special features in the failure and cracking of compressor discs under variable stresses.** T. K. Bragina and B. F. Balashov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR). *(Problemy Prochnosti,* vol. 3, July 1971, p. 69-77.) *Strength of Materials,* vol. 3, no. 7, Mar. 1972, p. 823-830. 7 refs. Translation.

Several cases of crack formation owing to variable stresses in compressor disks of gas-turbine engines are analyzed. Fatigue tests showed that in the evaluation of safety factors in the case of variable stresses, it is necessary to take into account the influence of the plane stress-strain state, the stress concentration, the scale factor, and the fatigue strength of disks. V.P.

A72-43768 # **A new ferrite commutator (Novyi ferritovyi kommutator).** V. A. Gordeev, A. I. Nagornov, V. P. Vasil'ev, and Iu. F. Strygin. *Radiotekhnika,* vol. 27, July 1972, p. 97-100. 5 refs. In Russian.

Description of a ferrite element which can be used as a microwave power switch or modulator in radar and navigational avionics applications requiring small dimensions and high reliability. A ferrite cylinder is placed in the input branch of a waveguide Y junction; the application of a current pulse to a coil wound on the ferrite cylinder switches the anisotropy of the ferrite material and directs the microwave power to one or the other of the output branches. T.M.

A72-43796 # **Investigation of the interaction between a circular wing and a flow of ideal liquid (Issledovanie vzaimodeistviia kolebliushchegosia kruglogo kryla s potokom ideal'noi zhidkosti).** V. I. Borisenko and S. G. Shpakova (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 8, July 1972, p. 86-91. In Russian.

A72-43809 # **Problems of interference between oscillating surfaces in subsonic flow (Problemas de interferencia entre superficies oscilantes en corriente subsónica).** J. J. Martinez. *Ingeniería Aeronáutica y Astronáutica,* vol. 24, May-June 1972, p. 1-20. 24 refs. In Spanish.

The interference between the horizontal and vertical stabilizers of an arbitrary tail is studied. The method of obtaining the integral equation corresponding to an isolated nonplanar surface which oscillates in a subsonic flow is described. Starting from this point, the corresponding expressions for various particular cases are developed. A numerical method for calculation of a T-tail is briefly outlined, and various limitations of the linearized theory are discussed. New procedures by which it is possible to eliminate these limitations are described. F.R.L.

A72-43810 **Developing a synthetic turbine oil.** C. G. Haupt (Shell International Petroleum Co., Ltd., London, England) and F. T. Barcroft (Shell Research, Ltd., Chester, England). *Shell Aviation News,* no. 410, 1972, p. 8-11.

New types of lubricating fluids, not derived from petroleum, were developed because of the limitations of mineral oils as lubricants for high performance gas turbines. The new lubricating fluids are generally referred to as synthetic turbine lubricants. The particular type of chemical compounds found to be efficacious were

esters. The development of synthetic lubricants for aviation gas turbines has, until recently, followed separate paths in the U.S. and in the UK. However, in formulating the latest round of oil requirements, specifying authorities appear to be approaching a commonalty of viewpoint. Aspects of oil evaluation are discussed together with details of oil performance. G.R.

A72-43868 * The optimal control of merging aircraft Implementation of the hybrid air traffic controller. J. G. Schatz (Bell Aerospace Co., Buffalo, N.Y.) and T. E. Stern (Columbia University, New York, N.Y.). In: Asilomar Conference on Circuits and Systems, 5th, Pacific Grove, Calif., November 8-10, 1971, Record. North Hollywood, Calif., Western Periodicals Co., 1972, p. 601-605. 15 refs. NSF Grant No. GK-2283; Grant No. NGL-33-008-090.

The control of merging aircraft is formulated as a finite-time, quadratic optimal control problem of a linear system with state and control constraints. The purpose of this paper is to demonstrate that the Hybrid Air Traffic Controller (HAC), which has been previously developed as a solution to this problem, may be easily implemented. Use is made of both the properties of the algebraic solution to the matrix Riccati equation and the structure of the linear model. This approach results in a real-time synthesis procedure for the HAC which does not rely on iterative numerical integration techniques. (Author)

A72-44024 # Selection of optimum version of specialized machinery (Vybor optimal'noi komponovki spetsializirovannogo oborudovaniia). G. M. Shchetinin and M. F. Kuznetsov (Kazanskii Aviatsionnyi Institut, Kazan, USSR). *Mashinostroenie,* no. 8, 1972, p. 163-167. 5 refs. In Russian.

The problem in preliminary design of determining the optimal version of an equipment or facility that will automatically perform a series of steps in the production of specialized products is examined. A method of obtaining an optimum version at least expense is developed and is applied to an example. V.P.

A72-44058 # Application of a time-dependent boundary-layer analysis to the problem of dynamic stall. S. J. Shamroth and H. McDonald (United Aircraft Research Laboratories, East Hartford, Conn.). *ASME, Transactions, Series E - Journal of Applied Mechanics,* vol. 39, Sept. 1972, p. 823-825. 6 refs.

A preliminary investigation of the trailing-edge stall problem is described. The analysis is based upon the assumption that airfoil stall is related to boundary-layer separation. The study consists of a solution of the time-dependent boundary-layer equations, and development of a model relating boundary-layer separation to airfoil stall. It appears that for many turbulent boundary layers of practical interest the major effect of unsteady phenomena may be the modification of the imposed pressure gradient. F.R.L.

A72-44125 # Supersonic turns without superbooms. H. S. Ribner (Toronto, University, Toronto, Canada). *Acoustical Society of America, Journal,* vol. 52, Sept. 1972, pt. 2, p. 1037-1041. 5 refs. Research supported by the National Research Council of Canada, Ministry of Transport, and Air Canada; Grant No. AF-AFOSR-70-1885.

It is shown that focused booms that arise in turning flight can be suppressed by the simple (although not always practicable) expedient of slowing down the aircraft. The correct deceleration will eliminate the local curvature of the wave front responsible for the focusing. Specifically, the tangential deceleration resolved along the normal to the wavefront is adjusted to cancel out the centripetal acceleration similarly resolved. Horizontal turns of a prescribed limiting sharpness are not of concern for this suppression technique: their focused booms will be cut off from reaching the ground by atmospheric refraction. The minimum turn radius for focus cutoff is related herein in a simple fashion to the tabulated width of the sonic boom carpet for rectilinear flight, as a function of Mach number and altitude. (Author)

A72-44146 * # Probability distribution of vertical longitudinal shear fluctuations. G. H. Fichtl (NASA, Marshall Space Flight Center, Aerospace Environment Div., Huntsville, Ala.). *Journal of Applied Meteorology,* vol. 11, Sept. 1972, p. 918-925. 9 refs.

This paper discusses some recent measurements of third and fourth moments of vertical differences (shears) of longitudinal velocity fluctuations obtained in unstable air at the NASA 150 m meteorological tower site at Cape Kennedy, Fla. Each set of measurements consisted of longitudinal velocity fluctuation time histories obtained at the 18, 30, 60, 90, 120 and 150 m levels, so that 15 wind-shear time histories were obtained from each set of measurements. It appears that the distribution function of the longitudinal wind fluctuations at two levels is not bivariate Gaussian. The implications of the results relative to the design and operation of aerospace vehicles are discussed. (Author)

A72-44195 * Application of quadratic optimization to supersonic inlet control. B. Lehtinen and J. R. Zeller (NASA, Lewis Research Center, Cleveland, Ohio). *Automatica,* vol. 8, Sept. 1972, p. 563-574. 13 refs.

This paper describes the application of linear stochastic optimal control theory to the design of the control system for the air intake, the inlet, of a supersonic air-breathing propulsion system. 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 controllers 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 a linear controller that minimizes the nonquadratic index. The two controllers are compared on the basis of unstart prevention, control effort requirements, and frequency response. It is concluded that while controls designed to minimize unstarts are desirable in that the index minimized is physically meaningful, computation time required is longer than for the minimum mean square shock position approach. The simpler minimum mean square shock position solution produced expected unstart frequency values which were not significantly larger than those of the nonquadratic solution. (Author)

A72-44196 Supersonic aircraft energy turns. H. J. Kelley and L. Lefton (Analytical Mechanics Associates, Inc., Jericho, N.Y.). *Automatica,* vol. 8, Sept. 1972, p. 575-580. 12 refs. Contract No. F44620-71-C-0123.

A brief review is given of some recent theoretical work on optimal atmospheric flight, comprising an extension of so-called 'energy climbs' to three-dimensional flight and an analytical recasting in terms of singular perturbation theory. A family of variable-altitude turns obtained by numerical integration in the reduced-order ('energy') approximation is presented for a hypothetical supersonic aircraft, including the effects of constraints on altitude, dynamic pressure, Mach number, lift coefficient, and normal load factor. An important part of the family consists of full-throttle turning maneuvers; another part features throttle closed and speed brakes extended for various initial periods of flight along the 'corner-velocity locus', the path in the Mach-altitude chart along which maximum lift coefficient and maximum normal load factor can be obtained simultaneously, followed by a period of full-throttle turning. The highest sustainable turning rate appears transonically at low altitude and such a steady turn is a member of the family. Extended-duration optimal turns tend to approach this equilibrium during central portions of their histories. (Author)

A72-44226 **The surface crack: Physical problems and computational solutions; Proceedings of the Winter Annual Meeting, New York, N.Y., November 26-30, 1972.** Meeting sponsored by the American Society of Mechanical Engineers. Edited by J. L. Swedlow (Carnegie-Mellon University, Pittsburgh, Pa.). New York, American Society of Mechanical Engineers, 1972. 205 p. Members, $16.; nonmembers, $20.

The characterization of part-through cracks in tension, surface flaws in aircraft structures, related fracture mechanics analysis problems, and experimental evaluation of yield induced by surface flaws are studied. The elastic analysis of the part-circular surface flaw problem by the alternating method, numerical evaluation of elastic stress intensity factors by the boundary-integral equation method, the line spring model for surface flaws, and three-dimensional finite element analysis for fracture mechanics are considered.

F.R.L.

A72-44228 **The surface flaw in aircraft structures and related fracture mechanics analysis problems.** C. D. Little and P. M. Bunting (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: The surface crack: Physical problems and computational solutions; Proceedings of the Winter Annual Meeting, New York, N.Y., November 26-30, 1972. New York, American Society of Mechanical Engineers, 1972, p. 11-42. 24 refs. Research sponsored by the General Dynamics Independent Research and Development Program; Contracts No. AF 33(657)-8260; No. AF 33(657)-13403.

A recent study of service failures in aircraft structures is reviewed. The surface flaw, while not the most prevalent type, is significant as a failure origin. Examples of structural failures occurring in service and test are described. From these examples and other sources, a list of uncertainties involved in fracture mechanics analyses of surface flaws in aircraft structures is compiled. The most significant analytical problems concerning surface flaws are defined, and involve predicting the effects of variable amplitude random loadings, complex boundary conditions, and complex stress fields on crack growth. (Author)

A72-44247 # **Experience with the NRC 10 ft. x 20 ft. V/STOL propulsion tunnel - Some practical aspects of V/STOL engine model testing.** R. A. Tyler and R. G. Williamson (National Research Council, Div. of Mechanical Engineering, Ottawa, Canada). *(Canadian Aeronautics and Space Institute, Annual General Meeting, Toronto, Canada, May 18, 1972.) Canadian Aeronautics and Space Journal,* vol. 18, Sept. 1972, p. 191-199. 21 refs.

A72-44276 **Aircraft jet-engine control; Conference, Velesin, Czechoslovakia, June 12-16, 1972, Proceedings (Regulace leteckych proudovych motoru; Konference, Velesin, Czechoslovakia, June 12-16, 1972, Proceedings).** *Zpravodaj VZLU,* nos. 3, 4 & 5, 1972. No. 3, 55 p.; no. 4, 53 p.; no. 5, 64 p. In Czech.

Topics discussed include the characteristics of a helicopter gas turbine engine, a time-optimal speed control for a two-shaft helicopter turbine, the design of engine control systems, the use of fluidic sensors to measure jet fuel temperature, the thermodynamic cycle of a turbofan jet engine, reliability analysis of a jet engine fuel system, the use of modeling methods in designing turbine engine control systems, optimal synthesis of a two-parameter jet engine controller, characteristics of jet engine simulators, simulation of turboprop engine dynamics, synthesis of control systems for a two-shaft gas turbine, the use of fluidic elements in jet engine control, hydraulic control of jet engine fuel feed, determination of the transfer functions of a gas turbine engine, and nonlinear digital modeling of gas turbine propulsion units.

A.B.K.

A72-44277 # **Contribution to the determination of the characteristics of a gas turbine engine for a helicopter and to the choice of the throttling law (Prispevek k urceni charakteristik turbinoveho motoru pro vrtulnik a k volbe zakona skrceni).** J. Ruzek (Vojenska Akademie, Brno, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 3, 1972, p. 11-16. 5 refs. In Czech.

Description of a correcting method for the approximate determination of the characteristics of a helicopter gas turbine engine. On the basis of a calculation of the characteristics of an engine with a 500-kW output it is concluded that the choice of an optimal throttling law gives a very small gain in fuel consumption, and for this reason it is recommended that such an engine be throttled at a constant rotor speed. A.B.K.

A72-44278 # **Optimal control of the speed of a two-shaft helicopter turbine (K optimalni regulaci otacek dvouhridelove turbiny vrtulniku).** L. Kroc (Vojenska Akademie, Brno, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 3, 1972, p. 17-21. In Czech.

Discussion of the structure of a time-optimal speed control for a free two-shaft helicopter turbine and of methods of compensating for the effect of the rotor blade angle on the turbine speed. A time-optimal controller structure obtained with the aid of Pontriagin's maximum principle is described, and it is recommended that the static compensation be replaced by a dynamic compensation or by a dynamic invariant coupling. A.B.K.

A72-44280 # **Fluidic heat sensors for measuring fuel temperature in jet engines (Fluidikova teplotni cidla k mereni teploty spalin v proudovych motorech).** M. Hibs (SVUSS, Bechovice, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 3, 1972, p. 33-42. 22 refs. In Czech.

Explanation of the principles used in analog and digital fludic heat sensors of convenient type. The main equations for the calculation of these sensors are derived, and certain characteristic properties of these sensors are compared with the properties of a thermocouple sensor. It is concluded that fluidic sensors are suitable for certain special applications, such as the measurement of rapidly varying temperature fields. A.B.K.

A72-44281 # **Structural and performance characteristics of a bypass turbojet engine (Konstrukcni a vykonove charakteristiky obecneho dvouproudoveho motoru).** T. Etlik, Z. Masek, Z. Pospisil, and M. Simer (Motorlet, Prague, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 3, 1972, p. 43-56. In Czech.

Analysis of the thermodynamic cycle of a turbofan jet engine in order to ascertain the effect of independent cycle parameters (the compressor pressure ratio, the bypass ratio, the fan pressure ratio, and the turbine inlet temperature) on the specific fuel consumption. The effect of these parameters on engine performance under various flight conditions and for various engine ratings is illustrated. From the standpoint of the engine control system two important conclusions are drawn - namely, the turbine inlet temperature is almost independent of flight conditions for a chosen engine rating if the high-pressure rotor rpm is constant, and a fan with variable-pitch rotor blades is most useful for engines with a high bypass ratio. An analysis is also made of the effect of the compressor pressure ratio and the bypass ratio on the main dimensions of the engine, the number of compressor and turbine stages, and the thrust-to-weight ratio of the engine. A.B.K.

A72-44282 # **Reliability analysis of a jet engine fuel system with the aid of an analog computer using operational data (Rozbor spolehlivosti palivove soustavy leteckeho motoru pomoci analogoveho pocitace s vyuzitim provoznich udaju).** M. Chrobot and Z. Przybylski (Wytwornia Sprzetu Komunikacyjnego, Wroclaw, Poland). *(Konference o Regulaci Leteckych Proudovych Motoru,*

Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU, no. 3, 1972, p. 57-61. 6 refs. In Czech.

Statistical analysis of aircraft engine fuel system movement between operational states. In deriving a mathematical model of the fuel system operation, it is assumed that the movement of the system between different states is a stochastic homogeneous Markov process. An analysis of the model leads to a system of linear differential equations with constant coefficients, the numerical values of which are determined from operational data. This system is solved with the aid of an analog computer. In conclusion, specific information is given concerning the operation of the fuel systems during their lifetimes. A.B.K.

A72-44283 # **Use of modeling and simulation methods in the design of gas turbine engine control systems (Vyuziti metod modelovani a simulovani pri navrhovani soustavy rizeni a regulace turbinovych motoru).** M. Chrobot and A. Hager (Wytwornia Sprzetu Komunikacyjnego, Wroclaw, Poland). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 4, 1972, p. 9-17. 9 refs. In Czech.

Consideration of the possibility of applying modeling and simulation methods involving the use of an analog computer to the solution of problems connected with the analysis and synthesis of gas turbine aircraft engine control systems. The results obtained by modeling on an analog computer are compared with those measured on a simulator and with results obtained from experimental tests on a brake. The costs connected with solving this problem by modeling and simulation are compared with the costs of a purely experimental method of solution. A.B.K.

A72-44284 # **Optimal synthesis of a two-parameter continuous controller for a jet engine with an afterburner (Optimalni synteza dvouparametroveho spojiteho regulatoru proudoveho motoru s pridavnym spalovanim).** J. Müller (Jihoceske Strojirny, Velesin, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 4, 1972, p. 19-28. In Czech.

Description of a method of synthesizing a linear controller with a given structure. The synthesis is optimal in accordance with an integral quadratic quality criterion which includes the effect of the derivative of the controlled variable. The control loop is described by a system of linear differential equations which is interpreted in a state space. The calculation of the integral criterion is reduced to the calculation of the integral of a real quadratic form of state coordinates. By transforming this quadratic form into another quadratic form, the desired integral (quality criterion) can be easily calculated from the initial conditions of the system. The application of this method, which can be realized on a digital computer, to the synthesis of a two-parameter control for a jet engine with an afterburner is demonstrated. A.B.K.

A72-44285 # **Planning and managing the development of control systems (Zadavani a rizeni vyvoje regulacnich soustav).** J. Silhanek (Jihoceske Strojirny, Velesin, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 4, 1972, p. 29-31. In Czech.

Discussion of several problems related to the planning and management of development and research work on jet engine control systems. Certain factors which can adversely affect the course of the development work are indicated, and the basic prerequisites for successful management of development work on control systems for aircraft jet engines are outlined. A.B.K.

A72-44286 # **Dynamic and static characteristics of jet engine simulators (Dynamicke a staticke charakteristiky simulatoru proudoveho motoru).** P. Neustupa (Jihoceske Strojirny, Velesin, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 4, 1972, p. 33-38. In Czech.

Review of the types of jet engine simulators which have been constructed. Three types of jet engine simulator are considered - one involving a combination of an electronic computer and an amplidyne, the second involving a combination of a transistorized computer and a hydraulic drive, and the third involving a combination of a transistorized computer and a thyristor drive. The basic technical parameters of these different types of simulators are indicated, with emphasis on the dynamics of these simulators. A.B.K.

A72-44287 # **Special tests of aircraft gas turbine engine controllers (Specialni zkousky regulatoru leteckych turbinovych motoru).** J. Barton (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 4, 1972, p. 39-44. In Czech.

Consideration of the problems involved in testing aircraft gas turbine engine control systems subjected to the action of extreme fuel temperatures and in testing the suction capacity of the fuel pumps. Descriptions are given of the procedures used in testing controllers with heated fuel and with fuel cooled with the aid of a freon condensation unit. Certain principles which must be kept in mind in setting up and operating the test arrangements are enumerated. A detailed study is made of the cavitation characteristics of different types of fuel pumps, showing that cavitation is not a steady phenomenon and that cavitation must be measured by methods suitable for the measurement of dynamic properties. A.B.K.

A72-44288 # **Simulation of the dynamics of a turboprop engine (Simulace dynamiky turbovrtuloveho motoru /TVM/).** B. Riha (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 4, 1972, p. 45-58. 8 refs. In Czech.

Consideration of the problems connected with simulating the dynamics of a turboprop engine with the aid of computers. The reproduction of a mathematical description by a model using computer technology is considered, noting the possibilities of using digital computers, but emphasizing the realization of a mathematical model with the aid of analog (and to some extent also hybrid) computers. The problem of simulating the converters of physical quantities is discussed in some detail, as well as the measurement and recording of the dynamics of a closed-loop turboprop engine control system during its simulation. A.B.K.

A72-44289 # **Synthesis of the control systems of a two-shaft helicopter gas turbine engine (Synteza regulacnich obvodu dvouhridelove spalovaci turbiny pro pohon vrtulniku).** J. Salaba (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 5, 1972, p. 9-19. 5 refs. In Czech.

Determination of the basic control systems for various versions of the speed control of a two-shaft gas turbine engine for helicopter propulsion. After determining the possible dynamic equations for the various control elements, solutions are obtained for various alternative control systems with a controller. The properties of static and astatic servomotors with both constant and variable working pressures are examined. From control solutions on an analog computer a need for further alternative control systems is established. A control system variant with a three-term controller is investigated, as well as the possibility of a control system with failure measurement. From a solution on the analog computer a control system with failure measurement is seen to be promising. A.B.K.

A72-44290 # **Use of fluidic elements for jet engine controllers (Vyuziti fluidikovych prvku pro regulatory proudovych motoru).** M. Balda (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 5, 1972, p. 21-31. 5 refs. In Czech.

Consideration of the possibility of employing fluidic elements in the design of sensors, amplifiers, and auxiliary systems of jet engine controllers. The use of the properties of the boundary layer between rotating cylinders for the design of an analog rpm sensor is described, as well as the use of vortex properties in pressure stabilization. The characteristics of CW amplifiers are considered, and certain experiences gained in the construction of digital systems for speed control are summarized. A.B.K.

A72-44291 # **A digital model of jet engine hydraulic fuel controller (Cislicovy model hydraulickeho regulatoru paliva proudoveho motoru).** S. Novacek and Z. Ohanka (Jihoceske Strojirny, Velesin, Czechoslovakia). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 5, 1972, p. 33-40. In Czech.

Consideration of the problem of the design and realization of a discrete model of a jet engine hydraulic fuel control system. A mathematical model is described which consists of three algebraic and two differential loops as well as several nonlinear and discontinuous functions. The problem of the adjustments required in the mathematical model to reduce it to a form suitable for solution by numerical methods is solved. In conclusion, the characteristics measured on a real controller are compared with those calculated on a digital computer, showing good agreement. A.B.K.

A72-44292 # **Determination of the operational transfer functions of a gas turbine engine on a digital computer (Urceni operatorovych prenosovych funkci turbinoveho motoru na cislicovem pocitaci).** W. Stepniewski and R. Kossowski (Warszawa, Politechnika, Warsaw, Poland). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 5, 1972, p. 41-45. In Czech.

Description of an algorithm for calculating the coefficients of the operational transfer functions of linearized multi-input/multi-output control plants for use in gas turbine engines. The proposed algorithm consists of a system of algebraic equations with coefficients in the form of polynomials. An initial system of equations describing a single-shaft turbojet engine with an afterburner is presented, as well as a system of linearized equations obtained on the basis of the initial system. A.B.K.

A72-44293 # **Problems of analog modeling of gas turbine engines as control plants (Problemy analogoveho modelovani turbinovych motoru jako objektu regulace).** S. Bramski, W. Pawlak, and R. Reichert (Instytut Lotnictwa, Warsaw, Poland). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 5, 1972, p. 47-55. 10 refs. In Czech.

Review of the use of mathematical computers in modeling the characteristics of gas turbine engines as control plants. The experimental determination of engine characteristics by means of statistical estimates is discussed, and the approximation of the characteristics on the basis of an analog model is demonstrated. An analog model of a gas turbine engine is constructed on the basis of flow-rate, heat-conduction, and dynamic equations. A.B.K.

A72-44294 # **Nonlinear digital modeling of gas turbine propulsion units (Nelinearni cislicove modelovani turbinovych pohonnych jednotek).** W. Stepniewski (Warszawa, Politechnika, Warsaw, Poland) and S. Draminski (Przemyslowy Instytut Automatyki i Pomiarow, Warsaw, Poland). *(Konference o Regulaci Leteckych Proudovych Motoru, Velesin, Czechoslovakia, June 12-16, 1972.) Zpravodaj VZLU,* no. 5, 1972, p. 57-66. 5 refs. In Czech.

Description of a method of nonlinear digital modeling used in analyzing transient processes in the GTD-350 helicopter gas turbine engine. The mathematical model of the control plant consists of a system of nonlinear differential and algebraic equations. On the basis of an analysis of the type of nonlinearity a program for the solution of these equations is developed. This program is written in the GIER ALGOL programming language. A scheme for organizing the program is presented, as well as the results of calculations. A.B.K.

A72-44296 The environmental effects of turbine aircraft engines (Die Umweltwirkungen von Turboflugtriebwerken). N. Scholz (Motoren- und Turbinen-Union München GmbH, Munich, West Germany). *(Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971.) Zeitschrift für Flugwissenschaften,* vol. 20, Sept. 1972, p. 317-330. 38 refs. In German.

These effects are mainly connected with the thermal radiation, the acoustic emissions, and the exhaust gas production of the engine. The effects of thermal radiation have no harmful characteristics. However, the acoustic emissions produce highly disturbing and sometimes even harmful noise effects. Certain components of the exhaust gases also have disturbing or deleterious effects. The physical mechanisms involved in the origin of the phenomena which produce the environmental effects are examined. Quantitative predictions of general validity concerning the individual effects are discussed, and the relation of these effects with the design parameters of the propulsion system is investigated. A number of suggestions for reducing the harmful environmental effects are made on the basis of the preceding analysis. G.R.

A72-44298 Computation of the potential-theoretical flow around wing-fuselage combinations and a comparison with measurements (Berechnung der potentialtheoretischen Strömung um Flügel-Rumpf-Kombinationen und Vergleich mit Messungen). H. Körner (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aerodynamik, Braunschweig, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 20, Sept. 1972, p. 351-368. 42 refs. In German.

An approach for the determination of pressure distribution and aerodynamic parameters in the case of a number of wing-fuselage combinations is discussed. The approach makes use of the representation of the wing by a vortex model which consists of individual discrete horseshoe vortices. The analytical procedure involved is discussed, giving attention to the general concept, the distribution of sources and sinks on the fuselage, and the approaches for the computations concerning the wing. A survey is presented regarding the experimental investigation of a number of configurations in a wind tunnel. The theoretical results are compared with the experimental data. Lift and moment distributions are examined for a wing and for wing-fuselage combinations. G.R.

A72-44308 Viscous interaction over concave and convex surfaces at hypersonic speeds. S. Mohammadian (Imperial College of Science and Technology, London, England). *Journal of Fluid Mechanics,* vol. 55, Sept. 12, 1972, p. 163-175. 18 refs.

Description of the growth of hypersonic boundary layers over both concave and convex surfaces, and asymptotic solution of the strong-viscous-interaction equation of Cheng et al. (1961) for small and large arguments in the case of two-dimensional curved surfaces with sharp leading edges. The aim is to improve the ability to predict the interaction between boundary layer growth and hypersonic external flow by comparing theory and experiments. The experiments were conducted in air using a hypersonic gun tunnel under cold wall conditions at Mach 12. They included schlieren studies for concave and convex models and measurements of surface pressure and heat transfer distributions. The viscous interaction theories described deviate in some cases from the usual assumptions of supercritical behavior of boundary layers over concave surfaces. M.V.E.

A72-44336 # **Analysis of the fundamental parameters and flight properties of aerobatic aircraft in a statistical framework (Analiza podstawowych parametrow i wlasnosci lotnych samolotow akrobacyjnych w ujeciu statystycznym).** E. Cichosz and J. Blaszczyk. *Technika Lotnicza i Astronautyczna,* vol. 27, Aug.-Sept., 1972, p. 13-20. In Polish.

Performance requirements posed for modern aerobatic aircraft are defined in terms of control-surface characteristics, lift forces in

upright and reversed flight, autorotation features, power margins, structural simplicity and integrity, weight limitations, and pilot comfort. Tables list surface dimensions and maneuverability parameters for monoplane and biplane aerobatic aircraft produced by various manufacturers throughout the world. T.M.

A72-44337 # Statistical analysis of the sound level distribution of aircraft noise as a function of time (Analiza statystyczna rozkladu poziomu dzwieku halasow lotniczych w funkcji czasu). T. Rajpert. *Technika Lotnicza i Astronautyczna,* vol. 27, Aug.-Sept., 1972, p. 21-24, 49. In Polish.

Description of a new method for evaluating the environmental annoyance of time-varying aviation noise on the basis of statistical data for instantaneous changes in the sound level of noise signals. The procedure is illustrated with statistical data collected by measurements near the approaches and on the runways of the Warsaw-Okecie airport. T.M.

A72-44338 # Optimal flight parameters of transport aircraft (Optymalne parametry lotu samolotow komunikacyinych). M. Kawczynski and R. Szopski. *Technika Lotnicza i Astronautyczna,* vol. 27, Aug.-Sept., 1972, p. 25-27. In Polish.

Description of flight conditions ensuring minimum operational costs of passenger and cargo transport aircraft. Graphs and tables illustrate operational costs per kilometer for Iliushin-18 and Tupolev-134 aircraft as a function of flight speed, altitude, and payload. The effects of flight distance and wind conditions on optimum flight speed and altitude are taken into consideration. T.M.

A72-44339 # Precipitation, deposits, and aircraft equipment (Opady i osady a sprzet lotniczy). J. Osos. *Technika Lotnicza i Astronautyczna,* vol. 27, Aug.-Sept., 1972, p. 28-30. In Polish.

The characteristics and distinguishing features of various forms of liquid and solid precipitation are described along with conditions accompanying the formation of ice deposits on aircraft surfaces. Glassy, porous, and crystalline ice formations are discussed in terms of potential hazards to engine components and control elements; preventive measures are outlined. T.M.

A72-44391 V for two. A. Hofton. *Flight International,* vol. 102, Sept. 28, 1972, p. 422, 422a, 423, 426, 427.

The fully operational two-seat Harrier (T.2), with identical weapon-carrying capacity and very similar performance to the GR.1, is described. The need to teach aircrew to make full use of the weapon systems's unique capabilities, such as operation from sites close to the forward battle area, and to use thrust vectoring during combat maneuvers, suggested the two-seat requirement. Major differences between the GR.1 and the T.2 are limited to the nose, forward fuselage, and fin and rudder. Various V/STOL operational characteristics are discussed. F.R.L.

A72-44451 An advanced variometer system. II. W. Toutenhoofd (National Center for Atmospheric Research, Boulder, Colo.) and R. H. Ball (Ball Engineering Co., Boulder, Colo.). *(Aero-Revue,* Aug. 1972, p. 440, 441.) *Aero-Revue,* Sept. 1972, p. 487, 488. 7 refs.

The Ball variometer for sailplanes is discussed. It gives a direct readout of the vertical speed of the air regardless of the attitude, speed, or acceleration of the sailplane. When the sailplane gains or loses altitude, air flows out from or into a reservoir through the basic capillary to or from the static pressure ports of the sailplane. The pressure difference that is established across the capillary is a measure of the vertical speed of the sailplane. The properties of reservoir capillary systems are discussed. F.R.L.

A72-44452 Influence of wing deformations measured during flight tests upon the flight performance of a glider made of synthetic materials. I (Einfluss der im Flugversuch vermessenen Tragflächendeformationen auf die Flugleistungen eines Kunststoffsegelflugzeuges. I). G. Stich (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aerodynamik, Braunschweig, West Germany). *Aero-Revue,* Sept. 1972, p. 490, 491. In German.

A72-44494 # Effects of transport velocity of wake vortex on aerofoil oscillations. Y. Tanida (Tokyo, University, Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report* no. 479, vol. 37, May 1972, p. 127-136. 10 refs.

The effects of the transport velocity of a wake vortex on an oscillating aerofoil is discussed theoretically. The calculated results show that, when an aerofoil performs translatory oscillations, the slow transportation of a wake vortex relative to the aerofoil deteriorates the aerodynamic damping effect, especially for the faster oscillation. Agreement with an experiment is obtained. (Author)

A72-44496 # Experiment of supersonic air intake buzz. T. Nagashima, T. Obokata, and T. Asanuma (Tokyo, University, Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report* no. 481, vol. 37, May 1972, p. 165-209. 15 refs.

A blowdown-type supersonic wind tunnel was used to examine supersonic intake instability. Inlet buzz experiments were made, using the throttle ratio and the center body position relative to the cowl lip as parameters. The effect of attack angle is also examined. Unsteady phenomena occur in the subcritical regime, and some characteristic frequencies are observed where the transition from lower to higher frequency occurs according to the decrease of throttle ratio, while the amplitude fluctuates in a rather arbitrary manner. The motion of the bow shock wave corresponds fairly well with the pressure records, showing complex boundary layer behavior on the center body surface when it is expelled from the cowl tip. A theory is proposed where calculations are made to explain some buzz characteristics emphasizing two boundary conditions, the front shock wave and the rear choked exit. F.R.L.

A72-44497 # A fundamental study on safe landing. A. Obata. *Tokyo, University, Institute of Space and Aeronautical Science, Report* no. 482, vol. 37, June 1972, p. 211-262. 33 refs.

It is ascertained that reachable or controllable points of a dynamic system in which a system equation is linear with respect to control variables can be obtained even for cases with first-order state-inequality-constraints by using an effective optimizing method based on linear programming. With this method, controllable height regions of aircraft for spot landing are investigated. The effects of flight parameters such as approach path angle and velocity and the effects of the constraint quantities of elevator angle, angle of attack, and pitch attitude on the controllable region are made clear for a middle size turbo-prop transport aircraft. (Author)

A72-44513 * Outer magnetosphere near midnight at quiet and disturbed times. M. P. Aubry, M. G. Kivelson, R. L. McPherron, and C. T. Russell (California, University, Los Angeles, Calif.). *Journal of Geophysical Research,* vol. 77, Oct. 1, 1972, p. 5487-5502. 23 refs. Research supported by the European Space Research Organization; Contracts No. NAS5-9097; No. NAS5-9098; Grant No. NGR-05-007-305.

Ogo 5 magnetic-field and energetic-electron (E greater than 50 keV) data are used to study both the quiet-time, steady-state configuration of the outer magnetosphere or near tail region near midnight and the disturbed time changes of this configuration. The nighttime cusp is found to be a distinct feature within the plasma sheet at quiet times but indistinguishable from the plasma sheet at disturbed times. The sequence of thinning and expansion of the plasma sheet in this region in association with the substorms is studied. The response of the plasma sheet in the near tail at about 10

earth radii is found to be similar to that in the more distant tail at more than 20 earth radii. Finally, the nature of field-aligned currents flowing on the plasma-sheet boundary is investigated. Assuming infinite current sheets, the sheet current density at Ogo 5 is found to be approximately .01 A/m. (Author)

A72-44556 Making a product from composites. II. I. J. Toth, W. D. Brentnall, and G. D. Menke (TRW, Inc., Cleveland, Ohio). *Journal of Metals*, vol. 24, Oct. 1972, p. 37-42. 23 refs.

The strongly anisotropic properties of composite materials complicate their secondary fabrication, relative to processes used for more conventional materials. Composite tape is rapidly becoming the customary starting material for forming into the final product shape. Diffusion bonding is currently the best joining technique. For most applications, however, furnace brazing or adhesive bonding remain the most practical composite joining technique. Electrodischarge machining and ultrasonic machining are suitable machining procedures. There are certain problems connected with the employment of thermo-mechanical processing methods. Physical properties of composites are briefly discussed, taking into account density, thermal expansion, specific heat, and thermal conductivity. G.R.

A72-44577 Design of a military air cargo transportation system by use of a large scale mathematical programming model. W. S. Demmy and K. E. Brant (USAF, Wright-Patterson AFB, Ohio). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 158-166.

The large scale of the USAF LOGAIR transportation system (up to 60 bases, 100 flight segments, and 2000 origin-destination pairs) prevents usage of many of the standard operations research techniques in determining the routes, schedules, and the aircraft, personnel, and load assignments. The problem may be solved by determining several best air routes by enumerative and iterative methods. Then the optimal linear combination of these best air routes along with ground transportation routes is obtained by means of a large linear program, involving as many as 6000 variables and 1500 constraints. The special structure of the LP problem is exploited to decrease the huge computational burden by use of the generalized upper bounding algorithm of Danzig and Van Slyke. (Author)

A72-44578 Forecasting models for cargo transportation requirements. F. E. James, Jr., L. L. Ostrom, O. M. Barrett, and J. R. Phillip (USAF, Air University, Wright-Patterson AFB, Ohio). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 179-188. 9 refs.

This study describes the current method used to forecast United States Air Force CONUS outbound cargo airlift requirements and identifies and evaluates, on a comparative basis, six alternative statistical forecasting techniques which may aid in increasing forecast accuracy. (Author)

A72-44579 Lockheed airline system simulation and aircraft scheduling models. J. F. Kahn (Lockheed-California Co., Burbank, Calif.). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 189-196.

Two computer models are described; the Lockheed Airline System Simulation and the Lockheed Aircraft Scheduling Model. The Airline System Simulation is an econometric model that uses simulation and dynamic programing to allocate aircraft over an airline's routes so that systems earnings are optimized. The Scheduling Model assigns aircraft to routes such that a minimum aircraft fleet results. The two programs can be used jointly which allows airline economic and scheduling problems to be analyzed together. (Author)

A72-44580 *A systems analysis of subsonic versus supersonic jet travel.* W. B. McCarter. In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 270-283. 12 refs.

This study examines the technical and cost factors of large subsonic and supersonic transports, as viewed by an international airline operator, whose objective is to maximise earnings, and whose criterion in assessing alternative solutions is the after-tax percentage return on initial investment. (Author)

A72-44581 The heavy lift helicopter - An operations research/technology/performance blend. B. Tencer and T. P. Peppler (Boeing Co., Vertol Div., Philadelphia, Pa.). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 296-307. 9 refs.

The techniques of Operations Research and Systems Analysis played a key role in resolving the central issues concerning the use of VTOL as an element in the Armed Forces global logistic system. Major elements of this analytic effort are described. Aspects of payload/performance analysis under uncertainty are discussed, giving attention to elements of uncertainty, container weight and size frequency, and the cost of mission completion assurance. The containership offload/aircraft interface is also considered, taking into account the random seaway, ship dynamics, and relative aircraft - containership motion analysis. A linear programming model was constructed to evaluate logistic fleet mixes under varying environmental contingencies. G.R.

A72-44582 An algorithm for optimal aircraft scheduling. N. I. Agin (Mathematica, Inc., Princeton, N.J.). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 317-326.

This paper describes an approach to finding local optimal solutions to the problem of aircraft scheduling, defined as follows. Find a daily routing of each aircraft (by tail number) for a given airline or group of airlines which maximizes the difference between revenue and operating costs and satisfies capacity, service and other restrictions. The aircraft scheduling problem is formulated as a large, mixed-integer multi-commodity flow problem. The solution method utilizes Dantzig-Wolfe decomposition. (Author)

A72-44583 Applications of operational research in the airline industry. C. Deetman (KLM - Royal Dutch Airline, Schiphol Airport, Netherlands). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 336-345.

Review of some of the problem areas specific to the airline industry that are suitable for application of operations research (OR) techniques. Successes and failures in the OR experience of a major airline over a period of 15 years are discussed. In particular, the effectiveness requirements of OR as a means of communication between scientists and management are examined and illustrated by concrete examples. M.V.E.

A72-44584 Airline crew scheduling - A large problem. B. O'Donald (Eastern Air Lines, Inc., Miami, Fla.) and I. Whiteman. In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, Aug. 14-18, 1972. North Hollywood, Calif., Western

Periodicals Co., 1972, p. 357-367.

Discussion of the peculiarities of the airline crew scheduling problem, and review of some heuristic procedures for its solution. Because of the size of its combinatorial space, the problem, recognized to be unwieldy, is broken up into a number of small problems and, through formulation of the appropriate heuristics, is made amenable to a practically manageable solution. M.V.E.

A72-44585 Systems approach to airport passenger terminal planning. A. Elek (Kates, Peat, Marwick and Co., Toronto, Canada). In: The application of operational research to transport problems; Proceedings of the Conference, Sandefjord, Norway, August 14-18, 1972. North Hollywood, Calif., Western Periodicals Co., 1972, p. 411-423.

The objective of airport passenger terminal planning is defined as the provision of transfer facilities between aircraft and ground transportation which are as convenient to the passengers as economically possible and ensure continuing convenience throughout the life of the terminal. In keeping with this objective three evaluation criteria are defined: passenger convenience, economy, and flexibility. A systematic planning approach is presented in which terminal concepts are analyzed in the light of these criteria. Two primary tasks are identified for the planning process: to overcome the spatial incompatibility of the airside, the terminal building, and the groundside and to ensure maximum sharing of terminal facilities by successive users. The first task is aimed at the maximization of passenger convenience through a reduction of walking distances. The second task is aimed at the maximization of economy and is usually in conflict with the first. (Author)

A72-44609 # Effects of projectile damage on critical helicopter components. P. A. Cox and P. H. Francis (Southwest Research Institute, San Antonio, Tex.). *U.S. Army Materiel Command, Army Symposium on Solid Mechanics: The Role of Mechanics in Design - Ballistic Problems, Ocean City, Md., Oct. 3-5, 1972, Paper.* 42 p. 10 refs.

A combined theoretical and experimental investigation of the deleterious effects of projectile damage to main rotor blades and rotor drive shafts is reported. Analytical methods for predicting the vulnerability of rotor blades and shafts to projectile impacts were obtained in the investigation. It is pointed out that the methods developed should be useful for improving component design, for setting flight envelopes with respect to a particular threat, and for determining failure probabilities in a hostile environment. The characterization of projectile damage is discussed together with stresses in the rotor blade, the mechanics of crack growth, a computer program for predicting residual blade life, and damage to shafting. G.R.

A72-44610 # Aircraft loading from an internal explosion. J. F. Proctor (U.S. Navy, Naval Ordnance Laboratory, Silver Spring, Md.). *U.S. Army Materiel Command, Army Symposium on Solid Mechanics: The Role of Mechanics in Design - Ballistic Problems, Ocean City, Md., Oct. 3-5, 1972, Paper.* 20 p. 9 refs. USAF-sponsored research.

A computer program has been developed at NOL that is capable of describing the shock and blast loading characteristics of the detonation of a high explosive projectile internal to an aircraft structure. With modifications, the code is readily adaptable to internal explosions in other structures such as naval ships, land vehicles, and buildings. Discussions are given on the technical aspects of the calculational methods used to determine the shock pressure-time loading functions and the confined-explosion gas pressure. Comparisons of code results with available data are presented to demonstrate confidence in the use of the code. A sample problem is given to show the various features of the computer program and the readily usable form of the code results. (Author)

A72-44614 # Airports today - Significance and problems of the airports in today's air traffic (Flughäfen Heute - Bedeutung und Probleme der Flughäfen im heutigen Luftverkehr). U. Wolffram (Arbeitsgemeinschaft Deutscher Verkehrsflughäfen, Stuttgart, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Flugbetrieb, Cologne, West Germany, Sept. 15, 1972, Paper 72-034.* 14 p. In German.

At present there are twelve international airports in West Germany and West Berlin. The construction of additional airports is planned. The function of airports within the general economy is analyzed. In connection with questions of airport location, attention has to be given to the geographical aspects of traffic, the space available, and problems of aircraft noise. It is pointed out that the locations of the present airports in West Germany coincide with the centers of gravity of the national economy. However, there are a number of serious problems in West Germany in connection with the limited capacity of the airports. Approaches to overcome these problems are discussed. The improvement of flight operations is also considered together with the effect of new technological developments on airport planning. G.R.

A72-44615 # Flight operations from the point of view of general aviation (Flugbetrieb aus der Sicht der allgemeinen Luftfahrt). W. Trinkaus. *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Flugbetrieb, Cologne, West Germany, Sept. 15, 1972, Paper 72-036.* 7 p. In German.

Aspects related to the safety of flight operations in West Germany are considered, taking into account airspace structure, air traffic rules, and flight procedures. Certain problems in the conduction of flight operations are related to the use of the airspace by mainly three different groups, including the aircraft of the commercial air traffic, the aircraft of the eight NATO countries, and the aircraft of general aviation. The development of a flight control system which takes into account the individual operational characteristics of each of the groups is considered. It is pointed out that some of the proposed regulations would be very restrictive for the operation of motorless gliders. G.R.

A72-44616 # The traffic terminals today (Die Verkehrslandeplätze Heute). K. Siebenwurst (Arbeitsgemeinschaft Deutscher Verkehrsflughäfen, Stuttgart, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Flugbetrieb, Cologne, West Germany, Sept. 15, 1972, Paper 72-033.* 18 p. In German.

Differences between airports and traffic terminals according to the definitions of German law are discussed. The traffic terminal is mainly used for the aircraft of general aviation. The infrastructural significance of certain user groups is discussed together with the objectives for a further development of traffic terminals, and the costs involved in the construction of new traffic terminals. Other topics considered include economical and operational questions regarding traffic terminals, aspects of air traffic control and safety, and problems of aircraft noise. G.R.

A72-44617 # Flight safety problems from the point of view of the air traffic controller (Flugsicherungsprobleme aus der Sicht der Fluglotsen). W. Kassebohm (Verband Deutscher Flugleiter, Frankfurt am Main, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Flugbetrieb, Cologne, West Germany, Sept. 15, 1972, Paper 72-038.* 7 p. In German.

The particular characteristics of the airspace of West Germany with its very small extension in the east-west direction in comparison to the north-south extension have to be taken into account in an evaluation of the flight safety problems in this country. Additional factors to be considered are the presence of a special zone for air defense purposes. Collision risks due to the dense air traffic are examined. It is pointed out that any significant improvement in safety would require a basic reform with regard to the airspace

structure and the rules of the air law. The creation of a central agency for the necessary planning involved in such a reform is proposed. G.R.

A72-44618 # **Flight operations from the point of view of an air line (Flugbetrieb aus der Sicht einer Luftverkehrsgesellschaft).** R. Bebber (Deutsche Lufthansa AG, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Flugbetrieb, Cologne, West Germany, Sept. 15, 1972, Paper 72-037.* 21 p. In German.

Aspects of the increase in air traffic are briefly discussed, giving attention also to problems presented by the introduction of the B 747. The controls to which flight operations are subjected are considered, taking into account differences between movement control and operations control. The German airline 'Lufthansa' has established an operations control center. The main principles which guide Lufthansa in its activities include safety, passenger comfort, schedule adherence, and economy. The implementation of these principles is discussed. Optimization in the utilization of the available aircraft is an important factor in increasing the economy of the flight operations. G.R.

A72-44625 **Supersonic motor fuels from gasoline vapor pyrolysis (Überschallkraftstoffe aus der Dampfpyrolyse von Benzin).** R. Erlmeier (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugtreib- und Schmierstoffe, Munich, West Germany) and E. Meisenburg (Union Rheinische Braunkohlen Kraftstoff AG, Wesseling, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie,* vol. 25, Apr. 1972, p. 183-187. 6 refs. In German.

Evaluation of supersonic jet engine fuels, structurally constituting mixtures of substituted decalins, produced by hydrogenation of the middle fraction of gasoline vapor pyrolysis. Fuels of this type are found to have a stability about 100 F higher than conventional jet fuels. Their physicochemical characteristics meet the highest supersonic fuel standards. Because of their molecular structure, however, their combustion behavior falls somewhat short of jet fuel requirements, but does not preclude their use. It is shown how they can be used to advantage. M.V.E.

A72-44643 # **Possible impact of area navigation upon MLS requirements for azimuth angular coverage and range.** J. E. Dratch (Service Technology Corp., Cambridge, Mass.). *Institute of Navigation, Annual Meeting, 28th, U.S. Military Academy, West Point, N.Y., June 27-29, 1972, Paper.* 31 p. Research sponsored by the U.S. Department of Transportation.

Examination of the possible impact of area navigation upon the microwave landing system (MLS) requirements for azimuth angular coverage and range. The model used for analysis purposes is a 180-deg turn from a final waypoint outside the assumed MLS coverage that terminates at an aim waypoint on the MLS azimuth centerline. The final waypoint is approached in an area navigation mode. The aim waypoint is approached from the final waypoint under an open-loop operational instruction under pilot control. The accuracy with which this aim waypoint can be reached is discussed, as well as the resulting distances along the azimuth centerline required to perform the remaining approach and landing operations. The resulting 'minimum' MLS azimuth angular coverage and range requirements are stated for the typical magnitudes of the disturbing sources assumed. (Author)

A72-44645 # **Midair collision prevention for Army aircraft.** R. T. Glover and A. J. Musillo (U.S. Army, Avionics Laboratory, Fort Monmouth, N.J.). *Institute of Navigation, Annual Meeting, 28th, U.S. Military Academy, West Point, N.Y., June 27-29, 1972, Paper.* 23 p.

This paper discusses the midair collision problem and the present collision warning technique being developed by the U.S. Army. The Avionics Laboratory, USAECOM, has a continuing program to develop a collision warning system. This program is directed toward providing US Army aircraft operating in tactical airspace with a means of collision prevention. The technical approach is based on the proximity warning devices developed for and operational at the US Army Aviation School and Center at Fort Rucker, Alabama. A modification of three proximity warning devices to obtain a collision warning capability for feasibility flight test was awarded to Honeywell, Inc. As a result, three ECOM collision warning devices were developed by Honeywell under an ECOM contract. An extensive feasibility flight test was conducted by ECOM with the three systems installed in an OH-58, UH-1, and OV-1. The test also demonstrates that the system can be utilized in both high speed Army fixed wing aircraft and small helicopters. (Author)

A72-44647 # **SECANT - A solution to the problem of mid-air collisions.** W. B. Miles (RCA, Electromagnetic and Aviation Systems Div., Van Nuys, Calif.). *Institute of Navigation, Annual Meeting, 28th, U.S. Military Academy, West Point, N.Y., June 27-29, 1972, Paper.* 11 p.

Description of the principal characteristics of SECANT, a system for the separation and control of aircraft using nonsynchronous techniques. This cooperative, transponding collision-avoidance system, designed to be compatible within the entire aviation community, is capable of accommodating the dense air traffic anticipated for the 1980s and beyond. It makes available to the pilot evasion or escape maneuvers in any direction - vertical, horizontal, or a combination. SECANT helps the pilot to avoid mid-air collisions by transmitting probes and receiving replies with a 1-microsec pulse up to 1000 pulses/sec on 24 different frequencies. Various discriminants are used to eliminate undesired signals, and the false alarm rate is near zero. The capabilities of each of the following modular equipments are discussed: remitter, proximity warning indicator, vertical escape collision avoidance system, vicinity traffic finder, collision-avoidance system, and traffic-monitoring system. The correlator, which transmits a randomly selected frequency probe and, when a corresponding frequency probe is received, retransmits an appropriate reply, is described. (Author)

A72-44649 # **Solutions to transportation problems using time/frequency technology.** J. F. Roeber and C. E. Potts. *Institute of Navigation, Annual Meeting, 28th, U.S. Military Academy, West Point, N.Y., June 27-29, 1972, Paper.* 38 p. 41 refs.

The application of time/frequency technology to the solution of current and future land, sea, and air transportation problems is discussed. The effectiveness of time/frequency technology is illustrated by examples which include vehicle surveillance and location, traffic management, collision avoidance, commmand and control, communications, navigation, and search and rescue operations. The close interrelationship between time determination and navigation is demonstrated. V.P.

A72-44651 **Conference on Reliability Testing and Reliability Evaluation, The Hague, Netherlands, September 4-8, 1972, Proceedings.** Conference sponsored by NATO. Edited by E. M. Scheuer. Northridge, California State University, 1972. 437 p. $12. In English and French.

Methods for determining confidence bounds on system reliability from subsystem data, a field reporting system for reliability analysis on telecommunication equipment, and reliability evaluation in systems with nonexponential downtimes are among the topics covered in papers concerned with reliability testing and evaluation. Other topics covered include ranking the reliability of two designs by Monte Carlo techniques, a new approach to reliability data exchange, and allocating optimum time for systems malfunction search. M.V.E.

A72-44656 **Optimal fleet reliability under fatigue and chance overload in service.** S. C. Saunders (Washington State University, Pullman, Wash.). In: Conference on Reliability Testing and Reliability Evaluation, The Hague, Netherlands, September 4-8, 1972, Proceedings. Northridge, California State University, 1972, p. II-D-1 to II-D-18. 5 refs.

A model is presented which considers the interaction between cumulative fatigue damage (due to wear) and chance overload (due to gust encounters) on an aircraft while in service. The reliability of the structure includes the probability of surviving a chance overload with an undetected crack as a function of the inspection. The fundamental probabilities of detection and survival are derived from the model; the appropriate renewal equation is solved to determine the reliability of the structure under inspection and repair. From this, the distribution of the time until first failure in a fleet is found using Monte Carlo methods to evaluate conditional expectations. (Author)

A72-44663 **Simulation procedure for mission and maintenance planning of an air force wing.** K. B. Brink, T. Conrady, and R. Keppeler (Dornier AG, Friedrichshafen, West Germany). In: Conference on Reliability Testing and Reliability Evaluation, The Hague, Netherlands, September 4-8, 1972, Proceedings. Northridge, California State University, 1972, p. IV-D-1 to IV-D-16.

Outline of a procedure for digital simulation of aircraft mission and maintenance services. The proposed procedure makes it possible to investigate the behavior of a real system subject to changes in its major parameters without interfering with the real-life operations of the system. Each aircraft is traced on its way through its missions. Mission simulation includes checking the aircraft for system or component defects on the basis of specific reliability data. The results of the simulation provide information about availability, utilization, and mission reliability; spare parts requirements; the determination of bottlenecks in the maintenance sequence; and the effectiveness of various maintenance techniques and organizational structures. A.B.K.

A72-44677 # **Community noise levels of the L-1011 Tristar Jet Transport.** N. Shapiro (Lockheed-California Co., Burbank, Calif.). *Acoustical Society of America, Spring Meeting, 83rd, Buffalo, N.Y., Apr. 18-21, 1972, Paper.* 11 p.

Comments on the recent noise certification of the L-1011 Tristar Jet Transport under the noise standards of the Federal Aviation Regulation (FAR) Part 36. Flyover noise levels below FAR Part 36 limits and as low as the state of the art would allow were established as basic objectives early in the design of this wide-bodied Lockheed jet transport. The recent flyover noise demonstrations have confirmed that these goals have been achieved, making possible a significant improvement in the community noise environment around airports. M.V.E.

A72-44678 # **Basic directivity and spectra of jet noise with improved correction for refraction.** G. R. MacGregor, H. S. Ribner, and H. Lam (Toronto, University, Toronto, Canada). *Acoustical Society of America, Spring Meeting, 83rd, Buffalo, N.Y., Apr. 18-21, 1972, Paper.* 48 p. 17 refs. National Research Council of Canada Grant No. A-203; Grant No. AF-AFOSR-7-1885.

Consideration of a method of experimentally correcting jet-noise polar plots for refraction to obtain basic directivities in narrow frequency bands. A previously outlined method of obtaining the experimental correction for refraction at each frequency from the difference in the directional patterns of a point source placed in the air jet with jet off and jet on is revised, incorporating a correction to the refraction effect measured with the loudspeaker-driven point source. The correction is specified by an assumed functional form as a polar plot, and the amplitude is dictated by the requirement of conservation of energy. A.B.K.

A72-44680 # **Investigation of propeller vortex noise including the effects of boundary layer control.** G. J. Healy (Lockheed-California Co., Environmental Sciences Laboratory, Burbank, Calif.). *Acoustical Society of America, Spring Meeting, 83rd, Buffalo, N.Y., Apr. 18-21, 1972, Paper.* 37 p. 6 refs.

An experimental investigation has been conducted on the vortex noise produced by a two-bladed, four-foot diameter model propeller capable of boundary layer removal. The propeller had a spinner comprising 70% of the total propeller radius. A porous section on both surfaces of the symmetric section airfoil allowed removal of the boundary layer. Free-field measurements were made in an anechoic chamber at three field points for three tip speeds (209.5, 314.2 and 366.5 ft/sec) and four blade angles (0, 2.5, 5, and 10 deg,) both without and with boundary layer control. Agreement with theory was good (within 2 dB) showing a sixth power of tip velocity relationship and a classical dipole radiation pattern for the overall sound pressure level of the vortex noise. Boundary layer removal primarily affected sound levels above 3150 Hz with no ordered effect on the overall level. (Author)

A72-44684 # **Results of an area wide noise monitoring system.** N. Ewers (Orange County Airport, Noise Abatement Center, Santa Ana, Calif.), G. Bricken (Northrop Corp., Anaheim, Calif.), and J. Hilliard (H & R Technology, Orange, Calif.). *Acoustical Society of America, Spring Meeting, 83rd, Buffalo, N.Y., Apr. 18-21, 1972, Paper.* 14 p. 6 refs.

Description and results of application of a multipoint real-time 24-hour computerized noise monitoring system which has permitted extensive diagnostic evaluation of a typical airport. A monitoring system, known as ECOLOG, is described which consists of five sensors arrayed in both the landing and departure zones of the Orange County Airport at Santa Ana, Calif. The central processor consists of an input/output buffer called the interface chassis and a general-purpose computer. A teletype and display unit are connected to the central processor. The application of the airport's noise monitoring system is discussed, as well as the genesis and subsequent modification of the airport's noise abatement program in response to citizen reaction. A.B.K.

A72-44685 **Helicopters in the Royal Navy.** L. B. Bryson, F. E. Heenan, and C. A. Johnson. *Aeronautical Journal,* vol. 76, Aug. 1972, p. 469-498; Discussion, p. 499, 500. 7 refs.

Following a historical review of the development of autogyros and helicopters, the development of the helicopter for various naval roles and the engineering problems encountered are examined. A major function of helicopters is search and rescue, and the techniques and equipment used are described. Procedures for operating helicopters from small ships, and the antisubmarine role of helicopters are discussed. Naval helicopters have seen extensive service in the commando role. Offensively armed helicopters can attack specific targets and support the operation of troops in locations held by the enemy. Miscellaneous roles are vertical replenishment, survey, passing of tow lines, transfers at sea, and towing. Various aspects of maintenance reliability and maintainability are considered. F.R.L.

A72-44686 **Energy flow diagrams.** R. Le Claire (Hawker Siddeley Aviation, Ltd., Kingston-on-Thames, Surrey, England). *Aeronautical Journal,* vol. 76, Aug. 1972, p. 507, 508.

Energy flow diagrams give an indication of the manner in which input energy varies within a system. They have the advantage of providing a pictorial, yet mathematically accurate, representation of the energy balance of the system, from which an overall appreciation of the energy variations can be obtained at a glance. Energy flow diagrams are prepared for two typical applications: a bypass jet engine, and a cabin conditioning system. F.R.L.

A72-44726 ***Aircraft fatigue: Design, operational and economic aspects.*** Edited by J. Y. Mann (Weapons Research Establishment, Aeronautical Research Laboratories, Melbourne, Australia) and I. S. Milligan (Department of Civil Aviation, Melbourne, Australia). Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972. 550 p. $25.

The design and operational aspects of the fatigue problem for general aviation and transport aircraft are examined along with economic aspects of the fatigue problem as it affects both operators and manufacturers. The papers cover structural load measurement and analysis, design and certification programs for a wide range of aircraft types including civil supersonic transports, structural reliability aspects, acoustic fatigue, the design of joints, the detection of fatigue cracks in service, and the effects of fatigue on the cost of design and operation of aircraft. Written discussions are included. F.R.L.

A72-44728 **Optimum design of joints - The stress severity factor concept.** L. E. Jarfall (Forsvarsdepartementet, Flygtekniska Forsoksanstalten, Bromma, Sweden). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 49-63. 8 refs.

A rational method of analysis is described which emphasizes the fatigue characteristics of the structure rather than its static strength, a central concept being the 'stress severity factor,' which is an analytically defined fatigue quality number. Experimental evaluation of fastener fatigue characteristics for the stress severity factor application is discussed, and some results from fastener deflection studies are given. Examples are given which demonstrate the application of the method as well as the correlation with test data and service experience. F.R.L.

A72-44729 **Fatigue testing of the F.28 Fellowship.** E. J. Van Beek (Koninklijke Nederlandse Vliegtuigenfabriek FOKKER, Schiphol-Zuid, Netherlands). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 65-98. 7 refs.

The major fatigue tests scheduled to demonstrate the integrity of the flight structure of the Fokker F.28 Fellowship transport with respect to fatigue during its typical short-haul operation are summarized. The tests have been based on the experience gained with the F.27 Fellowship, and are as follows: front fuselage, main fuselage behind cokpit up to rear pressure bulkhead with center wing and outer wing dummies, rear fuselage and T-tail, the complete wing, the flap with supporting and drive structure, and the landing gear with backup structure. The test setups are briefly described, followed by a discussion of the load spectra applied to imitate the operational use of the aircraft. The test equipment used to apply the required loads to the test specimen is described. F.R.L.

A72-44730 **Design and certification for executive type aircraft.** D. Lalli and G. Sergio (Industrie Aeronautiche e Meccaniche Rinaldo Piaggio, Savona, Italy). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 99-127.

Outline of the procedure used in designing the model PD-808 executive jet aircraft and in checking its fail-safe philosophy. A brief account is given of the structural components which have been designed to be fail-safe. The main structural solutions are described in order to show how the fail-safe concept has been introduced into the design. Of particular interest is the fuselage which, following a new concept, has been designed with large bays and with a corrugated skin inserted between the frames. The analytical methods employed in checking fail-safe strength of the airplane are reviewed. The whole procedure of analysis, purposely elaborated to be easily accomplished with the aid of ad hoc computer programs, is discussed. Much emphasis is given to the SIGMA program which has been prepared to investigate built-up structures following the stiffness method. This program seems particularly tailored for carrying out fail-safe evaluations and some interesting results are presented. An account is given of tests performed for fail-safe purposes, including tests on stiffened panels, tests on fuselage components, and nondestructive tests on two prototypes. (Author)

A72-44731 **Fan jet Falcon design and certification tests.** J. Besse (Avions Marcel Dassault, Merignac, Gironde, France) and M. Peyrony (Avions Marcel Dassault, Saint-Cloud, Hauts-de-Seine, France). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 129-147.

It is shown that a complete aircraft structure must be thought over before applying certain design rules, especially in the fail-safe area. A logical test sequence is: static tests up to ultimate load, static tests to failure, and fatigue tests on a complete airframe. A clearly understood fail-safe concept may prove better with respect to large-item component structures than for thin-skin assembly structures. The problem is one of reliable detection of an incipient structural crack before it develops into catastrophic failure. This may lead to systematic inspections, study of crack propagation, and classic static tests with a completely failed item. F.R.L.

A72-44732 **The application of Ti-6Al-4V titanium to helicopter fatigue loaded components.** H. T. Jensen (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 149-170. 9 refs.

The H-53 production helicopter is the first to use titanium successfully, with a weight saving of 840 lb. Emphasis is given to the design and qualification of titanium alloy components whose strength is determined by high-cycle low-stress fatigue in a normal temperature environment. The pertinent properties of titanium alloys for this purpose are considered in the design of components. The cost effectiveness of using Ti-6Al-4V in lieu of 4340 steel is discussed. The results of comparative fatigue tests of 4340 steel and Ti-6Al-4V components, and the testing of 101 Ti-6Al-4V components provide the principal data that justify the decision to use Ti-6Al-4V instead of 4340 steel. Test procedures are described. F.R.L.

A72-44733 **The fatigue and fail-safe program for the certification of the Lockheed Model 286 rigid rotor helicopter.** W. J. Crichlow, C. J. Buzzetti, and J. Fairchild (Lockheed-California Co., Burbank, Calif.). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 171-219. 15 refs.

This helicopter combines the principles of the rigid rotor system, which increases control power and maneuverability by a large factor relative to more conventional hinged rotor systems, and a unique application of a gyroscopic stabilizer mechanically coupled to the blade cyclic control system, thus improving the dynamic stability by a considerable factor. The unique design features, the structural design criteria, the laboratory fatigue and fail-safe test programs, and the flight-test program utilized to develop the realistic fatigue loading spectra for the major elements of the machine are described. Some of the analysis procedures to determine safe replacement times are described along with criteria and demonstration procedures to determine residual static strength and safe inspection intervals for fail-safe or damage-tolerant parts. The probability analysis to determine laboratory test life reduction factors is outlined. F.R.L.

A72-44734 **Agricultural aircraft flight loads - Typical spectra and some observations on airworthiness.** P. J. Foden (Weapons Research Establishment, Aeronautical Research Laboratories, Melbourne, Australia). In: Aircraft fatigue: Design, opera-

tional and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 221-240. 12 refs.

A mean agricultural flight load spectrum is presented, based on the results of measurements taken with 13 pilots. Reasons are given for using the pilot, rather than time, as the parameter. A gust spectrum for altitudes of less than 100 ft is derived. It is shown that, when choosing the severity of a maneuver, pilots make a quite accurate allowance for the load in their aircraft. The strains measured in the wing structure of the aircraft in these experiments are used to define an upper limit to the expected life of the aircraft. It is suggested that normal factors of safety on life need to be doubled to cover the wide differences in piloting techniques which have been noted in this type of flying. (Author)

A72-44735 The New Zealand light aircraft fatigue meter program. E. T. Labett (Department of Civil Aviation, Wellington, New Zealand). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 241-255.

Fatigue meters have been installed in topdressing and nonagricultural aircraft to indicate when selected vertical acceleration levels were exceeded. Fatigue life of agricultural aircraft is largely dependent on piloting technique, and is shown to be very variable, ranging from 11,000 to 113,000 hr. A load spectrum to be used for test purposes and life calculations is proposed. The most severe agricultural load spectrum recorded resulted in calculated fatigue lives of only 10% of the minimum life expected for nonagricultural operations. A recording period of 100 hr is suggested as sufficient to establish a long-term load spectrum for an agricultural aircraft/pilot combination with reasonable accuracy. F.R.L.

A72-44736 * An assessment of repeated loads on general aviation and transport aircraft. P. Donely, J. W. Jewel, Jr., and P. A. Hunter (NASA, Langley Research Center, Hampton, Va.). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 257-295; Discussion, p. 295, 296; Reply, p. 296. 7 refs.

An assessment is made of recent repeated loads data from short-haul jet transports and several general aviation airplanes. The jet transport data indicate that except for check flight maneuvers the load histories are essentially independent of operator and airplane type. General aviation data show a large amount of scatter in the repeated load history. The use and geographical location of operations may be the primary means of specifying the repeated loads environment. (Author)

A72-44737 Extreme value analysis of flight load measurements. O. Buxbaum and O. Svenson (Laboratorium für Betriebsfestigkeit, Darmstadt, West Germany). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 297-322. 26 refs.

An engineering method is described which makes possible the derivation of reliable maximum loads occurring once or only a few times within the service life from measured load frequency distributions by the application of both common and modified statistical methods as described by Buxbaum (1967). These maximum loads are defined by the probability with which they will be exceeded, by the distribution function of the frequency distribution, and by a value characterizing the size of the distribution. For the case in which the maximum load consists of a static load and a superimposed incremental load, the parameters are related to the load increments. The application and usefulness of the method is demonstrated by using examples of measured flight loads. F.R.L.

A72-44738 Undercarriage loadings of three aircraft Porter PC-6, Venom DH-112 and Mirage IIIS. J.-P. Weibel (Eidgenössisches Flugzeugwerk, Emmen, Switzerland). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 323-345. 5 refs.

Load measurements on the landing gear and main structure of the Pilatus PC-6 Porter STOL aircraft are described. The purpose of these measurements was, on the one hand, the gathering of statistic values (load spectrum) of the ground loads for a fatigue test and, on the other, the examination of load assumptions which have been calculated from the design requirements for aircraft. The results are discussed in relation to the differences in the loads whether the aircraft lands on a concrete or grass runway. The comparison of the stresses on the structure due to ground and air loads shows the importance of the former and that they must be respected, in addition to the ground-air-ground cycle. The discovery of fatigue cracks in the wing structure led to the formulation of a measuring program to determine the stresses due to ground loads. The results of the measurements on a DH-112 Venom aircraft are given together with the consequences with regard to the conduct of a full-scale fatigue test. The results obtained during the test and the observations of the aircraft in flying operations are compared. (Author)

A72-44739 Some considerations on acoustic fatigue. J. G. Wagner (Société Nationale Industrielle Aérospatiale, Toulouse, France). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 347-364.

The problem of assessing acoustic fatigue life first arises when determining stresses in structures. These stresses depend on the external excitation and the dynamic characteristics of the excited components. The problem can be solved by analysis, combined analysis and experiment, and experiment alone. Methods of testing include a turbojet installation to provide a realistic excitation and to study the structural response of complex components, sinusoidal excitation to investigate the resonant frequencies and associated vibration modes of the same components, and a noise generator with an experimentation chamber reproducing various vibration spectra at a high noise level. As a result of these tests certain improvements to conventional structures have been confirmed over a large number of flying hours. F.R.L.

A72-44740 The importance of service inspection in aircraft fatigue. J. A. B. Lambert (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England) and A. J. Troughton (Hawker Siddeley Aviation, Ltd., Woodford, Herts., England). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 365-400; Discussion, p. 400-402.

All available nondestructive testing (NDT) methods for aircraft structures in service are reviewed, including visual, magnetic crack detection, X-ray, eddy current detectors, and ultrasonics. The limitations and effectiveness of each method are discussed and illustrated by various examples from aircraft in service. The major problem in NDT is advance knowledge of the probable location of fatigue cracks in service. It is considered to be vital in a fail-safe aircraft to design a structure which can genuinely be inspected visually. The design of the stressed-skin structure should be kept simple, relying primarily on low crack-propagation rates to achieve a fail-safe structure, rather than overcomplicating the design with too many splice joints and sophisticated features. F.R.L.

A72-44741 Fatigue design and test program for the American SST. D. R. Donaldson and K. J. Kenworthy (Boeing Co., Renton, Wash.). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 437-475; Discussion, p. 475; Reply, p. 475, 476. 9 refs.

The American supersonic transport was intended to be a large, variable-sweep-wing aircraft constructed primarily of titanium-alloys, cruising at Mach 2.7, with a service life in excess of 50,000 flight hours. The fatigue considerations necessitated a structural development and verification program more comprehensive and demanding than that required for conventional aircraft. Full advantage was taken of a comparative type of approach based on fatigue analysis, test, and service experience, and extrapolating this experience to the SST by the relationships between design stresses, operating stresses, structural fatigue quality, and fatigue environment. F.R.L.

A72-44742 Economic and operational aspects of fatigue - Figures of a Swiss ground attack/fighter aircraft. H. Rhomberg (Département Militaire Fédéral, Services Techniques Militaires, Berne, Switzerland). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 477-493. 8 refs.

This paper proves, by presenting all relevant costs of the Swiss-built Venom DH-112, that considerable savings can result by performing valuable full-scale fatigue tests. A detailed breakdown of the man-hours for the production of the aircraft is given, as well as the cost of the fatigue test facility and the tests on six specimens. The costs of all modifications introduced to increase the allowable life from 500 to 1,800 h (875 to 3,150 flights) are outlined. The intervals for periodic inspection and partial overhaul of the service aircraft as well as the increasing of the overhaul period and the decreasing of the needed man-hours for an overhaul are given in full detail. The expense for the periodic maintenance of a fleet during the whole service life is presented. Finally, the costs of production, maintenance, modification and testing are calculated and related to one flying hour for two examples, which are compared. (Author)

A72-44743 Economic aspects of fatigue in commercial airlines. R. Axisa and D. Graff (Trans-Australia Airlines, Melbourne, Australia). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 495-515.

The structural fatigue problems which affect an airline are outlined, and some indication of the cost penalties involved is provided. Fatigue work load arises mainly from the need to carry out inspections to verify structural integrity of the aircraft, and to incorporate development modifications to prevent fatigue failures. Additional work arises when failures do occur, as these must be rectified. Most of this work load is carried out during scheduled maintenance periods, and the effect is to reduce the airline's available capacity. In the case of unscheduled maintenance, personnel in the airline's operations and commercial divisions must rearrange the remaining capacity in the best possible way to cope with existing demand. Assessments of costs associated with one fatigue failure and with maintaining a particular airframe have indicated amounts of $1,400 and $323,000, respectively. F.R.L.

A72-44744 Some thoughts on the economics of fatigue. R. C. Morgan (British European Airways Corp., London Airport, Heathrow, Middx., England). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 517-526; Discussion, p. 527; Reply, p. 527, 528.

The costs which arise in service due to the presence of fatigue in aircraft structures despite the efforts of manufacturers to design it out are explored. The normal costing methods do not differentiate between modifications and repairs for fatigue and for other forms of damage or failure. The costs considered include the airframe exclusive of engines and propellers, the mechanical systems, engine nacelles, and jet pipes. These costs are totalled and the results presented as cost per flying hour, and also as a percentage of the total cost of engineering and maintenance. F.R.L.

A72-44745 Observations on designing to combat fatigue and its effects on the economics of civil transport aircraft. D. M. McElhinney (British Aircraft Corp., Weybridge, Surrey, England). In: Aircraft fatigue: Design, operational and economic aspects. Rushcutters Bay, Pergamon Press (Australia) Pty., Ltd., 1972, p. 529-551.

The effects of fatigue on different stages of the development of a civil aircraft from the initial design to operation in airline service are considered. The extent of fatigue in design is emphasized. Comments are made on manufacturing techniques, and the fatigue resistance of integral construction is illustrated. Safety aspects are discussed and finally the direct cost to an operator of a fatigue-resistant aircraft is contrasted with the hidden benefits of long trouble-free service operation. (Author)

A72-44903 Approaches to verification and solution of magnetic particle inspection problems. C. A. Gregory, V. L. Holmes, and R. J. Roehrs (McDonnell Aircraft Co., St. Louis, Mo.). *(American Society for Nondestructive Testing, National Fall Conference, 31st, Detroit, Mich., Oct. 18-21, 1971.) Materials Evaluation,* vol. 30, Oct. 1972, p. 219-228.

This paper discusses several techniques for the identification of problems associated with magnetic particle inspection in the aerospace industry. Problem areas were identified by reviewing military and industry-accepted inspection processes and by analytically examining inspection processes by experimental investigation. Experimental approaches investigated were field mapping based on the Hall principle, the use of simulated cracks in permeable materials, magnetic flux measurements, and observations of the mobility of magnetic particles in slurry during the magnetization cycle. A method for the standardization of magnetic particle test techniques also has been investigated. (Author)

A72-44917 Tone noise from rotor/stator interactions in high speed fans. N. A. Cumpsty (Rolls-Royce, Ltd., Derby, England). *Journal of Sound and Vibration,* vol. 24, Oct. 8, 1972, p. 393-409. 5 refs.

The behaviour of some important aspects of fan noise is both highly complex and paradoxical. By using a qualitative theory based on the work of Kaji and Okazaki, however, it is possible to predict the behaviour in the forward arc of the tone noise from the aerodynamic interaction of the fan rotor and stator. In this paper the theory is developed and extensive results from a fan operating at subsonic tip speeds (although designed for supersonic operation) are used to justify and illustrate the theory. (Author)

A72-44918 # Radiation properties of the semi-infinite vortex sheet. D. G. Crighton (Imperial College of Science and Technology, London, England). *Royal Society (London), Proceedings, Series A,* vol. 330, no. 1581, Oct. 3, 1972, p. 185-198. 21 refs. Research supported by the Ministry of Technology.

The Orszag-Crow problem for a compressible fluid at low Mach numbers is considered. The effects of substantial compliance of the plate are discussed together with the imposition of Kutta conditions, and the generalization of Sommerfeld's classical half-plane diffraction problem to incorporate the vortex sheet. Questions of the relevance of the results to current problems in jet noise prediction are also examined. It is suggested that the interaction of shear layer instability with a large solid surface may be the mechanism responsible for the so-called 'excess noise' phenomenon. G.R.

A72-44945 An investigation of the endurance of D16AMO alloy under an acoustic load. L. E. Matokhniuk, Iu. A. Kashtalian, and V. A. Samgin (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *(Problemiy Prochnosti,* vol. 3, Sept. 1971, p. 116-120.) *Strength of Materials,* vol. 3, no. 9, Apr. 1972, p. 1126-1130. 5 refs. Translation.

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.

A72-44979 **Charge production, supertankers and supersonic aircraft.** P. R. Smy (Alberta, University, Edmonton, Alberta, Canada). *Nature*, vol. 239, Sept. 29, 1972, p. 269-271. 9 refs. Research supported by the National Research Council of Canada.

A recent series of explosions aboard supertankers during tank cleaning operations has raised the possibility that the sudden electrical discharge of an electrostatically charged mist may ignite an explosive mixture of hydrocarbon and air. The electrostatic charging of aircraft passing through heavy rain is also considered. Experiments were conducted to extend the range of previous work to much higher velocities. Velocities were obtained in the range from 20 to 80 m/sec for impact disintegration of drops of water and in the range from 20 to 500 m/sec for aerodynamic disintegration of the drops. G.R.

A72-44983 # **The sweepback effect in the subsonic region in the lower atmosphere and in the hypersonic region at high altitudes (L'effet de flèche en subsonique dans la basse atmosphère et en hypersonique aux hautes altitudes).** E. A. Brun (CNRS, Laboratoire d'Aérothermique, Meudon, Hauts-de-Seine, France) and J. J. Bernard (Paris, Université, Paris, France). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 17, no. 3, 1972, p. 475-483. 26 refs. In French.

Some advantages of swept back wings are outlined, first dealing with airplane flight, and then considering navigation at very high altitudes, a situation which arises in astronautics. There are certain difficulties with swept-back wings, in particular, the effectiveness of control surfaces and high lift devices is reduced, and flow separation occurs along the wing. At very high altitudes the sweepback angle must be increased to be effective. The difficulties presented by the sweepback configuration at low speeds become progressively less important in view of the necessity for high speed flight. They can be overcome at the cost of somewhat complicated solutions, such as variable geometry. F.R.L.

A72-44991 # **Remarks on supersonic aircraft inlets.** S. Pivko (Beograd, Univerzitet, Belgrade, Yugoslavia). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 17, no. 3, 1972, p. 607-612.

The air flow in divergent and convergent-divergent inlets at supersonic flight speeds is considered. To describe the performance of an inlet, the ratio of stagnation pressures at the inlet entrance and exit is used, as well as the efficiency of the air inlet, defined as the ratio of the kinetic energy which is actually converted into pressure in the inlet diffusion process, to the available kinetic energy which can be converted into pressure if no losses occur. It is shown that the appropriate use of several oblique shock waves set up in series ahead of the inlet entrance may greatly improve the performance of air inlets at supersonic flight speeds. (Author)

A72-44992 # **Preliminary design of a sailplane wing for dynamic gust loads (Präliminare bemessung des flügels eines segelflugzeuges auf die dynamische belastung in böen).** E. Racz (Budapesti Muszaki Egyetem, Budapest, Hungary). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 17, no. 3, 1972, p. 613-626. 5 refs. In German.

Consideration of the behavior of a sailplane wing when exposed to sudden gusts. In the presence of wind gusts the sailplane wing behaves elastically in that the mass elements of the wing begin to vibrate. The resulting mass forces yield the dynamic load on the wing. It is shown that if the mass and inertial moment distributions of a 'standard wing' are given it is possible to carry out a preliminary design of the wing on the basis of the natural vibrations and eigenfrequencies of the standard wing. A.B.K.

A72-45000 # **Welding airframe structures in titanium using tensile loading to overcome distortion.** A. Stanhope, R. H. Hazelhurst, and B. M. Swann (Hawker Siddeley Aviation, Ltd., Kingston-on-Thames, Surrey, England). *(International Conference on Welding and Fabrication of non-Ferrous Metals, Eastbourne, England, May 2-4, 1972.) Metal Construction and British Welding Journal*, vol. 4, Oct. 1972, p. 366-372.

In airframe structures made from titanium it was possible to design a highly efficient U-section stringer the edges of which could be fusion-welded directly to the skin, thus eliminating any need for a flange. The efficiency of this structure was further improved by the rigidity of a welded joint. The thickness of the skin between the frame member attachment points was reduced from 1.0 to 0.51 mm by a chemical milling technique. A tension-draw welding apparatus is discussed together with the residual stress measurement in the welded regions, the effects of applied tensile loading during welding, and the utilization of the finished panel. G.R.

A72-45002 **Two-dimensional flow of an ideal incompressible fluid past arbitrarily-shaped highly-cambered bodies.** V. B. Avdeev. *(Aviatsionnaia Tekhnika*, vol. 14, no. 3, 1971, p. 5-14.) *Fluid Mechanics - Soviet Research*, vol. 1, July-Aug. 1972, p. 104-115. 6 refs. Translation.

A computer solution is obtained to the direct stationary problem in a layer of constant thickness for large-camber profiles of arbitrary shape and thickness. The complex singularity-distribution function is defined on a quadratic parabola (or any other curve of parametric shape) in the form of a trigonometric series, whose coefficients are determined from two coupled singular integral equations. These equations are reduced to an infinite system of linear equations with coefficients expressed through Fourier-series coefficients, and are solved by the method of successive approximations. The determination of relative velocities at the profile is reduced to quadratures, using an expansion of the integrals into Fourier cosine-series. V.P.

A72-45113 # **Separated flows at bodies flying at supersonic and hypersonic speeds (Otryvnye techenie vblizi tel, letiashchikh so sverkh- i giperzvukovymi skorostiami).** A. I. Zubkov, Iu. A. Panov, A. I. Glagolev (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR), and D. M. Voitenko. *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper.* 17 p. 5 refs. In English and Russian.

The three-dimensional configuration of shock waves in front of a cylindrical obstacle on a supersonic wing and in front of a fluid jet blown into the main flow are analyzed. The formation of narrow regions with high pressure gradients, high physical loads, and heat flows is examined. The influence of the parameters of the oncoming flow, the boundary layer, the jet, the configuration and dimension of the obstacle, and the curvature of the body on the dimensions of the flow-separation area and the characteristic pressures in it is studied. V.P.

A72-45114 # **Investigation of the characteristics of supersonic flow past conical wings (Issledovanie osobennostei sverkhzvukovogo obtekaniia konicheskikh kryl'ev).** A. L. Gonor, V. I. Lapygin, N. A. Ostapenko (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper.* 31 p. 13 refs. In English and Russian.

The various flow conditions at the windward and leeward surfaces of conical wings in supersonic flow are studied on the basis of a numerical solution of the flow problem. The influence of the initial flow field and the boundary conditions on the solution is examined. Particular attention is given to the transition from the flow with a weak shock wave to the flow with a strong attached shock wave. The structure of the flow at the leeward surface of the wing and the possible existence of shock waves in the flow are studied, and the position of the Ferri point on the leeward surface is determined. V.P.

A72-45159 # **An approach to aircraft/spacecraft preliminary design, and its use in education.** M. Saarlas and G. C. Chang (U.S. Naval Academy, Annapolis, Md.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper.* 18 p. 5 refs.

The approach to aircraft preliminary design with integrated performance simulation presented is extended to spacecraft design. The use of the approach in classrooms with on-line computer facilities is described. A two-step aircraft design program is considered. According to this program a base line aircraft is obtained with the aid of iterative calculations. A follow-up program provides information concerning drag polars, a total weights breakdown by components, the sizes of major aircraft components, and performance data. In spacecraft design there are basically two approaches. The first approach starts with the spacecraft mission, while the second approach takes first the given launch vehicle into consideration. The space shuttle program as a special case is used in a comparison between the aircraft and spacecraft approaches. G.R.

A72-45272 **Power supply system for Frankfurt /Main/ airport (Stromversorgung des Grossflughafens Frankfurt /Main/).** K. Bäurle (Siemens AG, Erlangen, West Germany) and W. Walter (Siemens AG, Frankfurt am Main, West Germany). *Siemens-Zeitschrift,* vol. 46, May 1972, p. 364-369. In German.

Description of the general power supply, including standby supply units, for Frankfurt airport. After presenting some guidance figures for peak load values of various types of buildings in airports, the power supply system of Frankfurt airport is described, and details are given concerning the subsytem of the new terminal, including the control room and remote control equipment. A.B.K.

A72-45292 **Non-destructive testing in industry aviation.** A. G. Smith (Hawker Siddeley Aviation, Ltd., Kingston-on-Thames, Surrey, England). *Non-Destructive Testing,* vol. 5, June 1972, p. 170-174.

Discussion of the achievements and problems of nondestructive testing in the aircraft industry, taking into account the economics, management and organization. Particular attention is given to the selection of adequate test techniques for specific test requirements and objectives. Some typical examples of the application of ndt techniques to casting and forgings and to aircraft service life extension and monitoring are given. Acceptance standards. for ultrasonic flaw detection in Britain and other countries are compared. Ultrasonic methods and holography presently under development are seen as promising alternatives to hand-operated techniques, such as an Avro-Bond Tester and a Fokker Band Tester, in applications to aircraft components and materials. V.Z.

A72-45326 * **Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.** Conference sponsored by the American Institute of Aeronautics and Astronautics and NASA Ames Research Center. Moffett Field, Calif., NASA Ames Research Center, 1972. 234 p.

Limitations in the acquisition of nonlinear aerodynamic coefficients from free-oscillation data by means of the Chapman-Kirk technique, SAM-D control test vehicle trajectory plannning and flight test analysis, and determination of aerodynamic drag from radar data are among the topics covered in papers concerned with atmospheric flight mechanics. Other areas covered include fixed and rotary-wing aircraft, ordnance and reentry vehicles, and analysis and measurement techniques. M.V.E.

A72-45327 * # **Investigation of the stability of the tip vortex generated by hovering propellers and rotors.** J. L. Tangler (Bell Helicopter Co., Fort Worth, Tex.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers. Moffett Field, Calif., NASA Ames Research Center, 1972, p. 1.1-1.12. 14 refs. Contract No. NAS1-10946.

The objective of this experimental and theoretical investigation was to determine what factors and mechanisms are involved in vortex interaction and instability and how these phenomena manifest themselves. To answer these questions, the schlieren method of flow visualization was used to observe the wakes generated by two- and four-bladed model propellers and rotors. A concurrent free-wake analysis was conducted for comparative purposes. Schlieren pictures showing wake asymmetry, interaction, and instability are presented. Various factors and mechanisms believed to be responsible for these are discussed along with the effects produced by the number of blades, collective pitch, and tip speed. Free-wake calculations that qualitatively confirm those factors responsible for wake asymmetry and interaction are also presented. (Author)

A72-45328 # **Flight test investigation of the aerodynamic behavior of various-sized stabilizers on a small helicopter.** B. H. Boirun (U.S. Army, Advanced Methodology and Analysis Office, Edwards AFB, Calif.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers. Moffett Field, Calif., NASA Ames Research Center, 1972, p. 2.1-2.11. 8 refs.

Discussion of data obtained during a flight test program to investigate the autorotational entry characteristics of the TH-55A helicopter. One of the test objectives was to develop a new stabilizer configuration that would reduce nose-down pitching during a stick-fixed autorotational entry following a sudden power reduction. The stabilizer configurations tested were limited to simple geometric changes of the standard TH-55A stabilizer. During this effort, the aerodynamic characteristics of the various stabilizer configurations were determined using relatively simple instrumentation. The engineering techniques required to determine the flow direction and velocity at the horizontal stabilizer are presented, and the results are compared with theory and previous wind tunnel data. The resulting lift and drag coefficients for several stabilizer configurations are also presented, and the results are compared with two-dimensional data of similar aspect ratio tail surfaces. (Author)

A72-45329 # **The dissipation of tip vortices by mass injection with application to rotor systems.** R. P. White, Jr. and J. C. Balcerak (Rochester Applied Science Associates, Inc., Rochester, N.Y.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers. Moffett Field, Calif., NASA Ames Research Center, 1972, p. 3.1-3.10. 8 refs. Grants No. DAAJ02-72-C-0097; No. DAAJ02-71-C-0036; Contracts No. N00014-69-C-0169; No. N00014-71-C-0226.

Considerable effort has been expended by the V/STOL industry in attempts to understand the characteristics of the vortex which emanates from the tip of a rotor blade. Early theoretical analyses showed that the injection of a linearly-directed aerodynamic mass flow into the core of the vortex would increase this viscous dissipation of the vortex significantly through the action of eddy viscosity at lower mass flows or by the generation of jet-flow instability at higher mass flows. A series of wind tunnel tests conducted for various configurations, and empirical modifications to

the theoretical analyses have demonstrated the expected beneficial effects of the technique. The results also show that the benefits which were derived from the vortex-injection process for the various wind tunnel configurations could be realized on flight hardware as well. (Author)

A72-45330 # **Flying sideways during landing maneuvers.** A. Craig (Wichita State University, Wichita, Kan.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 4.1-4.3. 5 refs.

Landing a jet transport aircraft in gusty crosswinds requires considerable pilot effort to maintain a ground track along the extended runway centerline. A scheme for deflecting thrust laterally to generate side forces and thus move the aircraft sideways, wings level and at constant heading, was simulated for a contemporary aircraft. Shortcomings of this retrofit led to a design specifically configured to optimize the concept. The new aircraft makes the scheme operationally achievable. (Author)

A72-45331 # **Vortex-airfoil interaction tests.** D. D. Seath (Texas, University, Arlington, Tex.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 5.1-5.5.

Low-speed wind tunnel tests were conducted to determine the effect of a trailing vortex on the pressure distribution of a wing whose span is perpendicular to the vortex core. It was found that, in general, sections of the wing in the upwash region of the vortex-induced flow experience a decrease in upper surface pressure and an increase in lower surface pressure. Also, when the vortex passes close to the wing (less than the vortex core radius) only the forward half of the chordwise pressure distribution is affected. However, when the vortex is farther away (more than the vortex core radius) the pressure distribution of the entire chord is affected. In either case the wing surface away from the vortex is relatively unaffected aft of the mid-chord position. (Author)

A72-45332 # **An experimental investigation of a jet issuing from a wing in crossflow.** W. Mikolowsky and H. McMahon (Georgia Institute of Technology, Atlanta, Ga.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 6.1-6.9. 21 refs.

The aerodynamic interference resulting from a jet issuing normal to the chordal plane of a two-dimensional wing in a crossflow has been experimentally investigated. Measurements of the interference surface pressure distribution on the wing and of the wing interference force and moment coefficients have been made for a systematic variation of jet exit location, jet exit diameter, wing angle of attack, and the ratio of jet exit velocity to freestream velocity, lambda. A comparison of the contours of constant interference surface pressure on the wing lower surface with those for an infinite flat plate reveals that they are much the same for lambda greater than 6. The dissimilarity becomes greater as lambda is decreased, primarily through the growth of an extensive region of positive interference surface pressure forward of the jet on the wing. Interference lift losses of approximately the same magnitude for all geometries were observed for lambda greater than 6. (Author)

A72-45333 # **Effects of variations in lift and drag response to longitudinal control on the ease and quality of landing.** E. Seckel, D. R. Ellis (Princeton University, Princeton, N.J.), and A. Tal. In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 7.1-7.6.

The first phase of a flight investigation of light aircraft landing characteristics is described. The experiment makes use of a new variable-stability research vehicle in which lift and drag response characteristics may be varied over a wide range, representing different aerodynamic configurations or control concepts (conventional elevator vs direct lift control, for example). Favorable ranges and interactions of parameters are defined, using evidence of recorded landing time histories and pilot evaluations. A study is made of the flare and touchdown handling qualities for a certain class of landings executed with the longitudinal control only. (Author)

A72-45334 # **Low-altitude atmospheric turbulence around an airport.** S. D. Cass (U.S. Army, Washington, D.C.), J. R. Scoggins, and H. L. Chevalier (Texas A & M University, College Station, Tex.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 8.1-8.10. 10 refs. Army-sponsored research. Project THEMIS.

A small airplane was used to measure vertical accelerations due to atmospheric turbulence around an airport surrounded by large buildings, trees, and other objects. The data show the vertical and lateral extent and the intensity of turbulence in the wake of buildings and at other locations around the airport. Results are presented which indicate that the vertical accelerations of the airplane are related to gust intensities measured by conventional anemometers, and that reasonable forecasts of atmospheric turbulence which an airplane could expect to encounter near an airport surrounded by buildings, etc. may be made from wind data appropriately measured and analyzed. (Author)

A72-45344 # **A study of dedicated control surfaces for direct sideforce control.** G. K. L. Kriechbaum and R. R. Larson (Boeing Co., Seattle, Wash.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 27.1-27.3.

Direct sideforce control (DSFC) has been found to significantly improve the heading change response of an attack aircraft. Analytical and piloted simulation studies showed that significant improvement in aiming error resulted when DSFC was used in air-to-ground missions. An implementation study showed that the best way to develop the required sideforce was to use a dedicated vertical surface ahead of the center of gravity. This was used in conjunction with the rudder to produce the total desired sideforce while balancing out the yawing moment. A 'paper pilot' analytical technique was used to develop the control laws. The results proved to be very acceptable to the human pilot. (Author)

A72-45346 # **Dynamic simulation of an aircraft under the effect of vortex wake turbulence.** S. Bernstein (Washington, University, Seattle, Wash.) and J. D. Iversen (Iowa State University of Science and Technology, Ames, Iowa). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers.
Moffett Field, Calif., NASA Ames Research Center, 1972, p. 29.1-29.9. 14 refs.

A technique is developed to simulate the response of a trailing aircraft due to the induced rolling moments and loss of lift imposed by the vortices. In spite of the nonlinear and complex nature of the problem, the method was applied successfully using an EAI 8812 analog computer with no hybrid facilities. The simulated aircraft was free to roll and move vertically and laterally with respect to the generating aircraft. Results of such a simulation for the case of a C-130 behind another C-130 and behind a C-5A are presented. (Author)

A72-45349 # Control requirements for control configured vehicles. J. H. Watson (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers. Moffett Field, Calif., NASA Ames Research Center, 1972, p. 33.1-33.9. 6 refs. Research supported by the General Dynamics Corp.

Of the emerging new technologies, the control configured vehicle (CCV) concept of reduced static stability holds considerable promise in improving performance and maneuverability and in reducing weight while retaining excellent handling qualities. This paper defines additional pitch control power requirements for CCV airplanes; contains design charts for small fighter airplanes during power approach; and includes the effects of static margin, discrete gusts, lift coefficient, zero-lift pitching moment, pitch inertia, C sub m-C sub L linearity, and actuator rate limits, time constants and nonlinearities. Proper shaping of the pitching moment curve, and proper design of the automatic flight control system, during preliminary airplane design stages minimizes pitch control power requirements. (Author)

A72-45350 # Perturbation methods in atmospheric flight mechanics. P. H. Zipfel (USAF, Armament Laboratory, Eglin AFB, Fla.). In: Atmospheric Flight Mechanics Conference, 2nd, Palo Alto and Moffett Field, Calif., September 11-13, 1972, Informal Papers. Moffett Field, Calif., NASA Ames Research Center, 1972, p. 34.1-34.10. 5 refs.

The classical scalar perturbations of flight mechanics are compared with total vector perturbations. A component perturbation method is introduced which is the generalization of the classical technique, and is valid for all coordinate systems. This method, together with a new tensor formalism, is used to derive the general perturbation equations of atmospheric flight mechanics. These equations hold for any unsteady flight regime and are expressed in a tensor form, invariant under time-dependent coordinate transformations. The perturbation equations of all flight vehicles such as aircraft, missiles, shells, and Magnus rotors, are universally represented by these techniques. (Author)

A72-45351 Conference on Fluid Machinery, 4th, Budapest, Hungary, September 11-16, 1972, Proceedings. Conference sponsored by the Scientific Society of Mechanical Engineers and Magyar Tudomanyos Akademia. Edited by L. Kisbocskoi and A. Szabo. Budapest, Akademiai Kiado, 1972. 1528 p.

A new combined antisurging system for axial and radial turbocompressors, turbulent flow calculation for the axial gap between impeller and casing in centrifugal pumps, and the influence of the geometrical shape of solid surface microirregularities on cavitation bubble nucleation are among the topics covered in papers concerned with fluid machinery. Other topics covered include the behavior of hemispheric bubbles generated by electric sparks, a dimensional analysis of cavitation erosion, and the determination of pressure losses in turbomachines.

M.V.E.

A72-45363 # The determination of a general relation between the aerodynamic properties of a single airfoil and those of the same airfoil arranged in an arbitrary cascade. O. Popa (Timisoara, Institutul Politehnic, Timisoara, Rumania). In: Conference on Fluid Machinery, 4th, Budapest, Hungary, September 11-16, 1972, Proceedings. Budapest, Akademiai Kiado, 1972, p. 1015-1030. 6 refs.

A72-45364 # A method for estimation of axial turbomachinery stage characteristics on the basis of experimentally obtained data with a runner tested in a free blow-out aerodynamical scheme. Z. Protic. In: Conference on Fluid Machinery, 4th, Budapest, Hungary, September 11-16, 1972, Proceedings. Budapest, Akademiai Kiado, 1972, p. 1083-1090.

A72-45366 # On a certain system of turbine blade cascades. M. Ruzicka (Statni Vyzkumny Ustav Konstrukce Stroju, Bechovice, Czechoslovakia). In: Conference on Fluid Machinery, 4th, Budapest, Hungary, September 11-16, 1972, Proceedings. Budapest, Akademiai Kiado, 1972, p. 1155-1167. 7 refs.

The paper presents a study of the relationship that obtains between the principal parameters characteristic of velocity distribution at the suction side of a blade profile, and the geometrical parameters (i.e., pitch-width ratio and thickness-pitch ratio of the profile) of plane cascades of the turbine type. (Author)

A72-45371 # Flow analysis in the axial-flow compressor impeller with meridional stream acceleration. A. Witkowski (Slask, Politechnika, Gliwice, Poland). In: Conference on Fluid Machinery, 4th, Budapest, Hungary, September 11-16, 1972, Proceedings. Budapest, Akademiai Kiado, 1972, p. 1515-1541. 13 refs.

Investigation of the flow in an axial-flow compressor impeller with meridional acceleration and blades of arbitrary spatial shapes. Rotor tests concern the efficiency and rate of energy transfer for various combinations of flow quantity, rotational speed, and angles of attack. These general performance values have been obtained by calculation from measured value of fluid direction, total and static pressure, and velocity profiles, upstream and downstream of the impeller. Then a theoretical analysis for the three flow coefficients is made on the basis of a quasi-three-dimensional approach. The results obtained from experimental investigations of the flows through an isolated rotor row are compared with these theoretical predictions. On the basis of the experimental and theoretical results obtained with the designed impeller it would seem that the general designed criteria and design procedure used could be considered reliable. (Author)

A72-45378 # Iterative methods for the aerodynamic calculation of thin wings in a subsonic flow (Metode iterative pentru calculul aerodinamic al aripii subtiri in regim subsonic). N. N. Patraulea (Institutul de Mecanica a Fluidelor si Constructii Aerospatiale, Bucharest, Rumania). *Studii si Cercetari de Mecanica Aplicata,* vol. 31, no. 1, 1972, p. 3-14. In Rumanian.

Methods of numerical calculation for thin aircraft wings based on the iterative solution of a basic integral equation. It is shown that the procedure is convergent both in the case where the perturbation motion is represented by sources located on two close lying planes and in the case of turbulent singularities formed by adjacent loops of vortex lines. In both cases the unknowns are considered as potentials. Assuming networks with equal meshes (or meshes which are equal along certain portions of the wing), an easy programming is obtained, as well as a small required computer storage and a reasonable computation time. A.B.K.

A72-45386 New controls to shape future aircraft. M. L. Yaffee. *Aviation Week and Space Technology,* vol. 97, Oct. 16, 1972, p. 46-50.

Studies and development programs on control-configured vehicles (CCV) are expected to result in aircraft with greatly improved performance. The CCV concept involves application of advanced flight control technology, such as the static stability compensation system, to aircraft while they are still in the design stage. These new control systems can replace and enhance to a significant degree many of the control functions now performed by pilots and conventional control surfaces. They also will enable aircraft to make maneuvers such as side steps that could not be done

before. Fighter and bomber aircraft were studied, and an advanced development program was established that is structured to generate the flight control technology most appropriate to each class. F.R.L.

A72-45401 # **The Aero-Propulsion Systems Test Facility.** J. G. Mitchell (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1034.* 12 p. 6 refs. Members, $1.50; nonmembers, $2.00.

Studies which culminated in a proposal for a new propulsion system test capability are reported. The role of test facilities in propulsion system development is examined, giving attention to test facility utilization, cost and technical advantages, and aircraft inlet-engine systems compatibility. Types of tests to be conducted are considered, taking into account direct connect testing, semifree jet testing, and free jet testing. Deficiencies with regard to presently existing test facilities are related to the testing of turbojet engines and high-bypass turbofan engines. A description of the Aero-Propulsion Systems Test Facility is presented and aircraft engine growth trends are considered. G.R.

A72-45406 # **Thrust stand for evaluation of thrust vectoring nozzle performance.** D. W. Esker and A. V. Sedrick (McDonnell Douglas Corp., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1029.* 7 p. Members, $1.50; nonmembers, $2.00.

A new method of measurement of exhaust nozzle static thrust and direction is discussed. The measurement technique was devised for determination of thrust vectoring nozzle performance. The approach satisfies the requirements of versatility, measurement accuracy, and low cost operation, necessary for comparative evaluation of various V/STOL thrust deflection nozzle designs. Application of this technique to a simple, two-component thrust stand incorporating a rotating plenum-pendulum design is described. Measurements of nozzle gross thrust and discharge coefficients obtained with the thrust stand for several 3-in.-diam nozzles are reported. Good agreement of the measured nozzle performance is shown with design predictions and data reported elsewhere. Thrust measurement repeatability is shown to be within plus or minus 0.25%. Thrust measurement accuracy is estimated to be plus or minus 0.4% and the accuracy of the thrust direction measurement is estimated to be plus or minus 1.0 deg. (Author)

A72-45412 # **Blade torsional tuning to manage rotor stall flutter.** R. Gabel and F. Tarzanin, Jr. (Boeing Co., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-958.* 12 p. 5 refs. Members, $1.50; nonmembers, $2.00. Research sponsored by the Boeing Independent Research and Development Program.

Helicopter flight envelope growth is currently limited by stall flutter control loads. A systematic study with current tools shows that selection of the rotor blade torsional natural frequency has the potential for reducing the stall flutter loads, making further flight envelope growth possible. For the blade studied, the maximum stall flutter load occurred at torsional natural frequencies from 7.5/rev to 9.5/rev, and higher or lower torsional frequencies reduced the load. Torsional frequency variations due to changes in blade stiffness, control system stiffness, and pitch inertia yielded similar results, theoretically verifying that blade torsional frequency is a primary variable. (Author)

A72-45413 # **The use of complex coordinates in the study of rotor dynamics.** H. C. Curtiss, Jr. (Princeton University, Princeton, N.J.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-954.* 12 p. 11 refs. Members, $1.50; nonmembers, $2.00.

The application of complex coordinates to the study of the dynamic characteristics of the tip-path-plane of a helicopter rotor is considered. Expressing the variables describing the tip-path-plane motion in terms of complex coordinates converts the equations of motion from two coupled second order differential equations to a single second order differential equation with complex coefficients at low advance ratios. This formulation provides a convenient and natural framework for investigation of the response characteristics of fully articulated and hingeless rotors. Considerable insight into the influence of various physical parameters and the flight condition on the behavior of the tip-path-plane can be gained. The approach is illustrated by consideration of the transient and frequency response characteristics of the tip-path-plane and the influence of flapping feedback. An extension of the root locus method is described which makes the investigation of flapping feedbacks convenient. (Author)

A72-45415 # **An investigation of parameters and factors governing manual control of STOL aircraft in landing approach.** S. J. Craig and R. K. Heffley (Systems Technology, Inc., Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-987.* 11 p. 18 refs. Members, $1.50; nonmembers, $2.00. Contract No. DOT-FA70WA-2395.

A combined analytic and ground-based simulator investigation has been conducted to identify the vehicle parameters and factors governing manual control in an STOL approach situation. In this effort, emphasis was on the path control restrictions which are independent of short-period attitude control aspects. Generic and specific closed-loop analyses are applied to identify the crucial vehicle parameters and to predict suitable control techniques. From these analytic efforts test configurations were selected for the simulator evaluations to verify the predictions. Results of the experiments confirm that the path control problems are characterized by the nature of the airspeed (u) and altitude (h) response to the pertinent pilot inputs. For powered-lift STOL aircraft the inherent path control problems stem from coupling effects. Pilot background and experience were also found to play a role in the acceptability of a given technique and in the overall ability to control path. (Author)

A72-45450 # **Prospects and problems in the construction of modern aircraft (Perspective si preocupari in constructia de avioane moderne).** S. Ispas (Ministerui Industriei Constructiei de Masini, Bucharest, Rumania). *Studii si Cercetari de Mecanica Aplicata,* vol. 31, no. 4, 1972, p. 969-988. In Rumanian.

Analysis of the trends of development of modern aircraft, noting the scientific problems and the technical solutions adopted to satisfy the requirements imposed on military aircraft. A brief classification of fighter aircraft is presented, and the main requirements imposed on modern aircraft are reviewed, noting, in particular, various means for increasing the payloads of fighter aircraft - including the improvement of armament arrangements, increasing the armament efficiency, improving the fire control systems, creating new devices for using armaments on the ground and during fighter missions, improving onboard equipment, and installing modern power plants. Certain economic considerations concerning the organization of the research, design, and fabrication of military aircraft are presented. A.B.K.

A72-45524 # **Aerodynamics of airfoil cascades in an unsteady flow (Aerodinamika reshetok v nestatsionarnom potoke).** D. N. Gorelov, V. B. Kurzin, and V. E. Saren. Novosibirsk, Izdatel'stvo Nauka, 1972. 270 p. 137 refs. In Russian.

A description is given of currently used methods of calculating unsteady aerodynamic characteristics of turbine blade cascades, and

certain results which illustrate the dependence of these characteristics on a wide range of parameters are presented. Considering plane incompressible fluid flow, solutions are obtained for a plate cascade, a cascade consisting of thin curvilinear airfoils, a cascade consisting of arbitrary airfoils (by the integral equation method), and a cascade of solid airfoils (by the splicing method). In the case of compressible fluid flow a study is made of the natural vibrations of a gas flowing past a plate cascade at a subsonic velocity, the integral equation method and Mathieu functions are applied to a study of a plate cascade in a plane subsonic gas flow, a study is made of three-dimensional subsonic gas flow past a plate cascade, the vibrations of an airfoil cascade in a transonic gas flow are considered, and calculations are performed for various cases involving a plate cascade in a plane supersonic unsteady flow. Certain problems concerning the vibrations of axial-flow turbine blades in a gas flow are considered. A.B.K.

A72-45558 **Improving the helicopter - What next.** *Interavia,* vol. 27, Oct. 1972, p. 1121-1123.

Some of the technical advances in helicopters which have already been achieved or will soon be achieved are discussed. There are two types of rotor which can be applied to the pure helicopter: the classic articulated rotor and the rigid rotor. The former has reached a high state of development but its speed capability is low. The rigid rotor is basically simple, but it is not easy to put into practice. Compound helicopters, rotor drive systems, and flight control and avionics systems are considered. Both the tilt-rotor and stowed rotor concepts have received serious attention during the last few years. F.R.L.

A72-45622 # **Optimal modes of operation of a centripetal-compressor wheel with preswirling of the flow (Issledovanie optimal'nykh rezhimov raboty kolesa oseradial'nogo kompressora s predvaritel'noi zakrutkoi potoka).** L. V. Kochetkov. *Energomashinostroenie,* vol. 18, July 1972, p. 15, 16. In Russian.

A72-45779 # **Jet impingement under VTOL aircraft.** T. M. Houlihan and C. D. Thompson (U.S. Naval Postgraduate School, Monterey, Calif.). *AIAA Journal,* vol. 10, Sept. 1972, p. 1179-1182.

A previous analytical solution for the flowfield beneath a VTOL model was extended to include tilted jet configurations. Additionally, a laboratory model was constructed to test the effects of variation in the parameters governing the flow. Free streamline profiles, pressure coefficients on the 'ground' and 'fuselage' of the apparatus and velocity profiles in the nozzles were determined from hot wire anemometer traverses of the flowfield. Experimental data compared favorably with theoretical determinations over the flow regions tested. (Author)

A72-45780 # **Raindrop breakup in the shock layer of a high-speed vehicle.** G. D. Waldman, W. G. Reinecke, and D. C. Glenn (Aerospace Corp., San Bernardino, Calif.). *AIAA Journal,* vol. 10, Sept. 1972, p. 1200-1204. 8 refs. Contract No. F04701-68-C-0035.

The problem of predicting raindrop breakup effects in the shock layer of a high-speed vehicle is discussed. Relevant experimental data, obtained in a shock tube with shadowgraph and x-ray photography, are presented in the form of correlations of the nondimensional time to breakup with the Weber number, together with the drop mass variation and trajectory as a function of nondimensional time. The relationship between the experimental situation and the flight case is delineated for the stagnation and downstream conical-flow regions of a high-speed shock layer. Based on the experimental correlations, calculations are made of the impacting drop mass fractions, velocities, and impact angles for a vehicle traversing a rainstorm. (Author)

N72-31999 Royal Aircraft Establishment, Bedford (England).
MOMENTUM THEORY
P. L. Roe *In* AGARD Aerodyn. Probl. of Hypersonic Vehicles, Vol. 1 Jul. 1972 12 p refs

The use of the momentum theory to study aerodynamic lift and flow patterns on wing surfaces is examined. The data are used to help design wing shapes. E.H.W.

N72-32000 Royal Aircraft Establishment, Bedford (England).
FLOWS WITH HEAT ADDITION
P. L. Roe *In* AGARD Aerodyn. Probl. of Hypersonic Vehicles, Vol. 1 Jul. 1972 11 p refs

The influence of drag, heat additions, and flow patterns on hypersonic aircraft propulsion is studied. E.H.W.

N72-32005# Joint Publications Research Service, Arlington, Va.
REPORTS FROM THE HIGHER EDUCATIONAL INSTITUTIONS: AVIATION TECHNOLOGY
S. D. Yermolenko, V. G. Khrapovitskiy, M. T. Barinov, and A. V. Rovnykh 26 Sep. 1972 48 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1969 p 5-16, no. 1, 1968 p 10-20, no. 2, 1967 p 3-11, and no. 3, 1966 p 3-10
(JPRS-57100) Avail: NTIS HC $4.50

Selected articles on the aerodynamic characteristics of lifting surfaces are presented.

N72-32006 Joint Publications Research Service, Arlington, Va.
ON THE INFLUENCE OF THE COMPRESSIBILITY OF AIR ON THE AERODYNAMIC CHARACTERISTICS OF A WING MOVING CLOSE TO THE EARTH'S SURFACE AT SUBSONIC SPEEDS
In its Rept. from the Higher Educational Inst.: Aviation Tech. 26 Sep. 1972 p 1-14 refs

The effect of the proximity of the earth's surface on the aerodynamic characteristics of a horizontal wing is investigated by using a mirror image of the wing with respect to the earth's surface. Based on the Bio-Savara formula, the nonflow conditions are developed; downwash angles, and aerodynamic force coefficients are calculated for different attack angles. It is concluded that in the ranges of attack angles of practical interest, and for wings with span-chord ratios less than five, stability increases slightly with increase in speed. F.O.S.

N72-32007 Joint Publications Research Service, Arlington, Va.
CALCULATION OF THE AERODYNAMIC CHARACTERISTICS OF LIFTING SYSTEMS COMPOSED OF RECTANGULAR WINGS
In its Rept. from the Higher Educational Inst.: Aviation Tech. 26 Sep. 1972 p 15-26 refs

Calculative methods based on the nonlinear theory are applied to systems of rectangular wings arranged one behind the other. Systems of thin rectangular wings in a uniform stream of incompressible fluid are examined for any angle of attack that is less than the wing stall angle. Using the Bio-Savara formula, the projections of the velocity induced by a single horseshoe vortex are calculated. The results of calculating systems of two wings with different span-chord ratios are summarized in graphs. The results are in close agreement with those obtained experimentally. F.O.S.

N72-32008 Joint Publications Research Service, Arlington, Va.
ON THE NONLINEAR THEORY OF LIFTING SURFACES
In its Rept. from the Higher Educational Inst.: Aviation Tech. 26 Sep. 1972 p 27-36 refs

A solution to the problem of the forces acting on a li surface in a stream of incompressible fluid is proposed considers a rectangular wing to be a flat plate, which is repla with a vortex surface. The downwash angles of free vortices computed, and the formula for calculating the velocity induc by a single horseshoe vortex is derived. The calculate aerodynamic coefficients of wings for various span-chord ratio are in agreement with experimental data. F.O.S

N72-32009 Joint Publications Research Service, Arlington, Va.
CALCULATING THE DOWNWASH ANGLES BEHIND WINGS WITH SMALL SPANCHORD RATIOS MOVING AT SUBSONIC SPEEDS, ACCORDING TO NONLINEAR THEORY
In its Rept. from the Higher Educational Inst.: Aviation Tech. 26 Sep. 1972 p 3-10 refs

A method is presented for calculating downwash angles of the flow for rectangular wings with small span-chord ratios. The problem is reduced to the solution of nonlinear algebraic equations by successive approximations. To obtain acceptable accuracy in the calculated results, the wing is replaced by two vortices. F.O.S.

N72-32010*# Scientific Translation Service, Santa Barbara, Calif.
ON THE COMPUTATION OF THE NOSE PORTION OF A WING PROFILE IN SONIC FLOW
Yu. B. Lifshits Washington NASA Sep. 1972 9 p refs Transl. into ENGLISH from Uchenyye Zapiski TsAGI (USSR), v. 2, no. 4, 1971 p 1-6
(Contract NASw-2035)
(NASA-TT-F-14285) Avail: NTIS HC $3.00 CSCL 01A

A numerical method developed earlier is used to calculate the flow of sonic velocity at infinity around three series of symmetrical profiles, each of which is characterized by a certain two-parametric law governing the curvature change. The results obtained are the basis for establishing the properties of transonic flows around a profile. Author

N72-32011# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Engineering.
EXPERIMENTAL STUDY OF INDUCED DRAG AND LEADING EDGE TANGENTIAL SUCTION FORCE SPANWISE DISTRIBUTION OF THIN PLANE DELTA WINGS AT LOW SPEEDS INCLUDING THE EFFECTS OF FUSELAGE DIAMETER
Sven-Olof Ridder 1972 52 p refs
(KTH-AERO-TN-58) Avail: NTIS HC $4.75

The spanwise distribution of the leading edge tangential suction forces along the leading edge of a thin 60 degree delta wing has been obtained by means of a novel experimental method. This method is based on measurements of the pressure at the apex of the leading edge at various spanwise stations. The tests were carried out in a low speed wind tunnel, and also the total forces and moments were recorded. The delta wing was tested alone and in combination with two schematic fuselages of different diameters. It was found that the presence of a fuselage reduces the leading edge suction in the vicinity of the fuselage, but slightly increases the suction near the wing tips. Another effect of the fuselage was to reduce the lift curve slope and the span efficiency factor. The effects were small for the smaller fuselage of typical aircraft-proportions, but fairly pronounced for the larger fuselage of typical missile proportions. Author

N72-32012*# National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF THE VORTEX SPRINGING FROM A HELICOPTER BLADE TIP ON THE FLOW AROUND THE NEXT BLADE

STAR ENTRIES

N72-31988 Engineering Sciences Data Unit, London (England).
AERO-NORMALISED STABILITY DERIVATIVES: EFFECT OF WING ON YAWING MOMENT DUE TO YAWING
Sep. 1971 14 p refs Supersedes ESDU-Aero-A.07.01.02 Sponsored by Roy. Aeron. Soc.
(ESDU-71017; ESDU-Aero-A.07.01.02) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Aero-normalized yawing moment derivatives are presented for plain wings, wings with flaps, and separated flow. F.O.S.

N72-31989 Engineering Sciences Data Unit, London (England).
A METHOD FOR ESTIMATING THE PRESSURE DISTRIBUTION ON THE SURFACE OF A TWO-DIMENSIONAL AEROFOIL IN A SONIC STREAM
Jul. 1969 72 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-69013) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A method is presented for calculating the pressure distribution on an airfoil in a sonic stream. The method is based on theoretical and empirical relationships and comprises a number of separate procedures which are set out. To apply these procedures it is necessary to specify only the airfoil geometry and the angle of incidence for which the calculation is to be made. Each calculation is made essentially in four main stages. The first stage determines the stagnation point, the second and third stages evaluate the subsonic flow over appropriate portions of the airfoil and the fourth stage evaluates the region of supersonic flow. The method may be applied to a wide range of both round- and sharp-nosed, lifting and nonlifting sections including that category of airfoils exhibiting a velocity peak in the vicinity of the leading edge. Author

N72-31990 Engineering Sciences Data Unit, London (England).
LIFT-CURVE SLOPE AND AERODYNAMIC CENTRE POSITION OF WINGS IN INVISCID SUPERSONIC FLOW
Sep. 1970 18 p refs Revised Sponsored by Roy. Aeron. Soc.
(ESDU-70012) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Wings with straight leading and trailing edges and streamwise tips are considered in a study of the aerodynamic center of wings with subsonic trailing edges. The theory from which the data were derived is that of linearized supersonic flow, which limits its application to wings of small thickness, camber, and twist at low incidence. It is, in addition, a theory for inviscid flow in which separation is assumed to occur only from the trailing edge. A basis is provided on which to build modifications due to thickness, boundary layer effects, etc., to obtain the lift-curve slope and aerodynamic center position for any wing with straight leading and trailing edges in a real flow. Author

N72-31991 Engineering Sciences Data Unit, London (England).
LIFT-CURVE SLOPE AND AERODYNAMIC CENTRE POSITION OF WINGS IN INVISCID SUBSONIC FLOW
Jul. 1970 18 p refs Supersedes Aero-W.01.01.01 and in part Aero-W.S.01.03.03-06 and Aero-W.S. 08.01.02 Sponsored by Roy. Aeron. Soc.
(ESDU-70011; Aero-W.01.01.01; Aero-W.S.01.03.03.06; Aero-W.S.08.01.02) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Numerical representations of the lift-curve slope and aerodynamic center position of wings in inviscid, subsonic flow are presented. The data apply to wings with straight leading and trailing edges and streamwise tips. The theory is based on small perturbations and thus limits the application to wings of small thickness, camber, and twist at low incidence. The aerodynamic center is expressed as a fraction of the aerodynamic chord aft of the leading edge. Aerodynamic coefficients and mathematical models are included to support the theoretical aspects. Author

N72-31992 Engineering Sciences Data Unit, London (England).
AERO-NORMALISED STABILITY DERIVATIVES: EFFECTS OF FIN AND RUDDER ON ROLLING MOMENTS DUE TO SIDESLIP AND YAWING
Jun. 1970 8 p refs Supersedes ESDU-Aero-A.06.01.06 Sponsored by Roy. Aeron. Soc.
(ESDU-70006; ESDU-Aero-A.06.01.06) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Formulas for calculating the aero-normalized rolling moment derivative due to sideslip and yawing are presented. F.O.S.

N72-31994# Advisory Group for Aerospace Research and Development, Paris (France). Fluid Dynamics Panel.
AERODYNAMIC PROBLEMS OF HYPERSONIC VEHICLES, VOLUME 1
R. C. Pankhurst, ed. Jul. 1972 237 p refs Lectures presented at Rhode-St.-Genese, Belgium, 18-23 Jan. 1970; sponsored in part by the von Karman Inst.
(AGARD-LS-42-Vol-1) Avail: NTIS HC $14.00

A lecture series covering aerodynamic problems of hypersonic vehicle design is presented. Specific lectures cover optimum wing shapes, propulsion systems, viscous flow interaction, reentry aerothermodynamics, nonequilibrium flow, and vehicle optimization.

N72-31995 Royal Aircraft Establishment, Bedford (England).
AERODYNAMICS AT MODERATE HYPERSONIC MACH NUMBERS
P. L. Roe *In* AGARD Aerodyn. Probl. of Hypersonic Vehicles, Vol. 1 Jul. 1972 8 p refs

Research on the theory of inviscid hypersonic flow and its application to hypersonic transport aircraft is presented. A definition is given for hypersonic in relation to its use by the author as well as rules for the use of the term inviscid flow. E.H.W.

N72-31996 Royal Aircraft Establishment, Bedford (England).
OPTIMUM SHAPES
P. L. Roe *In* AGARD Aerodyn. Prob. of Hypersonic Vehicles, Vol. 1 Jul. 1972 21 p refs

The progress that was made in the application of optimization methods to hypersonic wing theory is reviewed. The wing design considered was the sharp-edged and nonslender. The efforts made to use optimization to define shapes for hypersonic transport vehicles were outlined. E.H.W.

N72-31997 Royal Aircraft Establishment, Bedford (England).
THEORY OF WAVERIDERS
P. L. Roe *In* AGARD Aerodyn. Probl. of Hypersonic Vehicles, Vol. 1 Jul. 1972 17 p refs

The use of waveriders to predict the hypersonic behavior of a given wing shape is discussed. Data cover accuracy of prediction method, standards for specific family shapes, levels of performance, and flow patterns about wing-like shapes. E.H.W.

Bernard Monnerie and Alain Tognet Feb. 1972 22 p refs Transl. into ENGLISH from Aeronaut. Astronaut. (Paris), no. 29, 1971 p 24-32
(NASA-TT-F-14462) Avail: NTIS HC $3.25 CSCL 01A

A wind tunnel investigation of the path of the vortex springing from each rotor blade tip of a helicopter rotor was conducted. Analysis of the path of the vortex makes it possible to define the position of a blade relative to the various vortices during a cycle. One of the positions was simulated in the wind tunnel by mounting two half-blades on the wall. The effects of the vortex on the overall forces and the pressure distribution were determined. The wind tunnel results are compared with those obtained by numerical analysis. Author

N72-32013 Engineering Sciences Data Unit, London (England).
FRICTIONAL AND RETARDING FORCES ON AIRCRAFT TYRES. PART 2: ESTIMATION OF BRAKING FORCE
Oct. 1971 50 p Sponsored by Roy. Aeron. Soc.
(ESDU-71026-Pt-2) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Numerical procedures for determining the frictional and retarding forces on aircraft tires are presented. The subjects discussed are: (1) coefficient of friction for unyawed tires in both braked and skidding conditions on hard surface runways, (2) limits of braking force due to brake energy and torque considerations, (3) maximum and locked-wheel tire-runway braking forces, and (4) mean effective braking force developed during period of braking, either manual or automatic. Mathematical models and graphs are included to support the theoretical presentation. Author

N72-32014 Royal Aeronautical Society, London (England).
ESTIMATION OF TAKE-OFF DISTANCE
Jan. 1971 8 p refs
(EG-5/1-Amend-A) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Mathematical models and formulas are presented for estimating the take-off distance over a screen, usually 35 to 50 feet high. Information on the calculation of accelerate-stop distances is also included. The methods apply to all types of propulsive units. A summary of methods for estimating take-off distance is provided. Author

N72-32015 Engineering Sciences Data Unit, London (England).
AVERAGE GUST FREQUENCIES SUBSONIC TRANSPORT AIRCRAFT
Sep. 1969 19 p refs Supersedes ESDU-Fat-L.01.01 Sponsored by Roy. Aeron. Soc.
(ESDU-69023-Amend-B; ESDU-Fat-L.01.01) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The measurement of the average gust frequencies on subsonic transport aircraft is discussed. The results were derived from accelerometer, VG, and VGH records reported during aircraft operations. Special gust investigations at high and low altitude conditions, as well as contour flying, are presented. Mathematical models and charts are developed to support the theoretical discussions. Author

N72-32016*# California Univ., Berkeley. Inst. of Governmental Studies.
LONGER TERM CONSEQUENCES OF THE SHORT TAKE-OFF AND LANDING (STOL) AIRCRAFT SYSTEM
Semiannual Report, 1 Nov. 1971 - 30 Mar. 1972
Todd R. LaPorte Jul. 1972 43 p refs
(Grant NGR-05-003-0471)
(NASA-CR-128197) Avail: NTIS HC $4.25 CSCL 01B

An assessment of the STOL aircraft and the various means of employing it are discussed in the light of a research study to evaluate the efficacy of such analyses. It was determined that current approaches to assessment are generally inadequate for investigating the full social consequences of implementing a new technology. It is stated that a meaningful methodology of technology assessment must reflect mechanisms underlying the relationship of technology to social change. Interrelated methods which are discussed are: (1) gaming and simulation as heurisitic approaches in analysis and inquiry, (2) long range planning and questions of the future, (3) planning theory as a background for critical analysis of policy planning, and (4) social theory, with particular emphasis on social change and systems theories.
Author

N72-32017# Advisory Group for Aerospace Research and Development, Paris (France).
HANDLING QUALITIES CRITERIA
Jun. 1972 293 p refs Proc. of the AGARD Flight Mech. Panel Specialists Meeting, Ottawa, 28 Sep.-1 Oct. 1971
(AGARD-CP-106) Avail: NTIS HC $17.00

The proceedings of a conference on the handling qualities of aircraft are presented. Subjects discussed are: (1) flying qualities requirements and criteria for conventional and V/STOL aircraft, (2) commercial flying quality standards and flight test validation, (3) establishment of flying qualities by analysis of current aircraft, simulation and analysis, and pilot opinion ratings, (4) special problems and interfaces in aircraft control, and (5) man machine relationships and research and development projects for improvement

N72-32018 Service Technique Aeronautique, Paris (France).
COMPARISON OF FRENCH AND UNITED STATES FLYING QUALITIES REQUIREMENTS
Jean-Claude Wanner and John W. Carlson (ASD) *In* AGARD Handling Qualities Criteria Jun. 1972 15 p

The flying qualities requirements for French and United States aircraft are compared. It was determined that the two sets of criteria are basically the same in intent and goals. The complications in applying these criteria to modern, high performance aircraft are discussed. Concepts in level of handling qualities, application of flight envelope restrictions, and effects of system failures on flying properties are examined. Author

N72-32019 Aeroplane and Armament Experimental Establishment, Boscombe Down (England).
THE NATURE AND USE OF THE RULES FOR JUDGING THE ACCEPTABILITY OF THE FLYING QUALITIES OF FIXED WING AIRCRAFT
S. J. Andrews *In* AGARD Handling Qualities Criteria Jun. 1972 10 p ref

The flying qualities requirements for the United Kingdom and the United States are compared. The documents involved in establishing the criteria are examined. The general content of the documents in relation to the requirements of the flight tester in assessing the acceptability of fighter aircraft, strike aircraft, and trainer aircraft is discussed. Comment is submitted on the flying qualities requirements for V/STOL aircraft. It is suggested that the requirements documents are of limited use to the flight tester because they are either out of date or inapplicable to new aircraft with special role demands or novel design features. It is recommended that, in addition to updating existing requirements, more attention should be given to the direct and immediate application of data from known and tried service aircraft. Author

N72-32020 Federal Aviation Administration, Washington, D.C.
FAA FLYING QUALITIES REQUIREMENTS
Richard Sliff and Robert F. LeSuer *In* AGARD Handling Qualities Criteria Jun. 1972 6 p

The need for flexibility and change of Federal Aviation Regulations to accommodate new designs and innovations to flying vehicles is an ever-increasing and complex situation. The current philosophies and projected difficult areas associated with airplane handling qualities are discussed. The subject is not intended to be covered as to the specific conditions or types of airplanes but, rather, to cover the qualitative evaluation needs for determining compliance with the existing airworthiness rules. Recognizing that aircraft development and capability is an ever-improving science, the relationship of Federal rulemaking procedures to the application of judgment in the requirements to produce timely and adequate determinations of compliance is discussed with consideration of complex control systems and rapidly-expanding flight envelopes. Author

N72-32021* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REVISIONS TO V/STOL HANDLING QUALITIES CRITERIA OF AGARD REPORT 408
Seth B. Anderson and Laurel G. Schroers (Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.) *In* AGARD Handling Qualities Criteria Jun. 1972 8 p refs

A brief review of selected handling qualities criteria for V/STOL aircraft shows that although a clearer understanding of the requirements for controversial areas such as roll control power, vertical flight path control, and transition is in hand, considerably more research is needed to refine these criteria for operational IFR activity. Because many items interact to influence the pilots' overall impression of the aircraft's behaviour, additional work of a systematic nature must be done to clarify this aspect. A better definition of a gust model which includes discrete gust effects is needed to firm up criteria for both hover and STOL operation. Author

N72-32022 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
US MILITARY V/STOL HANDLING QUALITY REQUIREMENTS
Charles R. Chalk and Charles B. Westbrook (AFFDL) *In* AGARD Handling Qualities Criteria Jun. 1972 13 p refs

The V/STOL aircraft handling qualities criteria specification is discussed. The evolution of the specification is traced over the five year period of its development. Problem areas requiring additional work are defined as well as research efforts to address some of the problem areas. Author

N72-32023 Canadair, Ltd., Montreal (Quebec).
APPLICATION OF V/STOL HANDLING QUALITIES CRITERIA TO THE CL-84 AIRCRAFT
O. E. Michaelsen *In* AGARD Handling Qualities Criteria Jun. 1972 26 p refs

The design concepts and flight characteristics of the Canadair CL-84 tilt wing V/STOL aircraft as related to handling qualities are reviewed. The achieved characteristics are compared with the revised AGARD V/STOL Handling Qualities Criteria. It is shown that the CL-84 characteristics are in general accord with the Criteria. While a few of the Criteria values appear inappropriate for the CL-84, it is concluded that the handling qualities of the aircraft would be improved if the aircraft met most of the Criteria in the areas where it presently falls short. Author

N72-32024 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
V/STOL HANDLING QUALITIES CRITERIA COMPARED WITH FLIGHT TEST RESULTS OF THE V/STOL SUPERSONIC FIGHTER VJ 101C AND THE V/STOL TRANSPORT AIRCRAFT DO 31E
G. K. Kissel and Horst Wuennenberg (Dornier AG, Friedrichshafen) *In* AGARD Handling Qualities Criteria Jun. 1971 15 p refs

The V/STOL aircraft handling qualities criteria are compared with the flight test results for the VJ 101C V/STOL supersonic fighter aircraft and the DO 31E V/STOL transport aircraft. The main features of the takeoff and landing procedures are presented. The handling qualities of the two aircraft in hover and transition flights are compared with accepted recommendations. The influence of the stabilization system and its characteristics on the control power is examined. The effects of the jet induced downwash and of the hot gas recirculation are shown. Author

N72-32025 Air Force Flight Test Center, Edwards AFB, Calif. Performance and Flying Qualities Branch.
CRITERIA TRENDS OBTAINED FROM ANALYSIS OF CURRENT AIRCRAFT
Charles F. Adolph *In* AGARD Handling Qualities Criteria Jun. 1972 9 p refs

The need for developing additional criteria specifically for evaluation purposes is discussed. Also included are discussions of several other topics in the flying qualities area which have been recurrent items of interest in evaluations of high performance aircraft. Included are comments on high angle of attack criteria, an overview of the results from evaluations of aircraft equipped with control augmentation systems, and a summary of experiences in applying flying quality criteria. Author

N72-32026 Northrop Corp., Hawthorne, Calif.
SIMULATION AND ANALYSIS IN ESTABLISHING FLYING QUALITIES CRITERIA
J. T. Gallagher *In* AGARD Handling Qualities Criteria Jun. 1972 25 p refs

The application of simulation and analysis in establishing the flying qualities criteria for piloted aircraft is discussed. Two areas are identified where better criteria are needed in the specification: (1) the effects of turbulence and (2) the impact of control system dynamics on flying qualities. A discussion is presented on a program which employs ground based simulation and pilot analysis in an attempt to better define the impact of turbulence on flying qualities. Methods for overcoming existing shortcomings in the procedure are evaluated. Author

N72-32027 Boeing Co., Seattle, Wash.
HANDLING QUALITIES CRITERIA FOR SUPERSONIC TRANSPORT
W. T. Kehrer *In* AGARD Handling Qualities Criteria Jun. 1972 5 p

The content and tone of a criteria specification for commercial transports are presented. A criteria must insure safe handling qualities for all regimes of flight operation. In addition to the normal flight operations, operation to the extremes of the flight envelope, and operation in severe turbulence must be specified. Also to be considered are flight operations with systems failures. A criteria specification must also consider the critical combinations of these items that have a reasonable probability of occurrence. For example: the airplane must be able to operate safely in turbulence of some specified level following flight controls systems failures. Author

N72-32028 Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Flight Research Dept.
THE ROLE OF PILOT RATING IN THE DEVELOPMENT OF HANDLING CRITERIA
Robert P. Harper, Jr. *In* AGARD Handling Qualities Criteria Jun. 1972 7 p refs

The application of pilot rating in determining the performance and handling criteria of aircraft is discussed. The role of pilot rating as a means of defining the quality of handling in those control situations where a direct measurement cannot be made is described. The development and application of a pilot rating scale for aircraft evaluation are examined. Author

N72-32029 London Univ. (England). Dept. of Aeronautical Engineering.

CRITERIA FOR STALL AND POST STALL GYRATIONS
G. J. Hancock *In* AGARD Handling Qualities Criteria Jun. 1972 10 p

Problems associated with the handling characteristics during approaches to and excursions beyond the operational limits of commercial aircraft are discussed. The evolution of airworthiness requirements for the stall and post stall operation of aircraft is described. The effects of minimum speed in steady level flight, the specification of the factors of safety, and the demonstration of satisfactory dynamic behavior beyond the operational limits on the design of the aircraft are analyzed. Author

N72-32030 Royal Aircraft Establishment, Bedford (England).
TURBULENCE MODELS FOR THE ASSESSMENT OF HANDLING QUALITIES DURING TAKE OFF AND LANDING
J. G. Jones *In* AGARD Handling Qualities Criteria Jun. 1972 15 p refs

Properties of atmospheric turbulence at low altitude are reviewed, with particular reference to those aspects relevant to an aircraft on a landing approach or during take-off. Measurements of power spectra are described and related to a simplified theoretical model. Looking beyond the power spectrum, an important property of turbulence is its intermittency, related to a tendency for aircraft response to show large peaks separated by regions of relative inactivity. Pilots appear to be particularly sensitive to this, intermittent structure, and their subjective comments can be related to measured turbulence characteristics. It is shown how a discrete gust model for turbulence may be employed to predict the magnitude of large response peaks. As an example, the response to gusts of an aircraft constrained to fly at constant attitude is discussed, with particular reference to the effects of aircraft speed. Author

N72-32031 North American Rockwell Corp., Los Angeles, Calif.
FLYING QUALITIES INTERACTION WITH ELASTIC AIRFRAMES
John H. Wykes *In* AGARD Handling Qualities Criteria Jun. 1972 13 p refs

The trends in modern aircraft structural design and aerodynamics are such that vehicle flexibility increasingly impacts on vehicle flying (handling) qualities and the design processes necessary to provide satisfactory vehicles. In recent years, the flexibility effects on ride quality have impacted on handling qualities and, perhaps, should be added to handling qualities requirements or criteria. A presentation is given of some of the approaches currently being considered to reduce this interaction. These include such techniques as active seat isolation and active structural mode control. It is concluded that any ride quality solution method that includes inducing motion between the pilot and his controls and displays should be excluded by handling qualities criteria. The structural flexibility and flight controls interface is briefly examined, and a typical pilot-induced structural excitation is discussed. It is suggested that a pilot prefilter, a modern stability augmentation system, and a structural mode control system designed to meet ride quality criteria can solve the problem without additional criteria. The handling qualities flexibility interaction and the vehicle design cycle are discussed.
Author

N72-32032 Societe Nationale Industrielle Aerospatiale, Toulouse (France).
INFLUENCE OF THE DESIGN AND FUNCTIONING CHARACTERISTICS OF THE FLYING CONTROL SYSTEM OF A TRANSPORT AIRCRAFT ON ITS FLIGHT QUALITIES
R. Deque *In* AGARD Handling Qualities Criteria Jun. 1972 12 p

The problems encountered in the course of flying quality studies for both a supersonic and a subsonic transport aircraft are described. A study is made of the influence of the static and dynamic characteristics of controls between cockpit controls and surfaces without automatic compensators. The specific problems raised by automatic compensators are examined. A study is made of how flying qualities are affected by flying control failures and by the safety and reliability objectives which must as a consequence be achieved. Author

N72-32033 National Aeronautical Establishment, Ottawa (Ontario).
PARAMETERS AFFECTING LATERAL DIRECTIONAL HANDLING QUALITIES AT LOW SPEEDS
K-H. Doetsch, Jr. *In* AGARD Handling Qualities Criteria Jun. 1972 13 p ref

A study is undertaken of the factors affecting the lateral-directional handling qualities of aircraft in typical VMC STOL flight as certain modal parameters are varied. It is found that for the low flight-speed and the low dutch roll frequencies investigated, the side force equation takes on added significance in establishing the oscillatory mode through the vector contribution of the weight component acting along the y-axis. When this contribution is large, secondary effects on handling qualities can arise if the relationship between the yaw rate and sideslip vectors in the oscillatory mode is established solely by varying the derivatives of the moment equations because, under these circumstances, unusual groups of derivatives may be necessary to satisfy the imposed constraints. Similar deviations from normal values for the moment derivatives may be required to force the zeros from the poles in the bank angle to aileron-control transfer function while simultaneously maintaining the correct vector relationships in the oscillatory mode. Author

N72-32034 Technische Hogeschool, Delft (Netherlands).
PILOT VEHICLE ANALYSIS
R. J. A. W. Hosman *In* AGARD Handling Qualities Criteria Jun. 1972 25 p refs

An experiment is described in which measurements were performed on human operators in single axis tracking tasks. The controlled element used was a simulated transport aircraft, the angle of pitch was controlled by the human operator. The forcing function was a gust signal acting on the simulated aircraft. The aircraft was simulated at three centre of gravity positions at which it was stable, neutral and unstable respectively. During the test runs the human operators had to perform simultaneously an auditory additional task. On the basis of the results obtained from this experiment a new sampled data pilot model is discussed. Author

N72-32035 Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany).
PILOT WORKLOAD
R. K. Bernotat and Jean-Claude Wanner (Service Tech. Aeronautique, Paris) *In* AGARD Handling Qualities Criteria Jun. 1972 9 p refs

Schematic diagrams and analyses of the functions of the human operator in the guidance and control loops are presented. Three hierarchical control loops are considered. Flow charts are established to define the stimuli received by the pilot, the data treatment by the brain, and the subsequent physical actions. The application of the analyses to establishing the pilot workload encountered for various portions of the flight is described.
Author

N72-32036 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
THEORETICAL PILOT RATING PREDICTIONS
Ronald O. Anderson *In* AGARD Handling Qualities Criteria Jun. 1972 14 p refs

Methods for specifying flying qualities of aircraft are discussed. Methods for correcting deficiencies in the present system are recommended. The recommendations range from the expansion of the classical approach to new dimensions to approaches that rely on theoretical predictions of pilot ratings. It is shown that the prediction of pilot ratings is a valid approach which is accurate within the range of pilot variability. Author

N72-32037 Naval Air Systems Command, Washington, D.C.
RECENT US NAVY FLYING QUALITIES RESEARCH
Raymond F. Siewert *In* AGARD Handling Qualities Criteria Jun. 1972 12 p refs

The results of U.S. Navy sponsored flying qualities research conducted over the past five years are presented. Inflight variable stability airplane investigations were conducted in simulated carrier approaches to determine the effect of the principle flying qualities parameters on approach performance. Limits have been established on the values of the major longitudinal and lateral-directional parameters, to insure good carrier approach characteristics. In addition to the carrier approach studies, moving base simulator investigations were conducted to further develop criteria, and extend the aircraft maneuvering potential at high angles-of-attack. The inclusion of maneuvering force gradient and/or stick sensitivity has been determined as a requirement for a meaningful criterion. Author

N72-32038* National Aeronautics and Space Administration, Washington, D.C.
RECENT NASA HANDLING QUALITIES RESEARCH
Richard J. Wasicko *In* AGARD Handling Qualities Criteria Jun. 1972 25 p refs

A comprehensive review of NASA research results documented since the mid-1960's and some recently completed programs on aircraft handling qualities are presented. In addition to handling qualities research pertaining to vehicle stability and control characteristics, investigations related to specialized piloting tasks, cockpit displays, and environmental factors are summarized. The background leading to NASA's handling qualities research activities is discussed, and programs that have received major emphasis are indicated. For general aviation aircraft, the survey includes investigations aimed at improving handling qualities by incorporating increasingly sophisticated stability augmentation and display systems, simplifying the approach and landing task for relatively inexperienced pilots, and establishing the basic effects of turbulence. Research on the specialized piloting problem of steeper instrument approaches for noise abatement and investigations with a representative first generation aircraft are reviewed in the section on subsonic jet transports. Supersonic cruise aircraft programs include a variety of simulation studies related to supersonic transport designs and flight tests with the XB-70 aircraft. Investigations of high angle of attack loss of control problems and a flight study of direct lift control utilization for formation flying and aerial refueling are discussed in the review of tactical military aircraft research.
Author

N72-32040*# Systems Control, Inc., Palo Alto, Calif.
ANALYSIS OF INSTRUMENTATION ERROR EFFECTS ON THE IDENTIFICATION ACCURACY OF AIRCRAFT PARAMETERS
John A. Sorensen Washington NASA 31 May 1972 104 p refs
(Contract NAS1-10791)
(NASA-CR-112121) Avail: NTIS HC $7.25 CSCL 01D

An analytical investigation is presented of the effect of unmodeled measurement system errors on the accuracy of aircraft stability and control derivatives identified from flight test data. Such error sources include biases, scale factor errors, instrument position errors, misalignments, and instrument dynamics. Two techniques (ensemble analysis and simulated data analysis) are formulated to determine the quantitative variations to the identified parameters resulting from the unmodeled instrumentation errors. The parameter accuracy that would result from flight tests of the F-4C aircraft with typical quality instrumentation is determined using these techniques. It is shown that unmodeled instrument errors can greatly increase the uncertainty in the value of the identified parameters. General recommendations are made of procedures to be followed to insure that the measurement system associated with identifying stability and control derivatives from flight test provides sufficient accuracy. Author

N72-32041*# Systems Control, Inc., Palo Alto, Calif.
SCIP2 FLIGHT INSTRUMENTATION SPECIFICATION FOR PARAMETER IDENTIFICATION: USER'S GUIDE
N. Taniguchi Washington NASA May 1972 137 p
(Contract NAS1-10791)
(NASA-CR-112122) Avail: NTIS HC $9.00 CSCL 01D

SCIP2 which is a digital computer program that can be used to investigate the effects of instrumentation errors on the accuracy of aircraft stability and control derivatives identified from flight test data is presented. The program is based on the assumptions that the aircraft differential equations of motion are linear and consist of small perturbations about a quasisteady flight condition. It is also assumed that a Newton-Raphson optimization technique is used for identifying the estimates of the parameters. A summary of the equations which are coded in the program are included. Author

N72-32042*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF AIRCRAFT NOISE DURING TAKE-OFF
Marc Pianko Feb. 1972 30 p Transl. into ENGLISH from Aeronaut. Astronaut. (Paris), no. 18, 1970-1972 p 4-14
(NASA-TT-F-14468) Avail: NTIS HC $3.50 CSCL 01B

The optimum paths providing for minimization of the noise level of an aircraft during take-off are studied. Determination of those paths emphasizes the aircraft parameter which, apart from engine noise, establish the noise intensity at take-off. The relative effect of each parameter is evaluated. The influence of engine technology, its restrictions and limitations on future progress in the field of take-off noise is examined. The extent to which the results may be altered by the introduction of the effective PNdB (duration correction) is analyzed. Author

N72-32043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
JET AIRCRAFT ENGINE NOISE REDUCTION
E. William Conrad and Carl C. Ciepluch 1972 11 p refs Presented at EASCON '72, Washington, D. C., 16-17 Oct. 1972
(NASA-TM-X-68131; E-7123) Avail: NTIS HC $3.00 CSCL 01B

The development of advanced technology to reduce the effects of aircraft flyover noise is described. The procedures are directed toward identifying and minimizing the noise sources in aircraft engines and to absorbing noises which cannot be eliminated. The economic impact resulting from reducing noise levels is examined. Improvements in engine noise reduction technology are discussed. Author

N72-32044*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC STABILITY DERIVATIVES AT ANGLES OF ATTACK FROM MINUS 5 DEG TO 90 DEG FOR A VARIABLE-SWEEP FIGHTER CONFIGURATION WITH TWIN VERTICAL TAILS
Sue B. Grafton and Ernie L. Anglin Washington Oct. 1972 52 p refs
(NASA-TN-D-6909; L-8426) Avail: NTIS HC $3.00 CSCL 01B

An investigation was conducted in the Langley full-scale tunnel to determine the dynamic stability derivatives in pitch, roll, and yaw over an angle-of-attack range of -5 deg to 90 deg for a variable-sweep fighter configuration with twin vertical tails. The study consisted of forced-oscillation tests of a 1/10-scale model of the airplane at a Reynolds number of 0.4 million based on the reference wing mean aerodynamic chord. Tests were conducted for wing sweep angles of 22 deg, 35 deg, 50 deg, and 68 deg, and the effects of the vertical and horizontal tails, wing leading-edge slats, nose-mounted canards, and frequency of the oscillation were also evaluated. Author

N72-32045*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THREE-TRACK RUNWAY AND TAXIWAY PROFILES MEASURED AT INTERNATIONAL AIRPORTS I AND J
Albert W. Hall Washington Oct. 1972 92 p refs
(NASA-TN-D-6932; L-8485) Avail: NTIS HC $3.00 CSCL 01B

Three-track runway and taxiway profiles are presented for use in studies of airplane response to ground roughness. Tabulated and plotted data for two international airports, (designated I and J), are included. Author

N72-32046# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
SPECIAL STUDY: MIDAIR COLLISIONS IN US CIVIL AVIATION, 1969 - 1970
7 Jun. 1972 81 p refs
(NTSB-AAS-72-6) Avail: NTIS HC $6.25

A special study of midair collisions in U.S. civil aviation during 1969 to 1970 is presented. The study analyzes the commonality of midair collisions of aircraft as an accident prevention measure. The functions of the National Transportation Safety Board are discussed. Author

N72-32047*# Addis Translations International, Woodside, Calif.
DETERMINING THE SOUND FIELD PRODUCED BY THE MANEUVERING OF JET AIRCRAFT
Michel Kobrynski Washington NASA Mar. 1972 27 p refs Transl. into ENGLISH of "Determination du Champ Sonore Produit par l'Evolution des Avions a Reaction", ONERA preprint TP-697, 1969 16 p Sponsored by NASA
(NASA-TT-F-14489; TP-697) Avail: NTIS HC $3.50 CSCL 01B

The relation between the total sound-pressure field emitted by a stationary rotating jet and the sound field from that same jet in motion, observed at a fixed point on the ground, is studied by introducing into the generalized equation for the local over-all sound-pressure level, whose form is recalled, a new convection index derived from the Ribner expression. The influence of the flight speed on the sound emission is demonstrated over a broad range of angles (from 20 to 160 deg with respect to the jet axis). Deduced from it are the relation between the convection effect of the vortices in stationary and moving jets, and the variation of the acoustic power produced by propulsion of the jet through the atmosphere. The results of the analytic study, confirmed by many experimental findings, have shown that at the different angles of acoustic radiation the relative speed is not the significant parameter to use for determining the levels of the local over-all sound pressure. Author

N72-32048# Air Pollution Control District, Los Angeles, Calif.
JET AIRCRAFT OPERATIONS: A THREAT TO THE AIR ENVIRONMENT
Ralph E. George, John S. Nevitt, and Julien A. Verssen 30 Jun. 1971 38 p refs Presented at 64th Ann. Meeting of the Air Pollution Control Assoc., Atlantic City, 30 Jun. 1971
(Contract CPA-22-69-137)
(Paper-71-117) Avail: NTIS HC $4.00

A summary is presented of the results of a comprehensive air pollution study of jet aircraft operations at the Los Angeles International Airport. Included in the data obtained from this study are: (1) jet engine exhaust measurements for currently used turboprop, turbojet and turbofan engines, (2) measurements of specific contaminants in the atmosphere inside and outside of passenger terminals and ticketing areas, and in aircraft cabins during ground operations including passenger loading and taxiing prior to takeoff; and (3) ambient air measurements in a two-mile radius of the airport. An evaluation is made of the emissions of contaminants from air transport operations and all related ground activities including motor vehicles, that contribute to the total atmospheric contaminant burden at the airport. Author

N72-32049# Sandia Labs., Albuquerque, N.Mex.
FORMULATION OF THE EQUATIONS OF MOTION FOR FLIGHT VEHICLES WITH SEMIPASSIVE ROLL CONTROL SYSTEMS
John K. Kryvoruka Apr. 1972 50 p refs
(Contract AT(29-1)-789)
(SCL-RR-720007) Avail: NTIS

The relations which govern a class of semi-passive, roll control systems utilized by the vehicle for flight stability augmentation are included. Particular attention is given to the construction of a comprehensive aerodynamic model which is general for most applications. The development is suitable for programming on a large-scale digital or hybrid computer. Author

N72-32050# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
STUDY OF FLIGHT-LOAD PARAMETERS OF THE NAVY FLIGHT DEMONSTRATION TEAM F-4J AIRCRAFT Final Report
Robert J. McAvoy and David J. Rhoads 25 Feb. 1972 346 p refs
(AD-743476; NADC-72021-VT) Avail: NTIS CSCL 01/3

The report presents 42.9 hours of valid flight loads data recorded on three F-4J aircraft assigned to the Navy Flight Demonstration Team (Blue Angels). The data includes both practice sessions and official flight demonstrations during the months of May and June 1970. Histograms, graphs, and tables are used to describe the load histories of the aircraft during the study. In addition, data comparisons are made of the flight loads recorded at three different locations on the aircraft structure, and these loads are also compared to load counts recorded by the Navy statistical counting accelerometer. As a result of this study, the Navy counting accelerometer transducer was relocated to the center of gravity of all the Navy Flight Demonstration Team F-4J aircraft. Additional important recommendations are made as a result of this study. Author (GRA)

N72-32051# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE M MARK
Karl-Heinz Eyermann 4 Apr. 1972 17 p Transl. into ENGLISH from Armee Rundschau (East Germany), no. 1, 1971 p 88-92
(AD-744159; FTD-HT-23-1491-71) Avail: NTIS CSCL 01/3

The report lauds the superiority of Russia's nuclear weapons over the USA, and the designer Valdimir Mikhaylovich Myasishchev for the M-4 long-range aircraft. Author (GRA)

N72-32052# School of Aerospace Medicine, Brooks AFB, Tex.
NOISE WITHIN FIXED-WING UTILITY AIRCRAFT USED BY THE MILITARY Progress Report, Mar. - Sep. 1971
Donald C. Gasaway Dec. 1971 26 p refs
(AF Proj. 7755)
(AD-742972; SAM-TR-71-43) Avail: NTIS CSCL 01/3

A variety of small fixed-wing aircraft are used by the military services to perform numerous utility tasks. The character of the noise encountered within the utility-type aircraft is described and illustrated. Noise envelopes are depicted for 14 aircraft powered by small reciprocating engines rated at less than 600 horsepower, 9 powered by reciprocating engines rated at 1200 to 1525 horsepower, and 8 powered by turboprop engines. In addition to general noise profiles representative of normal cruise, levels are shown for other phases of operation. The noise encountered within utility aircraft constitutes a significant auditory risk since personal ear protection (including headsets mounted in crash helmets) is not routinely worn in most of these aircraft. Author (GRA)

N72-32053# Boeing Co., Philadelphia, Pa. Vertol Div.
HELICOPTER DEVELOPMENT RELIABILITY TEST REQUIREMENTS. VOLUME 2: STUDY PARAMETERS INTERRELATIONSHIP Final Report
R. B. Aronson Ft. Eustis, Va. Army Air Mobility Res. and

Develop. Lab. Feb. 1972 28 p
(Contract DAAJ02-70-C-0039; DA Proj. 1F1-62203-A-143)
(AD-741377; D210-10207-2; USAAMRDL-TR-71-18B) Avail: NTIS CSCL 01/3

Two of the key activities in programs to develop higher levels of helicopter equipment reliability are test activities: reliability problem-identification testing and reliability demonstration testing. This document introduces the variables that must be dealt with in testing: demonstrated mean time between failures (MTBF), desired level of confidence, demonstration duration, and probability of passing. It also explains their relationships and the testing strategy which derives from the fact that helicopter hardware must have a real MTBF greater than demonstrated MTBF in order to have a reasonable probability of passing a prescribed demonstration. GRA

N72-32054# Boeing Co., Philadelphia, Pa. Vertol Div.
HELICOPTER DEVELOPMENT RELIABILITY TEST REQUIREMENTS. VOLUME 3: SENSITIVITY ANALYSIS Final Report
Robert H. Jines Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Feb. 1972 78 p
(Contract DAAJ02-70-C-0039; DA Proj. 1F1-62203-A-143)
(AD-742247; D210-10207-3; USAAMRDL-TR-71-18C) Avail: NTIS CSCL 14/2

Variables used in Volume I, Study Results, which are of the type heavily influenced by management philosophy, available resources, etc., are investigated for their effect on problem identification test costs. Cost optimizations of bench test versus flight test were performed at 126 data points. In particular, the variables studied are: MTBR off-the-board, corrective action efficiency, test effectiveness, and test operating time/calendar time, MTBR off-the-board and corrective action efficiency are identified as the variables which can heavily influence the problem identification test costs. Author (GRA)

N72-32055# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BASIC PROBLEMS IN PRODUCING LAMINATED AIRCRAFT STRUCTURES
H. Oltarzewski 11 Apr. 1972 14 p Transl. into ENGLISH from Tech. Lotnicza Astronautyczna (Poland), v. 26, no. 3, 1971 p 16-18
(AD-742780; FTD-HC-23-191-72) Avail: NTIS CSCL 11/4

The article gives a short description of technology and production of laminates. In it, attention was drawn to the difficulties encountered by introducing laminates into production of aircraft structures, which stems from a certain way of thinking, usages, and customs connected with producing traditional structures. Reasons for the stagnation in national planning were given. Author (GRA)

N72-32056# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
STATIC AND DROP TESTS OF A QUARTER SCALE MODEL OF THE CC-115 AIRCRAFT EQUIPPED WITH AN AIR CUSHION LANDING SYSTEM
John C. Vaughn, III, Shade Campbell, and David J. Pool Jan. 1972 44 p refs
(AD-743829; AFFDL-TM-72-01-FEM) Avail: NTIS CSCL 01/3

Static load deflection tests and vertical drop tests were performed on a quarter scale model of a Canadian CC-115 (Buffalo) aircraft equipped with an Air Cushion Landing System (ACLS). The model weighed 610 lbs and the ACLS air supply was furnished by two electric fans. The static load deflection tests showed that the model weight could be increased from 610 lbs to 1310 lbs before the fans stalled. The model deflection one inch when 560 lbs were added to it during hover over a solid surface. The portion of the weight supported by the trunk (instead of the cushion) increased from 3% at 610 lbs to 24% at 1310 lbs. Author (GRA)

N72-32057# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MICROWAVE ILS SCANNING BEAM DATA RATE ANALYSIS APPLIED TO THE CH-53A HELICOPTER M.S. Thesis
Paul R. Stolz Apr. 1972 96 p refs
(AD-743612; GSA/MA/71-18) Avail: NTIS CSCL 01/2

Data rate requirements for low visibility approach with a sample data measurement of glideslope deviation was investigated analytically using CH-53A helicopter dynamics. A window was defined by specifying certain allowable deviations in the aircraft motion variables which are acceptable for continuation of the landing at a 100 ft decision altitude. The approach performance was defined as the probability of missing the window, which corresponds to the probability of a missed approach. The landing approach process was modeled by a system of stochastic differential equations which account for the aircraft dynamics, atmospheric disturbances, guidance errors and data rate. The flight control system was modeled by a state estimator and a state feedback matrix which was optimized so as to minimize the probability of a missed approach subject to rms constraints on control activity. Author (GRA)

N72-32058# Lockheed-Georgia Co., Marietta.
ANNEALED FOIL FATIGUE SENSOR DEVELOPMENT Final Report, Dec. 1967 - May 1971
Robert S. Horne and Oscar L. Freyre Mar. 1972 231 p refs
(Contract F33615-68-C-1221; AF Proj. 3170)
(AD-743968; LGR-ER-11411; AFFDL-TR-71-127) Avail: NTIS CSCL 14/2

The development testing of the C-5A full-scale fatigue specimens presented a timely opportunity to continue the development of a system of fatigue sensing devices. The fatigue sensor selected for use was previously evaluated during an Air Force funded feasibility study and has been adapted to meet the application requirements on full-scale C-5A structure. The report constitutes the final report regarding this effort and applies specifically to an evaluation of the sensor on the C-5A laboratory fatigue test specimens. The techniques of sensor installation, location, data acquisition methods, and analysis of sensor response are herein evaluated in view of potential utilization on fleet aircraft. Author (GRA)

N72-32059# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
EVOLUTION AND DESCRIPTION OF THE TRACERS GROUND TO AIR ESCAPE/RESCUE SYSTEM Final Report
C. R. Lampart and J. L. Kaminski 21 Apr. 1972 175 p refs
(AD-743477; NADC-72043-VT) Avail: NTIS CSCL 06/7

A study was conducted to determine a workable configuration for a Ground-to-Air Escape/Rescue System called TRACERS. The study showed that a low-cost, self-rescue aircraft, capable of vertical take-off and 75-nautical mile cruise is feasible. Author (GRA)

N72-32060# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
TEST PLAN REPORT FOR ARRESTED LANDING FATIGUE TEST OF MODEL E-2 A/B AIRPLANE
Edward F. Kautz 1 May 1972 18 p ref
(AD-743478; NADC-72047-VT) Avail: NTIS CSCL 01/3

A laboratory fatigue test will be performed on an E-2 airframe to determine whether the airframe will sustain the effects of 3000 arrested landings without structural failure. Author (GRA)

N72-32061# Naval Aerospace Medical Research Lab., Pensacola, Fla.
ORIENTATION-ERROR ACCIDENTS IN REGULAR ARMY AIRCRAFT DURING FISCAL YEAR 1969: RELATIVE INCIDENCE AND COST

W. Carroll Hixson, Jorma I. Niven, and Emil Spezia 7 Apr. 1972 45 p refs
(MF12524005)
(AD-743483; NAMRL-1161; USAARL-72-13) Avail: NTIS CSCL 01/2

The report is the third in a longitudinal series of reports dealing with the pilot disorientation/vertigo accident problem in Army fixed wing and rotary wing flight operations. Incidence and cost data presented for fiscal year 1969 include a total of 71 major and minor orientation-error accidents (22 of which were fatal), resulting in 51 fatalities, 79 nonfatal injuries, and an over-all aircraft damage cost of $11,928,660. The contribution of rotary wing accidents to these totals was 65 accidents (20 of which were fatal), resulting in 46 fatalities, 78 nonfatal injuries, and $11,724,852 aircraft damage. Author (GRA)

N72-32062# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF METHODS AND MEANS FOR STUDYING THE ACCUMULATION OF FATIGUE DAMAGE IN AIRCRAFT STRUCTURES
I. G. Kolker 6 Apr. 1972 12 p Transl. into ENGLISH from Tr. Elektrotekhn. Inst. (Novosibirsk), 1967 p 223-230
(AF Proj. 1347)
(AD-744280; FTD-MT-24-1454-71) Avail: NTIS CSCL 01/3

Inertial force-loading apparatus for simultaneous endurance testing of a large number of specimens and structural elements under simple, compound, and variable loading is described. The apparatus, developed for designing airframes, employs a biharmonic vibroplatform with a program mechanism for varying vibration amplitude and frequency and a four-rail trolley. The accumulation of fatigue damage is determined by statistical indicators. The indicators are calibrated under laboratory and flight conditions. When installed on aircraft, they make it possible to establish statistical equivalents between the damage of indicator specimens and the airframe elements of the aircraft being tested. Author (GRA)

N72-32063# Minnesota Univ., Minneapolis.
STUDY OF PARACHUTE FORCES AND CANOPY PRESSURE DISTRIBUTION MEASURED IN A SUBSONIC WIND TUNNEL UNDER INFINITE MASS CONDITIONS Final Report, 1 Aug. 1969 - 15 Aug. 1971
Helmut G. Heinrich and D. P. Saari Wright-Patterson AFB, Ohio AFFDL Mar. 1972 243 p refs
(Contract F33615-68-C-1227; AF Proj. 6065)
(AD-744103; AFFDL-TR-71-175) Avail: NTIS CSCL 01/3

For the purpose of parachute canopy stress analysis during the period of inflation, the pressure distribution measured on a ring-slot parachute model is related to the instantaneous parachute force. The correlation of pressure and force data is based on test results established at the Deutsche Forschungsanstalt fuer Luft-und Raumfahrt (DFLR), Braunschweig, Germany. The final pressure-force-time relationship incorporate individual as well as averaged test data. A fair agreement could be shown between measured forces and those obtained from numerical integration of differential pressure over the canopy surface. Author (GRA)

N72-32064# Systems Control, Inc., Palo Alto, Calif.
DUAL CONTROL AND IDENTIFICATION METHODS FOR AVIONIC SYSTEMS. PART 1: DUAL CONTROL Final Report
Edison T. S. Tse, Anthony J. Tether, Yaakov Bar-Shalom, and Lewis Meier May 1972 98 p refs
(Contract F44620-71-C-0077; AF Proj. 9769; SCI Proj. 5971)
(AD-744115; AFOSR-72-1186TR-Pt-1) Avail: NTIS CSCL 12/1

The report constitutes Part I of a one-year study on the dual control method for nonlinear systems. The difficulties associated with the general stochastic control problem are discussed, and a new approach to the problem is developed using the concepts of dual control and the principle of optimality from dynamic programming. An adaptive dual control strategy is derived which has the characteristic of actively regulating learning which achieves the control objective. The theoretical development is specialized to a class of problems of controlling a time-varying linear system with random parameters. A specific algorithm is derived for this class of problems, and example problems are presented to demonstrate the computational feasibility of the new algorithm, the performance level of the new algorithm, and to give insight into the present theory. Finally, several areas of applications for the present results are outlined, and abstracts of technical papers supported by this contract are given.
Author (GRA)

N72-32065# Systems Control, Inc., Palo Alto, Calif.
DUAL CONTROL AND IDENTIFICATION METHODS FOR AVIONIC SYSTEMS. PART 2: OPTIMAL INPUTS FOR LINEAR SYSTEM IDENTIFICATION Final Report
Raman K. Mehra, Raman K. Stepner, James S. Tyler, Jr., and John A. Casti May 1972 80 p refs
(Contract F44620-71-C-0077; AF Proj. 9769; SCI Proj. 5971)
(AD-744116; AFOSR-72-1187TR-Pt-2) Avail: NTIS CSCL 12/1

The report presents the results of the second part of a one-year study on Dual Control and Identification Methods for Avionic Systems. First, a general theory is developed for designing optimal inputs to identify parameters in linear dynamic systems. It is shown that the optimal energy constrained input maximizing a weighted trace of the Fisher information matrix is an eigenfunction of a positive self-adjoint operator corresponding to its largest eigenvalue. Several numerical algorithms are described for computing the optimal inputs. A computer program based on the Riccati Equation algorithm is developed and used for computing optimal elevator deflection time histories to identify the short period stability and control derivatives of C-8 aircraft. Author (GRA)

N72-32066# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
A STUDY OF THE EFFECTS OF PARAMETER VARIATION ON THE FLYING QUALITIES OF THE XV-4B V/STOL AIRCRAFT Technical Report, Oct. 1967 - Oct. 1969
Arthur G. Jones Mar. 1972 136 p refs
(AF Proj. 8219)
(AD-744104; AFFDL-TR-72-44) Avail: NTIS CSCL 01/3

The dominating influence of the propulsion system on the dynamic motion of a V/STOL aircraft operating in the hover or low-velocity flight modes has greatly increased the difficulty of developing such an aircraft to be stable and controllable during these modes. Small variations in stability derivatives caused by either changes in the propulsive system or errors in measurement or analytical prediction programs have been shown to cause significant changes in the dynamic characteristics of such aircraft. To better understand relationships, a program was performed using the Lockheed XV-4B jet-lift aircraft as a subject configuration. During this program, the magnitudes of ten of the stability derivatives used to describe the aircraft were varied individually, and the change in the roots of the linearized, uncoupled equations of motion noted. Author (GRA)

N72-32067# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
STATIC AND DYNAMIC NONLINEAR STRUCTURAL PROBLEMS Final Rept.
T. H. H. Pian and Pin Tong Mar. 1972 13 p refs
(F44620-67-C-0019; AF Proj. 9782)
(AD-744114; ASRL-TR-144-6; AFOSR-72-0808TR) Avail: NTIS CSCL 01/3

The objective of this research is to develop mathematical tools for determining stresses, deformation, and stability of aerospace vehicle structures. The nonlinear structural behavior, such as geometrical nonlinearity due to large deflection and the

material nonlinearity due to post-yielding and time-dependent behavior of the material, is included in the investigation.
Author (GRA)

N72-32068# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
DESIGN METHOD FOR FULLY AUGMENTED SYSTEMS FOR VARIABLE FLIGHT CONDITIONS Final Technical Report, 5 Oct. 1970 - 5 Sep. 1971
Albert J. VanDierendonck Wright-Patterson AFB, Ohio AFFDL Jan. 1972 300 p refs
(Contract F33615-71-C-1058; AF Proj. 8219)
(AD-744491; F0042FR; AFFDL-TR-71-152) Avail: NTIS CSCL 01/3

A practical controller design procedure for aircraft for their entire flight envelope is developed based on quadratic optimal control technology. The resulting design is an optimal gain schedule with some gains fixed and some gains variable. The procedure is applied to two example aircraft, the F4 Lateral-Direction Axes and the YF-12 Pitch Axis. Good handling qualities are a criteria for both examples. An additional criterion of minimizing accelerations due to flexure is included in the YF-12 design. The handling-quality criteria are expressed as model-following errors while the ride qualities are expressed as mean square accelerations. A computer algorithm is developed to solve this fixed-plus-variable-gain optimization problem with measurement realizability constraints. The algorithm successfully handled 11 flight conditions and 22nd-order dynamics over four flight conditions. A pole-placement algorithm is also extended to multiple flight conditions but is not applied. Author (GRA)

N72-32069# Owens-Illinois, Inc., Toledo, Ohio. Administrative Div.
PLASMA DISPLAY TERMINAL Final Report, 18 May - 18 Dec. 1971
Leonard J. Roth Griffiss AFB, N. Y. RADC May 1972 124 p refs
(Contract F30602-71-C-0272)
(AD-744096; RADC-TR-72-113) Avail: NTIS CSCL 09/5

The report contains the results of a study and test program to determine the feasibility of using an Owens-Illinois, Inc. DIGIVUE model 512/60 (sixty element per linear inch) plasma display/memory device in military airborne environments. The study used MIL-E-5400L, Class 1A as a baseline. Five panels were tested to the following MIL-STD-810B environments: Altitude: Method 500, Procedure 1; High Temperature: Method 501, Procedure II, 2 cycles only; Low Temperature: Method 502; Temperature Shock: Method 503, Step 1-5, 8-10; Temperature-Humidity-Altitude: Method 518 (Modified), one cycle only and limited to the following thermal conditions: Operating -25 C to -55 C, Non-Operating -62 C to -85 C. GRA

N72-32072*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND COLD-AIR INVESTIGATION OF A TURBINE FOR A SMALL LOW-COST TURBOFAN ENGINE
Milton G. Kofskey and William J. Nusbaum Washington Sep. 1972 33 p refs
(NASA-TN-D-6967; E-6850) Avail: NTIS HC $3.00 CSCL 10A

An 8.00-in mean diameter two-stage turbine was investigated over a range of speeds from 0 to 110 percent of equivalent design speed and over a range of pressure ratios from 1.79 to 5.14. Presented are design information and turbine performance for first-stage and two-stage operation. Results are presented in terms of equivalent specific work, torque, mass flow, rotor exit flow angle, and efficiency. Author

N72-32183# Federal Aviation Administration, Washington, D.C.
REPORT ON LIVE TEST OF A CATHODE-RAY TUBE (CRT) TERMINAL AS AN M-28 TELETYPE REPLACEMENT
May 1972 19 p
(AT-7330-OT) Avail: NTIS HC $3.00

Benefits are examined which can be gained from the use of ASCII terminals in air traffic control teletypewriter operations. The experiment covered 60 days of on-circuit testing. Attention was focused on message functions associated with preparation (formatting and editing) and queueing (message storage prior to transmission). K.P.D.

N72-32245# Bendix Corp., Sidney, N.Y. Electrical Components Div.
RELIABLE INTEGRATED WIRE TERMINATION DEVICES Semiannual Report, 1 Jul. - 31 Dec. 1971
D. L. Pfendler and D. H. Gould Jun. 1972 93 p refs
(Contract DAAB07-71-C-0090; DA Proj. 1F1-62203-A-119)
(AD-744476; ECOM-0090-2) Avail: NTIS CSCL 09/1

The purpose of the investigation is to cover the design and evaluation of a wire termination system capable of interconnection to a variety of multi-contact connectors such as cylindrical, rectangular rack and panel, printed circuit board, and terminal junction devices. The connective devices are to be capable of assembly and maintenance with a common tool for terminal insertion and withdrawal. In addition, the various connective devices shall be capable of reliably withstanding the environmental conditions encountered by both ground and airborne Army equipment. Primary emphasis is directed toward a significant improvement of the reliability and maintainability of wiring systems in Army aircraft. Protype test samples containing size 22D terminals have been fabricated and tested. Prototype test samples containing size 20 terminals (both metallic and dielectric retention) are being fabricated and will be evaluated according to the prepared test procedure. Terminal insertion and removal tools have been revised and will be evaluated according to a test procedure to be prepared. Author (GRA)

N72-32264*# Scientific Translation Service, Santa Barbara, Calif.
WIND TUNNEL CORRECTIONS FOR MEASUREMENTS OF TWO-DIMENSIONAL PROFILES IN THE TRANSONIC WIND TUNNEL OF THE AERODYNAMIC TESTING FACILITY GOETTINGEN
P. Mackrodt Washington NASA Jun. 1972 16 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick), v. 19, Nov. 1971 p 449-454
(NASA-TT-F-14316) Avail: NTIS HC $3.00 CSCL 14B

Pressure distribution measurements on an airfoil at high subsonic speed were carried out in the transonic wind tunnel of the AVA Goettingen 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

N72-32270# Federal Aviation Administration, Washington, D.C.
MANTI-EPHRAIM AIRPORT, PROJECT 72-1-07-49-0018-01, EPHRAIM, UTAH. Final Environmental Impact Statement
27 Apr. 1972 33 p Supersedes PB-207064-D
(PB-207064-F; PB-207064-D; ELR-4333) Avail: NTIS HC $3.00 CSCL 13B

The proposed action, is to improve the general aviation airport at Manti-Ephraim, Utah. The airport is located between the towns of Ephraim and Manti and some increase in noise pollution will occur as traffic increases. Infrequent usage by business jet aircraft will occur. Author

N72-32271# Federal Aviation Administration, Washington, D.C. Airports Service.
BAXLEY MUNICIPAL AIRPORT, BAXLEY, GEORGIA Final Environmental Impact Statement

14 Apr. 1972 30 p Supersedes PB-206167-D
(PB-206167-F; PB-206167-D; ELR-4227) Avail: NTIS HC $3.00 CSCL 13B

The project is to extend and widen the existing paved runway at the Baxley, Georgia, airport. There will be approximately 10 acres of clearing, slightly increased noise levels due to occasional operations of twin-engine business aircraft, slightly increased air pollution due to operation of these aircraft, and short term adverse environmental effects associated with normal construction techniques. GRA

N72-32272# Federal Aviation Administration, Washington, D.C. Airports Service.
DADE COUNTY AIRPORT, TRENTON, GEORGIA Final Environmental Impact Statement
27 Apr. 1972 49 p Supersedes PB-205578-D
(PB-205578-F; PB-205578-D; ELR-4334) Avail: NTIS HC $3.00 CSCL 13B

The project is to construct a basic utility airport adequate for propeller driven aircraft weighing less than 12,500 pounds. There will be approximately 10 acres of clearing, slightly increased intermittent noise levels, slightly increased air pollution, and short-time adverse environmental effects associated with normal construction techniques. GRA

N72-32273# Federal Aviation Administration, Washington, D.C. Airports Service.
JASPER-PICKENS COUNTY AIRPORT, JASPER, GEORGIA Final Environmental Impact Statement
27 Apr. 1972 43 p Supersedes PB-204959-D
(PB-204959-F; PB-204959-D; ELR-4332) Avail: NTIS HC $3.00 CSCL 13B

Pickens County, Georgia, proposes a project to construct a general utility airport adequate to accommodate propeller aircraft of less than 12,500 pounds. There will be about 100 acres of tree clearing, slightly increased intermittent noise levels, slightly increased air pollution, and short-term adverse environmental effects associated with normal construction techniques. GRA

N72-32274# Federal Aviation Administration, Washington, D.C. Airports Service.
NEILLSVILLE MUNICIPAL AIRPORT, NEILLSVILLE, WISCONSIN Final Environmental Impact Statement
14 Apr. 1972 51 p Supersedes PB-204576-D
(PB-204576-F; PB-204576-D; ELR-4228) Avail: NTIS HC $3.00 CSCL 13B

The proposed project includes four items of work to be performed in the development of a new airport. The development will probably cause the following adverse environmental effects: elimination of producing farm land, a slight increase in dust quantity during construction, and a slight increase in ambient noise near the airport. GRA

N72-32275# Federal Aviation Administration, Washington, D.C. Airports Service.
IOWA, OTTUMWA-WAPELLO COUNTY, OTTUMWA INDUSTRIAL AIRPORT, IOWA Final Environmental Impact Statement
27 Apr. 1972 18 p Supersedes PB-207235-D
(PB-207235-F; PB-207235-D; ELR-4329) Avail: NTIS HC $3.00 CSCL 13B

The proposal is described for the installation of an instrument landing system (ILS) and approach lighting system (ALS) for Runway 13/31 (NW/SE). Most of the proposed work is located within the existing boundaries of the airport, except for additional land used for installation of the ALS. Author

N72-32276# Federal Aviation Administration, Washington, D.C. Airports Service.
ASHE COUNTY AIRPORT AUTHORITY, WEST JEFFERSON, NORTH CAROLINA Final Environmental Impact Statement
26 Apr. 1972 28 p Supersedes PB-206552-D
(PB-206552-F; PB-206552-D; ELR-4295) Avail: NTIS HC $3.00 CSCL 13B

The project is to construct a general utility airport which will accommodate substantially all propeller-driven aircraft weighting less than 12,500 pounds. There will be slightly increased intermittent noise levels, slightly increased air pollution and short term adverse environmental effects associated with normal construction techniques. GRA

N72-32277# Federal Aviation Administration, Washington, D.C. Airports Service.
HEMPHILL MUNICIPAL AIRPORT, HEMPHILL, TEXAS Final Environmental Impact Statement
27 Apr. 1972 49 p Supersedes PB-206262-D
(PB-206262-F; PB-206262-D; ERU-433) Avail: NTIS HC $3.00 CSCL 13B

The new Sabine County, Texas, airport is expected to be used primarily by light piston-powered aircraft. It is not expected that the proposed project will measurably increase air or water pollution. Due to location of airport in a substantially uninhabited area, low levels of noise generated by light aircraft operations will have minimal impact. GRA

N72-32278# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
MAT SETS, LANDING Final Report
16 Feb. 1972 7 p refs
(AD-741857; TOP-7-3-070) Avail: NTIS CSCL 01/5

The report describes a method for evaluation of landing mat sets operational and functional performance characteristics. It identifies supporting tests, facilities, and equipment required. It provides procedures for functional performance tests.
Author (GRA)

N72-32279# Dayton Univ. Research Inst., Ohio.
RUNWAY DISTRIBUTION STUDY, EUROPEAN COUNTRIES
Robert P. Boehmer Apr. 1972 173 p refs
(Contract F33615-72-C-1049)
(AD-742096; UDRI-TR-72-22) Avail: NTIS CSCL 01/5

The purpose of this study was to establish the distribution of main operating bases (MOB) and forward operating bases (FOB) within 18 European countries. Each country was divided into cells of equal area and the distributions of the runways are with respect to the midpoints of the cells. The report graphically presents the airfield distributions generated by this study. The results are to be used in conjunction with an airlift study to determine the effectiveness of STOL and VTOL aircraft.
Author (GRA)

N72-32280# Dayton Univ. Research Inst., Ohio.
RUNWAY DISTRIBUTION STUDY, SELECTED COUNTRIES Technical Report, Sep. 1970 - Sep. 1971
Robert P. Boehmer Sep. 1971 337 p refs
(Contract F33615-71-C-1075)
(AD-742093; UDRI-TR-71-48) Avail: NTIS CSCL 01/5

The purpose of this study was to establish the distribution of main operating bases (MOB) and forward operating bases (FOB) within 44 selected countries. Each country was divided into cells of equal area and the distributions of the runways are with respect to the midpoints of the cells. The report graphically presents the airfield distributions generated by this study. The results are to be used in conjunction with an airlift study to determine the effectiveness of STOL and VTOL aircraft.
Author (GRA)

N72-32281# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
APPLICATION OF MODULE THEORY TO DESIGN AND

EVALUATION OF AIRFIELD PAVEMENT
Y. T. Chou and O. O. Thompson Mar. 1972 80 p refs
(DA Proj. 4A0-61102-A-859)
(AD-741368; AEWES-Misc-Paper-S-72-7) Avail: NTIS CSCL 01/5

Model-to-prototype similitude requirements were developed in the study for unsurfaced, landing-mat-surfaced, and conventional flexible and rigid pavement structures for airfields. An extensive literature search of model studies was first conducted. The general concept of dimensional analysis in the area of pavement systems was then introduced, followed by identification of important variables, development of pi terms, and formulation of similitude requirements for true and distorted models. A compensated model that distorts one or more design conditions in such a manner that the distortion is compensated is proposed for pavement systems. Other uses of model facilities are also discussed herein. Author (GRA)

N72-32282# Northrop Corp., Hawthorne, Calif. Aircraft Div.
PRELIMINARY DESIGN STUDY FOR AN ADVANCED FIGHTER TYPE IN-FLIGHT SIMULATOR Final Report, 22 Mar. - 22 Oct. 1971
J. T. Gallagher, I. Saworotnow, and R. J. Seemann Wright-Patterson AFB, Ohio AFFDL Oct. 1971 96 p refs
(Contract F33615-71-C-1366; AF Proj. 8219)
(AD-743970; NOR-71-207; AFFDL-TR-71-149) Avail: NTIS CSCL 14/2

A need was identified for an advanced fighter type inflight simulator. A preliminary design study was conducted to determine the nature and extent of modifications required to convert an existing airplane into an effective, large amplitude six-degree-of-freedom inflight simulator. Conceptual designs of the airplane configuration and variable stability system lead to a preliminary design of a model-following flight control system employing an airborne digital computer to be carried in a modified version of the Agile Eagle II F-4E. The preliminary design involved reconfiguration of the structural, electrical, and hydraulic systems of the airplane. The front and rear cockpits were reconfigured and aerodynamic analyses performed to establish the force and moment capability available to the variable stability system. The performance envelope of the modified airplane was established and the preliminary design study indicated that large amplitude six-degree-of-freedom total mission simulation was realizable with state-of-the-art equipment and techniques. Author (GRA)

N72-32283# Naval Postgraduate School, Monterey, Calif.
A FIXED BASE VARIABLE STABILITY CARRIER APPROACH LANDING SIMULATOR (CALS) M.S. Thesis
John Henry Kahrs, III Mar. 1972 96 p refs
(AD-743768) Avail: NTIS CSCL 14/2

The report describes the design and construction of a fixed-base variable-stability simulator facility combined with the task of landing to a carrier or runway. The solution was mechanized on a hybrid computer with the analog computer solving the equations of motion and the digital computer used for storage, control and graphics generation. The display was in the form of a computer drawn picture on a graphics terminal. Control was by a simulated cockpit placed in front of the display and connected to the analog computer. This project was undertaken not as a design of a training aid but rather as a research tool for further studies in control systems, human engineering and aircraft dynamics. Author (GRA)

N72-32284# Research Analysis Corp., McLean, Va.
TRANSPORTATION SYSTEMS FOR MILITARY AND CIVILIAN OPERATIONS IN NORTHERN REGIONS
N. Ray Sumner, Jr., Stanley Alper, Edward W. Girard, and Andrus Villu Jun. 1972 130 p refs
(Contract DAHC19-69-C-0017)
(AD-743990; RAC-TP-450) Avail: NTIS CSCL 15/5

The report examines the performance and cost of various transportation systems in the northern (Arctic) environment. The scenarios used include both civilian and military transportation problems, and the study explores some of the relationships among these in an Alaskan environment. Systems examined include such conventional systems as railroads, trucks, boats, and tracked vehicles, plus more advanced systems as fixed- and rotary-wing aircraft and surface effect vehicles (SEVs). In addition to these comparative analyses, certain specific issues are examined in some detail. Included in such issues are the economics of using SEVs as transitional vehicles in undeveloped regions, prior to investment in roads and railroads, the potential utility of a SEV-helicopter team in search and rescue missions, and the relationship between transportation and Alaskan development. Author (GRA)

N72-32302*# Scientific Translation Service, Santa Barbara, Calif.
SUBSONIC AND SUPERSONIC FLOW AROUND NONAXISYMMETRIC FUSELAGES
Hermann Rothman Washington NASA Sep. 1972 20 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick), v. 20, Mar. 1972 p 98-105
(Contract NASw-2035)
(NASA-TT-F-14547) Avail: NTIS HC $3.00 CSCL 20D

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

N72-32457# Advisory Group for Aerospace Research and Development, Paris (France).
FLIGHT RECORDING IN NATO COUNTRIES, SECOND EDITION
Hollis G. Zerkle, ed. Jul. 1972 75 p refs
(AGARD-AR-39) Avail: NTIS HC $5.75

The characteristics and applications of flight recording instruments in NATO countries is discussed. The instruments and systems are presented according to manufacturer and the standard format contains the following data: (1) general information, (2) scope, (3) basic principles, (4) main characteristics, (5) history, (6) operational experience, and (7) installation. Flight recording projects leading to the development of new instruments are discussed, using similar format. A bibliography of pertinent reports and documents on various aspects of flight recorder application and performance is provided. Author

N72-32458*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODULARIZED INSTRUMENT SYSTEM FOR TURBOJET ENGINE TEST FACILITIES
William C. Nieberding and D. R. Englund, Jr. 1972 26 p ref Presented at Symp. on Instrumentation for Airbreathing Propulsion, Monterey, Calif., 19-21 Sep. 1972; sponsored in part by AFAPL, Naval Air Systems Command, Army Aviation R and D Labs., ONR, and AFOSR
(NASA-TM-X-68123; E-7089) Avail: NTIS HC $3.50 CSCL 14B

A modular instrument system is being developed to handle the many data channels encountered in turbojet engine testing. Each module contains a group of transducers and all the signal conditioning multiplexing, and digitizing electronics necessary for

direct interface with a digital computer. The digital interface within each module is the same for all modules; in addition, each module provides a controlled environment for its contents. A minicomputer in the control room gathers the data, performs on-line calculation and display, and interfaces with a shared recording and computing system. The advantages of this system are: (1) reduced manpower for system installation, setup, and checkout; (2) standardized equipment interfaces; (3) increased reliability through automatic system testing and minimization of manual adjustments; and (4) reduced cost through minimization of wiring and simplification of control room display. Author

N72-32459*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PYROMETER FOR MEASUREMENT OF SURFACE TEMPERATURE DISTRIBUTION ON A ROTATING TURBINE BLADE
Donald R. Buchele and Daniel J. Lesco 1972 21 p refs Presented at Symp. on Instrumentation for Airbreathing Propulsion, Monterey, Calif., 19-21 Sep. 1972
(NASA-TM-X-68113) Avail: NTIS HC $3.25 CSCL 14B

A conceptual optical method and some test results are presented for measuring the surface temperature distribution on one of the rotating turbine blades with a surface resolution of 0.05 cm spot diameter at a tip speed of 400 m/sec. The blade is scanned line-by-line by a fixed optical system. During each line-scan, the detector analog output signal is converted to two hundred consecutive digital values that are temporarily stored in a high speed buffer memory, and then transferred at a slower rate to a computer for processing. The signal-to-noise ratio of the silicon avalanche detector is large enough to obtain an accuracy of one percent at 1050 K blade temperature. By averaging 25 scans of the same line the same accuracy can be obtained at 900 K. Author

N72-32476# Army Aeromedical Research Lab., Fort Rucker, Ala.
HELICOPTER IN-FLIGHT MONITORING SYSTEM
Harlie W. Huffman, Mark A. Hofmann, and Michael R. Sleeter Mar. 1972 42 p
(DA Proj. 3A0-62110-A-819)
(AD-745118; USAARL-72-11) Avail: NTIS HC $4.25 CSCL 14/2

A helicopter in-flight monitoring system is described. This system measures and records in real time, all six degrees of freedom of the aircraft, cyclic, collective, and pedal inputs as well as some status values. Author

N72-32483# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
A TECHNIQUE FOR MEASURING IN-PLANE DISPLACEMENTS BY HOLOGRAPHIC INTERFEROMETRY Technical Report, Jan. - Sep. 1971
Frank D. Adams and Richard R. Corwin Feb. 1972 32 p refs
(AF Proj. 1467)
(AD-744490; AFFDL-TR-72-5) Avail: NTIS CSCL 14/2

An experimental technique for measuring in-plane displacements from a single hologram is described. The method is based upon imaging the entire wave reflected from a single point and recorded on a hologram. Experimental results are presented. Application and limitations of the technique are discussed. Author (GRA)

N72-32484# ARO, Inc., Arnold Air Force Station, Tenn.
THE DEVELOPMENT OF A TEMPERATURE MEASURING PROBE FOR USE IN A TWO-PHASE (GAS-LIQUID) ENVIRONMENT Final Report
John M. Pelton, H. K. Clark, and R. A. Paulk AEDC Jun. 1972 47 p refs
(Contract F40600-72-C-0003; ARO Proj. RW0856; ARO Proj. RW2116; ARO Proj. RW2216)
(AD-744513; ARO-ETF-TR-71-228; AEDC-TR-72-19) Avail: NTIS CSCL 14/2

A series of aspirating thermocouple probes was designed and built to measure the gas temperature in a two-phase (gas-liquid) system similar to that encountered in a jet engine exhaust gas spray color. These probes were tested over a wide range of flow conditions to determine the probe performance and to determine the influences of probe size, relative flow angle, and aspiration pressure ratio on the temperatures measured by the probe. The final configuration of the aspirating thermocouple measured the gas phase temperature over the range from 710 to 81 degrees R when operating at liquid-to-gas flow rates from 0.13 to 2.3, at 13.0-psia pressure and free-stream Mach numbers in the range from 0.05 to 0.08. Author (GRA)

N72-32503# Curtiss-Wright Corp., Wood-Ridge, N.J.
IMPROVED MANUFACTURING METHOD FOR PROCESSES FOR SUPER FINISHED SPUR AND HELICAL GEARS Final Report, 7 Aug. 1969 - 7 Mar. 1971
Neil DeBruyne 1972 93 p
(Contract DAAJ01-70-C-0171)
(AD-742655; CW-WR-69-114 F) Avail: NTIS CSCL 13/9

The report presents the results of an experimental program which evaluates the scuffing resistance properties of a conventional (AISI 9310) and an advance high hot hardness steel (Vasco-Jet 1000-2) gear material when various surface treatments and methods of surface finishes are used. Author (GRA)

N72-32507# Franklin Inst., Philadelphia, Pa.
DERIVATION OF A FATIGUE LIFE MODEL FOR GEARS Final Report, 25 Jun. 1970 - 25 Nov. 1971
John H. Rumbarger and Larry Leonard May 1972 130 p refs
(Contract DAAJ02-70-C-0068; DA Proj. 1G1-62203-D-144)
(AD-744504; FIRL-F-C2864; USAAMRDL-TR-72-14) Avail: NTIS CSCL 13/9

A load-life model is developed for calculating the fatigue life and reliability of a spur gear mesh. The dynamic capacity of a gear mesh is defined as the tangential load which can be transmitted for one million pinion revolutions with a 90% probability of survival. The model is an extension of the currently accepted Lundberg-Palmgren Rolling Element Bearing Life Model. Limited rolling contact testing of cylindrical samples with and without traction in the contact was accomplished. At a low coefficient of traction (below 0.1), no statistically significant effect on fatigue life was noted. Scanning electron microscopy studies were performed of all test samples. One rolling test sample was SEM examined periodically during testing to observe initiation and progression of failure. Numerical examples are presented for the calculation of the dynamic capacity of a standard contact ratio and a high contact ratio spur gear mesh. Author (GRA)

N72-32579# Army Aeromedical Research Lab., Fort Rucker, Ala.
IMPROVING US ARMY AIRCRAFT PROPELLER AND TAIL ROTOR BLADE CONSPICUITY WITH PAINT
John K. Crosley, Ronald G. Tabak, Erwin G. Braun, and Robert W. Bailey May 1972 25 p refs
(DA Proj. 3A0-62110-A-819)
(AD-744453; USAARL-72-15) Avail: NTIS CSCL 11/3

Rotating propellers and tail rotors represent a potential hazard for personnel while aircraft are on the ground. This study was conducted to ascertain if rotating blades could be visually detected more easily by the judicious application of paint. A total of twenty-two observers rated nine different paint schemes for effectiveness. The results showed that (1) the two schemes presently being used on Army aircraft rated the poorest of all those investigated, and (2) the most conspicuous scheme was one which had (from the tip toward the hub) a four inch section painted red-orange fluorescent, with the remaining surface divided into thirds and painted alternately flat black and gloss white. The black and white sections of the other half of the blade were reversed to provide a nonconcentric pattern. Author (GRA)

N72-32596# Army Foreign Science and Technology Center, Charlottesville, Va.
SOLUTION OF ONE PROBLEM IN NONLINEAR PROGRAMMING
G. T. Kalchenko and A. Ya. Shidlovskii 1972 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv., Ser. Fiz. i Tekh Nauk (Riga), no. 3, 1966 p 93-96
(AD-743569; FSTC-HT-23-848-71) Avail: NTIS CSCL 12/1

The article presents an approximate method for solution of the problem of maximization of a nonlinear separable function with bilateral limitations on the unknowns and fixed general lower boundary of the modulus of the unknowns difference. The possibility is demonstrated of applying this method to some problems of air traffic control. Author (GRA)

N72-32639*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
AN ALGORITHM FOR TERMINAL AIR TRAFFIC CONTROL
Alexander H. Sarris and Michael Athans Dec. 1971 40 p refs
(Grants NGL-22-009-124; AF-AFOSR-1941-70)
(NASA-CR-128298; ESL-P-466) Avail: NTIS HC $4.00 CSCL 17G

An area-navigation method for automatic control of aircraft arriving in a random fashion from the en-route centers to the near terminal area is proposed. Control is exercised by a ground computer that sequences and schedules the aircraft. Altitude segregation is used to separate aircraft in velocity classes. Merging of all aircraft occurs near the outer marker. The merging region is designed so that no near misses will occur if the aircraft follow the assigned trajectories. Author

N72-32640# Joint Publications Research Service, Arlington, Va.
HEADING INDICATING AND AUTOMATIC FLIGHT CONTROL SYSTEMS ON AIRPLANES OF THE CIVIL AVIATION SERVICE
N. M. Bogdanchenko, G. Yu. Voloshin, and V. S. Belykh 15 Sep. 1972 304 p refs Transl. into ENGLISH of the book "Kursovyye Sistemy i Navigatsionnyye Avtomaty Samoletov Grazhdanskoy Aviatsii" Moscow, Transport Publishing House, 17 Jun. 1971 268 p
(JPRS-57031) Avail: NTIS HC $17.25

The general principles are presented of the structure and operation of heading indicator systems, astrocompasses and automatic navigation systems. A study is made of the problems of the errors, causes of their occurrence and methods of improving the operating precision of the indicated devices. The problems of the volume, content and procedures of technical servicing and maintenance are discussed. A general procedure is presented for determining the basic reliability characteristics of the devices, and the general principles of technical diagnostics of failures are given. Heading indicator systems, astrocompasses and automatic navigation systems used on civil aircraft are described. Author

N72-32642# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
VOR TACAN LOW ALTITUDE FLIGHT CHECK SUMMARY
Frank Bassett [1972] 42 p
Avail: NTIS HC $4.25

A low altitude flight check to determine the accuracy of VOR Tacan air navigation aid is discussed. To calculate bearing ergors, eight arbitrary points were used, the four cardinal points and the four semicardinal points. The method used to extract the data and prepare the error summary is described. Charts are included to present the results of the numerical analysis. Author

N72-32644# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
CONCEPT DEVELOPMENT AND EVALUATION OF AIRBORNE TRAFFIC DISPLAYS Ph.D. Thesis
Thomas Imrich Jun. 1971 105 p refs
(FTL-R71-2) Avail: NTIS HC $7.25

A system concept for a cockpit traffic situation display (TSD) was developed and a preliminary evaluation was undertaken to investigate the effect of a TSD on safety, efficiency, and capacity in the 3rd generation NAS/ARTS ATC system environment. The optimum display configuration, examples of procedural changes, benefits to the pilot, and benefits to ATC are discussed. The test program was conducted in three phases: basic tracking tests, ATC procedural tests, and spacing tests using position command data. Both quantitative and qualitative measures were used for determining safety, pilot and controller workload, and task performance. Pilot response to the TSD as a safety device was strongly favorable. In tasks which involved limited pilot participation in the ATC control process, improvements in spacing accuracy and a decrease in communications at satisfactory pilot workload levels were demonstrated. Author

N72-32645# Mitre Corp., McLean, Va.
CONCEPTS, DESIGN AND DESCRIPTION FOR THE UPGRADED THIRD GENERATION AIR TRAFFIC CONTROL SYSTEM, AS OF JANUARY 1972. CONUS ATC SYSTEM. OCEANIC ATC SYSTEM
Jan. 1972 145 p refs Sponsored by FAA
(AD-743635; FAA-ED-01-1) Avail: NTIS CSCL 17/7

The document presents the concepts and an overall system design which is capable of satisfying specific goals and objectives presently established for the system of the late 1970s and the 1980s. It describes the proposed new features, equipment, and automation now being programmed for development and evaluation. The emphasis is on the bases for the proposed design and the operational implications of the design for both the aircraft operators and pilots and for the air traffic controllers and flight services specialists. Author (GRA)

N72-32648# National Bureau of Standards, Washington, D.C.
EXTENSION OF A CAPACITY CONCEPT TO DUAL USE RUNWAYS AND MULTI-RUNWAY CONFIGURATIONS Final Report
W. A. Horn Dec. 1971 113 p refs
(Contract DOT-FA69WAI-166)
(AD-744481; NBS-10593; FAA-RD-71-19) Avail: NTIS CSCL 17/7

The document is based on a previous investigation which yielded a maximum throughput rate concept for the capacity of a facility serving a single stream of customers of various types, in particular a runway serving a stream of landing aircraft. The present study develops four extensions of this concept, of progressively broader scope, to facilities serving several customer-streams. An explicit capacity-formula is derived for each extension. The second extension is applied to a runway serving both landings and takeoffs, while the final extension provides a theoretical basis for evaluating the capacity of complexes of runways at airports. An appendix gives several illustrations of how such results can be used to analyze the enhancement of capacity of appropriate settings of operational parameters. Author (GRA)

N72-32649# Army Aeromedical Research Lab., Fort Rucker, Ala.
DIFFERENTIAL VELOCITY AND TIME PREDICTION OF MOTION
Kent A. Kimball, Mark A. Hofmann, and Richard O. Nossaman Apr. 1972 25 p refs
(DA Proj. 3A0-62110-A-819)
(AD-745119; USAARL-72-14) Avail: NTIS HC $3.25 CSCL 17/7

The effects of differential target velocity, horizontal or vertical plane conditions, and air traffic controller experience were investigated for intersection time estimation accuracy of two converging targets. Accuracy in magnitude and direction

was found to vary significantly as a function of cursor speed, with slower speeds producing poorer performance. A differential effect for various speed combinations was also noted. Estimation accuracy on the lowest cursor speed when paired with the two faster speeds was decreased, while accuracy on the intermediate speed was degraded when combined with either slower or faster speeds. Estimations on the fastest speed were not affected by differential pairings. Author

N72-32742*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ECONOMIC STUDY OF FUTURE AIRCRAFT FUELS (1970-2000)
Arthur D. Alexander, III Sep. 1972 30 p refs
(NASA-TM-X-62180) Avail: NTIS HC $3.50 CSCL 21D

Future aircraft fuels are evaluated in terms of fuel resource availability and pricing, processing methods, and economic projections over the period 1970-2000. Liquefied hydrogen, methane and propane are examined as potential turbine engine aircraft fuels relative to current JP fuel. Author

N72-32746 Engineering Sciences Data Unit, London (England).
CURVES FOR USE IN THE DETERMINATION OF GROSS THRUST AND MASS FLOW IN FLIGHT. (AIR BREATHING DUCTED-FLOW ENGINES WITH CONVERGENT NOZZLES)
Apr. 1969 21 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-69008) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Curves are presented for use with total head and static pressure sampling methods for measurement of thrust and flow in flight. Gamma curves for combustion products are given for various fuel/air mixtures. The two sampling methods are analyzed mathematically for gross thrust, mass flow, and choking pressure ratio. K.P.D.

N72-32747 Engineering Sciences Data Unit, London (England).
THE DETERMINATION OF GROSS THRUST AND MASS FLOW IN FLIGHT. (AIR BREATHING DUCTED-FLOW ENGINES WITH CONVERGENT NOZZLES)
Mar. 1969 10 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-69007) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The measurement of gross thrust and nozzle mass flow is considered. These may be calculated from the total pressure, static pressure, and total temperature distribution. Techniques involving measurements in the jet pipe are discussed, as well as techniques for measurements in the efflux. K.P.D.

N72-32748 Engineering Sciences Data Unit, London (England).
INTRODUCTION TO THE MEASUREMENT OF THRUST IN FLIGHT. (AIR BREATHING DUCTED-FLOW ENGINES)
Jul. 1969 10 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-69006) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Intrinsic thrust and drag are considered for air breathing engines in flight. A definition of standard thrust is given. Overall thrust and the compatibility of thrust and external force definitions are discussed. K.P.D.

N72-32754*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRCRAFT ENGINE POLLUTION REDUCTION
Richard A. Rudey 1972 10 p refs Presented at EASCON 72, Washington, D. C., 16-17 Oct. 1972
(NASA-TM-X-68129; E-7118) Avail: NTIS HC $3.00 CSCL 21A

The effect of engine operation on the types and levels of the major aircraft engine pollutants is described and the major factors governing the formation of these pollutants during the burning of hydrocarbon fuel are discussed. Methods which are being explored to reduce these pollutants are discussed and their application to several experimental research programs is pointed out. Results showing significant reductions in the levels of carbon monoxide, unburned hydrocarbons, and oxides of nitrogen obtained from experimental combustion research programs are presented and discussed to point out potential application to aircraft engines. Author

N72-32755# Royal Aircraft Establishment, Farnborough (England).
POSSIBILITIES FOR THRUST DETERMINATION IN AN AIRCRAFT
Heinz Dissen Aug. 1972 19 p refs Transl. into ENGLISH from Z. Flugwiss. (West Ger.), v 19, no. 4, 1971 p 173-279
(RAE-Lib-Trans-1650) Avail: NTIS HC $3.00

A series of possible methods for thrust determination in an aircraft are described. An indication of the thrust can be made use of in the test phase of an aircraft; but it can also be employed at a later stage for monitoring of the propulsion unit, for propulsion unit and flight control, and, finally, for flight optimization. Indirect methods for thrust measurement are described, and the relation between the measurement parameters and the thrust is indicated. The sensitivity of the procedure to measurement errors is considered. Finally, the problems of a direct thrust measurement are considered; and the necessary requirements on the propulsion unit mounting are stated. The procedure most likely to solve the problems described is a direct thrust measurement. Author

N72-32756# Dayton Univ. Research Inst., Ohio.
COMPUTER PROGRAMS FOR SINGLE STAGE AXIAL COMPRESSOR TEST DATA ANALYSIS. VOLUME 2: PROGRAM LISTINGS AND SAMPLE CALCULATIONS Final Technical Report, 16 Jun. 1971 - 17 Apr. 1972
Richard M. Hearsey Wright-Patterson AFB, Ohio AFAPL Jun. 1972 196 p refs
(Contract F33615-71-C-1751; AF Proj. 3066; AF Proj. 7065)
(AD-744503; UDRI-TR-72-21-Vol-2; AFAPL-TR-72-43-Vol-2)
Avail: NTIS CSCL 21/5

A pair of special-purpose computer programs have been written for the analysis of axial compressor aerodynamic test data. The axisymmetric flow of a thermally-perfect compressible fluid is assumed, and the streamline curvature method of solution is employed. By optionally incorporating details of the blade geometry in the input data, a detailed account of the flow through the blading may be obtained. A unique feature of the analysis is the option to determine annulus blockage due to boundary layers and blade wakes by utilizing experimental wall static pressure readings in addition to the usual traverses of total pressures and temperature. This second volume of two that describe the programs contains program and sample input data listings, and the corresponding computed results. Author (GRA)

N72-32759*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUASI-THREE-DIMENSIONAL CALCULATION OF VELOCITIES IN TURBOMACHINE BLADE ROWS
Theodore Katsanis 1972 20 p refs Proposed for Presentation at Winter Ann. Meeting of the ASME, New York, 12-16 Nov. 1972
(NASA-TM-X-67959; E-6666) Avail: NTIS HC $3.00 CSCL 21E

A practical way of obtaining an approximation to a three dimensional flow is to combine several two-dimensional solutions (quasi-three-dimensional solution). Three basic types are discussed of two-dimensional solutions (meridional, blade-to-blade, and channel) and several ways of combining them. A centrifugal impeller is analyzed as an example. All recommended methods are based on available NASA general purpose computer programs. Author

N72-32762*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DRIVE TURBINE SYSTEM FOR 20-INCH TURBOFAN SIMULATORS. 2: CORE TURBINE DESIGN
Warren J. Whitney Sep. 1972 20 p refs
(NASA-TM-X-68130; E-7121) Avail: NTIS HC $3.00 CSCL 21E

Drive-turbines for a given set of 20-inch turbo-fan simulators are described. The simulators had both single-stage and two-stage fans that had design pressure ratios as low as 1.25 and as high as 3.0. The desired objective of the study was to be able to drive all of the single-stage fans with one core turbine and to drive all of the two-stage fans with this same core turbine in combination with a duct turbine. The core turbine is described. Included are the design operating conditions, design velocity diagram and a power-speed envelope determined by an off-design performance procedure. Also discussed is the adaption and scaling of an existing turbine design to this particular application. Author

N72-32763*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A CONCEPT FOR JET NOISE SUPPRESSION FOR AN AFTERBURNING TURBOJET ENGINE
Rene E. Chambellan and Robert J. Turek Oct. 1972 19 p refs
(NASA-TM-X-68144; E-7167) Avail: NTIS HC $3.00 CSCL 21E

A conceptual design of an afterburner system for turbojet engines which may reduce the jet exhaust noise by approximately 10 decibels is presented in this report. The proposed system consists of an array of swirl-can combustors and jet dividing nozzle tubes. The nozzle tubes translate axially upstream of the swirl cans when not in use. Results of preliminary design calculations and photographs of a kinematic model as applied to a hypothetical turbojet engine are presented. Author

N72-32765*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC AND ACOUSTIC PERFORMANCE OF TWO CHOKED FLOW INLETS UNDER STATIC CONDITIONS
Brent A. Miller and John M. Abbott Washington Sep. 1972 25 p refs
(NASA-TM-X-2629; E-7008) Avail: NTIS HC $3.00 CSCL 21H

Tests were conducted to determine the aerodynamic and acoustic performance of two choking flow inlets under static conditions. One inlet choked the flow in the cowl throat by an axial translation of the inlet centerbody. The other inlet employed a translating grid of airfoils to choke the flow. Both inlets were sized to fit a 13.97 cm diameter fan with a design weight flow of 2.49 kg/sec. The inlets were operated in both the choked and unchoked modes over a range of weight flows. Measurements were made of inlet pressure recovery, flow distortion, surface static pressure distribution, and fan noise suppression. Choking of the translating centerbody inlet reduced blade passing frequency noise by 29 db while yielding a total pressure recovery of 0.985. Noise reductions were also measured at 1/3-octave band center frequencies of 2500, 5000, and 20,000 cycles. The translating grid inlet gave a total pressure recovery of 0.968 when operating close to the choking weight flow. However, an intermittent high intensity noise source was encountered with this inlet that precluded an accurate measurement of inlet noise suppression. Author

N72-32768# ARO, Inc., Arnold Air Force Station, Tenn.
MEASUREMENT OF POLLUTANT EMISSIONS FROM AN AFTERBURNING TURBOJET ENGINE AT GROUND LEVEL. PART 1: PARTICULATE EMISSIONS Final Report, 23 Mar. - 13 May 1971
J. W. Gearhart and J. A. Benek AEDC Jun. 1972 54 p refs
(Contract F40600-72-C-0003; AF Proj. 3066; ARO Proj. RW-5139)
(AD-744048; ARO-ETF-TR-72-29-Pt-1; AEDC-TR-72-64-Pt-1) Avail: NTIS CSCL 13/2

Quantitative radiance measurements from NASA's ATS-3 geosynchronous satellite have been used to develop and test a statistical forecast method to predict air terminal weather over the very short range (0-6 hours) time period. Results from more than 800 hourly weather situations at a wide range of U.S. weather stations show that the parameters of ceiling and total opaque cloud cover can be specified or predicted with skill, exceeding persistence forecasts for time periods greater than two hours. Author (GRA)

N72-32769# ARO, Inc., Arnold Air Force Station, Tenn.
A KINETIC MODEL FOR TWO PHASE FLOW IN HIGH TEMPERATURE EXHAUST GAS COOLERS Final Report
John M. Pelton and C. E. Willbanks AEDC Jun. 1972 84 p refs
(Contract F40600-72-C-0003; ARO Proj. RW0856; ARO Proj. RW2116)
(AD-744514; ARO-ETF-TR-72-68; AEDC-TR-72-89) Avail: NTIS CSCL 21/8

An analytical model was developed to describe the thermodynamic and fluid dynamic processes in an exhaust gas cooler employing liquid water injection. The model is based on the solution of the equations of conservation of species, momentum, and energy for the system and the equations for the exchange of these quantities between liquid and gaseous phases. These equations are programmed for solution on an IBM 360 computer. The predictions of the model are compared with measured data from a series of turbojet tests in the Propulsion Development Test Cell (T-1) spray cooler. Author (GRA)

N72-32772# Defence Research Information Centre, Orpington (England).
ANALYSIS OF THE CONDITIONS OF OPERATION OF GAS TURBINE ROTOR BEARING FROM THE RESULTS OF COMPUTER CALCULATIONS OF THEIR THERMAL REGIMES
V. M. Demidovich and V. A. Chernoglazov Jun. 1972 10 p ref Transl. into ENGLISH from Tr. Seriya Aviats Divgateli (USSR), v. 110, 1969 p 122-127
(AD-744297; DRIC-Trans-2779) Avail: NTIS CSCL 21/5

In order to facilitate the practical application of methods of calculation of the thermal regime, and for speedy graphical analysis of the influence of basic parameters on the thermal regime, the authors conceived the idea of a large series of thermal calculations for bearings (a series of 4000) on the E.TS.V.M. 'Nairi'. The use of nomograms in the analysis of the effect of various parameters on the thermal regime of gas turbine rotor bearings can be helpful in the design of new bearing assemblies and oil systems for gas turbine engines. GRA

N72-32773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY AND DESIGN OF AIRCRAFT TURBOMACHINES
K. V. Kholshchevnikov 29 Feb. 1972 981 p refs Transl. into ENGLISH from the monograph "Teoriya i Raschet Aviatsionnykh Lopatochnykh Mashin" (USSR), 1970 p 1-610
(Contract F33657-71-D-0057; AF Proj. 6040)
(AD-744183; FTD-HC-23-754-71) Avail: NTIS CSCL 21/5

The textbook examines the fundamentals of turbomachine theory and also the configurations and operating principles of turbomachines of various types: axial, centrifugal, and mixed-flow compressors and axial turbines. Considerable attention is devoted to turbine and compressor performance and regulation and also the problems of matching their parameters in the gas turbine engine system. The text is intended for students of aviation colleges and schools. It may also be used by engineering and technical personnel working in aircraft engine construction. Author (GRA)

N72-32882*+ General Dynamics/Fort Worth, Tex.
LEVEL 12 NASTRAN EXPERIENCES AT GENERAL

DYNAMICS, CONVAIR AEROSPACE DIVISION, FORT WORTH OPERATIONS
Merle Allen *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1972 p 235-261 refs

Avail: NTIS CSCL 20K

The level 12 NASTRAN was used to support the NASA/LaRC advanced transport technology study, a predesign, short response time effort. Aeroelastic analyses were performed. NASTRAN calculated the vibration modes for the supported airfoil components and the entire unsupported vehicle. Other procedures were then used for the aeroelastic analysis, with procedure interfacing accomplished through use of the NASTRAN-produced restart tape. Stiffness matrices were used in static aeroelastic analyses; natural vibration modes were used for flutter and flight control system definition. Various level 12 NASTRAN characteristics were discovered and are discussed; e.g., the ability to solve singular matrices in rigid format 1, run times using multipoint constraints, restart tape problems, and the inaccurate stresses from the quad membrane when used with anisotropic materials. Author

N72-32884* Army Air Mobility Research and Development Lab., Fort Eustis, Va.
A COMPARISON OF THE CAPABILITIES OF THREE FINITE ELEMENT PROGRAMS
David D. Loendorf *In* NASA. Langley Res. Center NASTRAN Users' Experiences Sep. 1972 p 277-287 refs

CSCL 20K

Three finite element programs are compared to assess their capabilities as an analysis tool in a structural design process. Because of the need for repetitive analyses as an integral part of a design loop, a candidate program must be capable of handling large problems, operate efficiently, and be readily adaptable for use in computer-aided design. The three programs considered in the study, ELAS,SNAP, and NASTRAN, range from a relatively small finite element program limited to static structural analysis (ELAS) to a large complex general analysis system (NASTRAN). Results are given for comparative speeds and computer resources required for each program in the analysis of sample fuselage problems representative of practical aircraft design. Author

N72-32885* Lockheed-California Co., Burbank.
ADAPTATION OF NASTRAN TO AN INTEGRATED SYSTEM OF STRUCTURAL DESIGN ANALYSIS
Gernot W. Haggenmacher *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1972 p 289-302 refs

CSCL 20K

Efforts to integrate NASTRAN into a complete structural analysis system for use by large airframe design projects are discussed. NASTRAN was implemented as a major finite element structural analysis program to determine the static and dynamic behavior of complete airframes, as well as structural components. This requires modifications and additions to NASTRAN, to communicate with an existing system, and to provide facilities needed to work within the integrated structural analysis. For this purpose, several special DMAP modules were developed and introduced into the CALAC version of the NASTRAN system. Author

N72-32900* AiResearch Mfg. Co., Torrance, Calif.
HIGH PRESSURE TURBINE BLADE STRESS ANALYSIS

Robert R. VanNimwegen and Samuel Tepper *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1972 p 477-484
CSCL 21E

Combinations of high temperature gradients associated with strong transients in both temperature and rotational speed fields are discussed. Blade definition and results of the analysis are shown. Since the same model should later be used to define some dynamic characteristics and certain areas would require a nonlinear analysis, NASTRAN was chosen as a convenient program to manage the several alternatives. Author

N72-32911*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC STRUCTURAL TESTS OF A 1.5-METER DIAMETER FABRIC ATTACHED INFLATABLE DECELERATOR
Conrad M. Willis and Martin M. Mikulas, Jr. Washington Oct. 1972 32 p refs
(NASA-TN-D-6929; L-8389) Avail: NTIS HC $3.00 CSCL 20L

Meridional tape forces, permeability, and change in model contours were measured on the aft half of a 1.5-m-diameter attached inflatable decelerator (AID). Inflation pressures up to 103 kN per square meter and external pressures of 0.14 to 102 kN per square meter were used. The results indicated that the model stresses were near the desired isotensoid condition. Future AID designs should consider both stiffness and strength of the meridional tapes to obtain the optimum division of load between tapes and fabric. Permeability of pressurized fabric structures is a few orders of magnitude higher than that obtained in the standard low-pressure test on material specimens. Author

N72-32913# National Bureau of Standards, Washington, D.C.
THE EFFECTS OF SONIC BOOM AND SIMILAR IMPULSIVE NOISE OF STRUCTURES
31 Dec. 1971 21 p refs Sponsored by EPA
(NTID300.12) Avail: SOD $1.00

A brief discussion is given of the physical nature of sonic booms, and other impulsive noises, and the parameters, such as over-pressure, duration, and mechanical impulse, which are used to characterize booms. This is followed by an overview of the response of structures, particularly buildings, to sonic booms and a review of the damage history observed due to supersonic overflights. A summary of the observed effects of impulsive noise on terrain and natural structures is included. Author

N72-32916# Naval Civil Engineering Lab., Port Hueneme, Calif.
LAYERED PAVEMENT SYSTEMS. PART 1: LAYERED SYSTEM DESIGN. PART 2: FATIGUE OF PLAIN CONCRETE Technical Report, Apr. 1970 - Mar. 1971
J. B. Forrest, M. G. Katona, and D. F. Griffin Apr. 1972 78 p refs
(YF38534002)
(AD-742337; NCEL-TR-763-Pt-1-Pt-2) Avail: NTIS CSCL 01/5

The report describes a recent Naval Civil Engineering Laboratory study of airfield pavement overlay design that indicates that elastic layered analysis may be a better design approach than any other currently available technique. A finite element theory of analysis has been developed that considers horizontal sliding between layers, and the superimposed load effects of multiple-wheel landing gear. This theory also provides for automatic finite element mesh generation, and automatic plotting of stress, strain, and displacement output data. The report also presents a review of the literature about fatigue of plain concrete. It reveals information about beam and cylinder testing but discloses no conclusive experimental work on the fatigue behavior of uniformly supported pavement slabs. Fatigue behavior estimates based upon beam and cylinder tests would necessarily have to be conservative and therefore self-defeating insofar as achieving economy of design by adoption of minimum feasible thickness of pavement slab overlays. Author (GRA)

N72-32937# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF INSULATION FOR CRASH FIRE PROTECTION OF NEW FLIGHT RECORDERS Final Report, Jul. 1971 - May 1972
Thomas Rust, Jr. Sep. 1972 40 p refs

(FAA Proj. 215-721-01X)
(FAA-NA-72-49; FAA-RD-72-75) Avail: NTIS HC $4.00

The evaluation of flight recorder insulation arrangements relative to their ability to provide thermal protection for record tapes under conditions of crash fire is discussed. The evaluation encompassed fire testing four different types of insulation arrangements in accordance with three different time-temperature fire environments. It was found that a combination of high temperature insulation and a heat sink material employing water as the heat absorber provided the best protection for the record tapes when exposed to a realistic severe thermal environment. Author

N72-32949*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF HEAT TRANSFER CHARACTERISTICS OF THREE COOLING CONFIGURATIONS FOR AIR-COOLED TURBINE VANES TESTED IN A TURBOJET ENGINE
Frederick C. Yeh, Herbert J. Gladden, and James W. Gauntner Washington Oct. 1972 37 p refs
(NASA-TM-X-2580; E-6948) Avail: NTIS HC $3.00 CSCL 20M

A comparison was made of the heat transfer characteristics of three air cooled vanes. The vanes incorporated cooling schemes such as impingement cooling, film cooling, and convection cooling with and without extended surfaces. A redesign study was made for two vanes to improve the cooling effectiveness. An average impingement heat transfer coefficient was calculated on the bases of experimentally determined temperatures at the leading edge and a one dimensional heat transfer calculation. This heat transfer coefficient was compared with existing impingement heat transfer correlations. Author

N72-32958# National Aeronautical Lab., Bangalore (India).
[AERONAUTICAL RESEARCH AND TECHNOLOGY] Annual Report, 1970 - 1971
1971 69 p
Avail: NTIS HC $5.50

The research activities for the various divisions of the National Aeronautical Laboratory are reported for 1970-1971. The research for the following areas is included: aerodynamics, propulsion, structural sciences, materials science, electronics, instrumentation, and mathematical sciences. F.O.S.

N72-32966# Department of Transportation, Washington, D.C. Office of Systems Analysis and Information.
NATIONAL TRANSPORTATION STATISTICS Summary Report
Frances T. Boleger, comp. (MIT), Pamela Werner, comp. (MIT), and Gill V. Hicks, comp. 1 Nov. 1971 88 p refs
Avail: NTIS HC $6.50

A compendium of national transportation statistics is presented and consists of summaries in the form of tree displays, modal profiles, and transportation trends. Indices to the data base covering the years 1958 through 1970 are included. It is felt that with the time series data, the user can identify trends and undertake regression analysis. N.E.N

N72-32972# Carleton Univ., Ottawa (Ontario). Div. of Solid Mechanics and Structural Engineering.
INTERCITY PASSENGER TRANSPORT: A SYSTEM DESIGN OPTIMIZATION MODEL
Salah G. Hamzawi Jun. 1972 135 p refs
(TR-72-1) Avail: NTIS HC $8.75

An optimization model for designing intercity passenger transport systems in situations where the system demand is sensitive to its supply is developed. The model comprises a set of relationships that estimate the system travel demand (expressed as a fraction of a given total common carrier traffic), the system performance measures, and the system costs in terms of its basic design variables. The basic design variables are the travel speed and the vehicle size, and their optimal values are obtained by minimizing the total system cost per passenger-mile traveled. Other system design variables are accordingly analyzed in terms of these two basic design variables. The model is applied to the design of a STOL air link between Toronto and Montreal. The results are believed to be reasonable and appear to be consistent with the real world practice. The model is applicable to any public transport technology. Author

N72-32973# National Aerospace Lab., Amsterdam (Netherlands).
NLR REPORT FOR THE YEAR 1971 [VERSLAG OVER HET JAAR 1971 STICHTING NATIONAAL LUCHT-EN RUIMTEVAARTLABORATORIUM]
1971 108 p refs In DUTCH; ENGLISH summaries
Avail: NTIS HC $7.50

Research projects of the National Aerospace Laboratory of the Netherlands are presented. The subjects discussed are: (1) aircraft noise problems, (2) calculation of subsonic, steady flow over aircraft configurations, (3) aircraft development, (4) scale effects in wind tunnels, (5) strength and stiffness in structures, (6) temperature effects on the properties of materials, (7) air traffic control, and (8) spacecraft development. Author

N72-32981# Federal Aviation Administration, Washington, D.C. Flight Standards Service.
FAA VIEWS ON NONDESTRUCTIVE TESTING
Jaime D. Serra [1972] 17 p refs Presented at Air Transport Assoc. Nondestructive Testing Subcomm. Meeting, Denver, 20-22 Sep. 1972
Avail: NTIS HC $3.00

The role of nondestructive testing in the improvement of aircraft operations from a safety and economic aspect is discussed. The application of nondestructive tests in various airworthiness areas is described. The establishment of schools and training courses for qualifying personnel in nondestructive testing techniques is presented. The various problem areas and efforts to overcome recognized deficiencies are analyzed. Author

N72-32982# Department of Transportation, Washington, D.C.
THE 1972 NATIONAL TRANSPORTATION REPORT: PRESENT STATUS, FUTURE ALTERNATIVES
Jul. 1972 28 p
Avail: NTIS HC $3.50

A comprehensive picture and future outlook of transportation, estimates of investment needs and program priorities, analyses of selected issues in urban and intercity transportation, and guidelines for future action by Federal, State, and local governments, as well as the private sector, are presented. The long range planning process which underlies the report is designed to support statutory planning efforts in specific modes of transporation. Data are presented to show increases in traffic and predictions of future requirements. Author

N72-32983# World Airways, Inc., Oakland, Calif.
CHARTERS, THE NEW MODE: SETTING A NEW COURSE FOR INTERNATIONAL AIR TRANSPORTATION
Jerrold Scoutt, Jr. [1972] 48 p refs Presented at 1st World Congr. on Air Transportation and Tourism, Madrid, 17-21 Apr. 1972
Avail: NTIS HC $4.50

The increased utilization of charter airline service as a method for enlarging the overall air transportation capability is discussed. It is recommended that a five year trial period be instituted in which international charter services would be given recognition through a series of bilateral regimes. Each regime would be based on the traffic flows, both scheduled and charter,

between the signatory parties but the emphasis would always be on expanding the charter concept while attempting to reach a reasonable distinction between scheduled and charter services. Each pair of bilateral partners would meet yearly to analyze the results and agree to further expansion. Author

N72-32984# World Airways, Inc., Oakland, Calif.
MINIMUM TRANSPORTATION REGULATION MAXIMIZES TOURISM'S CONTRIBUTION TO ECONOMIC GROWTH
Howell M. Estes, Jr. [1972] 17 p refs Presented at 1st World Congr. on Air Transp. and Tourism, Madrid, 17-21 Apr., 1972
Avail: NTIS HC $3.00

The effect of minimum transportation regulation on the contribution of tourism to economic growth is discussed. It is concluded that tourism has assumed major stature as a world economic force and that the future of airlines is closely tied to the development of tourism. It is also concluded that tourism can achieve its full growth potential only in a policy framework that permits the highest level of freedom to all elements in the tourism picture. Author

N72-32985# Department of Transportation, Washington, D.C.
THE IMPLEMENTATION OF THE STATEMENT ON NATIONAL TRANSPORTATION POLICY Annual Report
May 1972 120 p refs
(AR-1) Avail: NTIS HC $8.00

A succinct restatement, except for minor modifications, is given of the broad scheme of transportation policy as presented in the Statement on National Transportation Policy. Those departmental actions of the past year which, as either new initiatives or measures receiving continuing emphasis, served to further the policies set forth in the statement are outlined. Individual reports from the operating administrations of the department are appended, as well as reports on certain other departmental programs of an operational nature. These accounts, in contrast to the material in the basic report, set forth in quite detailed terms specific departmental activities which aid in the implementation of various facets of transportation policy. Author

N72-32986# Federal Aviation Administration, Washington, D.C. Aviation Forecast Div.
LARGE AND MEDIUM HUB: AVIATION ACTIVITY FORECAST AIR CARRIER AIRPORTS, 1967 - 1983
Apr. 1972 58 p refs
Avail: NTIS HC $5.00

This report summarizes certain forecast data condensed from the Terminal Area Forecast report pertaining to those airports which account for 90 percent of the air carrier market in the United States. Included in this report are 69 hub areas with 89 air carrier airports. The focus upon the air carrier segment of aviation activity naturally dictates a concentration upon the large and medium hubs - a designation premised upon relative air carrier market shares. These hubs have been taken along with five additional cities which border upon the medium hub category and San Juan and summaries have been prepared for aviation activity forecasts along with pertinent economic data. Author

N72-32987 Engineering Sciences Data Unit, London (England).
PROFILE DRAG COEFFICIENT INCREMENT DUE TO FULL-SPAN SINGLE-SLOTTED FLAPS (HANDLEY PAGE AND NACA TYPES)
Aug. 1971 3 p refs
(ESDU-02.01.06) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The profile drag coefficient increment due to full span, single slotted flaps for the Handley Page and NACA type airfoils is plotted against flap angle for various ratios of flap chord/wing chord. The flap angle refers to the deflection of the flaps from the neutral position. The data refer to rectangular wings of aspect ratio 6 at an angle of incidence of 6 degrees above zero lift angle. The effect of aspect ratio different from 6 is considered negligible. Author

N72-32988 Engineering Sciences Data Unit, London (England).
LOW-SPEED NORMAL FORCE AND PITCHING MOMENT OF SLENDER WINGS IN GROUND EFFECT
Jun. 1971 10 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-71007) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The low speed normal force and pitching moment of slender wings in ground effect are discussed. The analysis applies to pointed slender wings with aspect ratio less than two with an unswept trailing edge, small amounts of camber or twist, and with separation along the whole of the leading edge. Curves from which the changes to normal force coefficient and the pitching moment coefficient can be calculated are presented. Author

N72-32989 Engineering Sciences Data Unit, London (England).
LOW-SPEED LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF SLENDER WINGS
Jun. 1971 14 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-71006) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The low speed longitudinal aerodynamic characteristics of slender wings are presented. The normal and axial force coefficients, the pitching moment coefficient, and the position of the aerodynamic center of uncambered, untwisted, pointed wings with unswept trailing edges and aspect ratio of two are analyzed. Mathematical models for determining the lift and drag coefficients are developed. Author

N72-32990 Engineering Sciences Data Unit, London (England).
LIFT COEFFICIENT INCREMENT DUE TO FULL-SPAN SPLIT FLAP: FLAP CHORD 0.20 c
Apr. 1971 2 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-01.01.04) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The determination of the lift coefficient increment due to full span split flap configurations is presented. The lift coefficient is plotted against flap angle for various thickness/chord ratios of the wings. The data refer to wings of aspect ratio 6 at an angle of incidence of degrees above the zero lift angle. It was determined that the lift coefficient increment does not depend on the wing section and is not sensitive to Reynolds number. Author

N72-32992# Cranfield Inst. of Technology (England). Dept. of Aerodynamics.
FLOW CHARACTERISTICS ABOUT A DELTA WING AT 15 DEG INCIDENCE WITH AND WITHOUT EDGE BLOWING
J. Spillman and M. Goodridge Apr. 1972 23 p refs Sponsored by Min. of Defence
(Cranfield-Aero-9) Avail: NTIS HC $3.25

Surface flow pictures and total head surveys have been taken to study how the flow about an uncambered, slender, delta wing at an incidence of 15 deg is changed by blowing high energy air from slots in the leading edge. The investigation was aimed at explaining why the increments of lift coefficient obtained with blowing were so much smaller than expected. It was found that in the region of the leading edge the blown air mixed with the free stream air to form spiral vortex sheets in which the total head varied from less than the free stream value in the cores to values considerably greater than that of the free stream in the mid-radius regions of the vortices. The general level of total head pressure in these vortices increased with increase in blowing momentum. Author

N72-32993*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
COMPARISON OF AEROGRIDS AND PUNCHED PLATES FOR SMOOTHING FLOW FROM SHORT ANNULAR DIFFUSERS
R. L. Rumpf and W. B. Shippen 27 Jul. 1972 44 p refs
(NASA Order C-54545-B)
(NASA-CR-120960) Avail: NTIS HC $4.25 CSCL 01A

Scale model tests were conducted to evaluate the effectiveness of aerogrids and punched plates in producing flat velocity profiles downstream of short diffusers as would be used between the compressor and combustor of advanced aircraft engines. The diffuser had an area ratio of 4.17 and a length-to-inlet-height ratio of 2.07. The aerogrids tested were plates containing 1123 contoured venturis in parallel with geometric blockages of 83, 74, and 61 percent, respectively. The punched plates contained 1123 sharp-edged orifices with blockages of 58 and 30 percent. The results show that aerogrids, with higher effective blockage for the same pressure loss, are more effective flow-smoothing devices than the punched plates. Also, the overall pressure loss decreases and the exit velocity profile becomes flatter as either type of grid is moved closer to the diffuser exit plane. Author

N72-32995*# Rochester Applied Science Associates, Inc., N.Y.
MAIN ROTOR FREE WAKE GEOMETRY EFFECTS ON BLADE AIR LOADS AND RESPONSE FOR HELICOPTERS IN STEADY MANEUVERS. VOLUME 1: THEORETICAL FORMULATION AND ANALYSIS OF RESULTS
S. Gene Sadler Washington NASA Sep. 1972 109 p refs
(Contract NAS1-8448)
(NASA-CR-2110; RASA-71-13-Vol-1) Avail: NTIS HC $3.00 CSCL 01C

A mathematical model and computer program were implemented to study the main rotor free wake geometry effects on helicopter rotor blade air loads and response in steady maneuvers. The theoretical formulation and analysis of results are presented. Author

N72-32996*# Wichita State Univ., Kans. Dept. of Aeronautical Engineering.
EFFECTS OF LEADING-EDGE CAMBER ON LOW-SPEED CHARACTERISTICS OF SLENDER DELTA WINGS
W. H. Wentz, Jr. Washington NASA Oct. 1972 107 p refs
(Contract NAS1-10082)
(NASA-CR-2002) Avail: NTIS HC $3.00 CSCL 01A

Wind-tunnel studies have been conducted to determine the effects of leading-edge camber on the low-speed aerodynamic characteristics of a thin, sharp-edge 74 deg delta wing. The results include force and moment measurements, pressure distributions, and flow visualization patterns determined from oil flow, tuft and water vapor observations. The study indicated that leading-edge camber near the apex is effective in controlling the pitch-up tendency of slender delta wings. Author

N72-32997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF THE LEADING EDGE SUCTION ANALOGY TO PREDICTION OF LONGITUDINAL LOAD DISTRIBUTION AND PITCHING MOMENTS FOR SHARP EDGED DELTA WINGS
Melvin H. Snyder, Jr. (Wichita State Univ.) and John E. Lamar Washington Oct. 1972 21 p refs
(NASA-TN-D-6994; L-8224) Avail: NTIS HC $3.00 CSCL 01A

The leading-edge-suction analogy of Polhamus has been used to develop the longitudinal load distribution of the vortex lift for delta wings. This distribution is shown to be similar in shape to that of the potential-flow longitudinal loading for delta wings having aspect ratios of 2 or less. The totals of the two theoretical distributions for delta wings with an aspect ratio near 1 are in good agreement with the experimentally determined loadings over the angle-of-attack range from 0 to 30 deg. The corresponding predicted pitching moments show slightly more stability than those measured, because of loss of lift near the wing tips. Author

N72-32998# Hydronautics, Inc., Laurel, Md.
ON THE AERODYNAMICS OF WAKE VORTICES
Clinton E. Brown May 1972 36 p refs
(Contract F44620-71-C-0080; AF Proj. 9781)
(AD-744860; TR-7115; AFOSR-72-1209TR) Avail: NTIS CSCL 01/2

The effect of wing span loading on the development of fully rolled up wing trailing vortices is discussed. It is shown that parabolic wing loadings produce potential flow maximum core rotary speeds which are finite and less than fifty percent of the downwash speeds at the plane of symmetry. The development of turbulent cores is analyzed and core growth is predicted. Axial flow effects of the wing profile drag and lifting system are shown to lead to axial jets on the vortex axis which may either follow the aircraft or exceed the free stream velocity depending on the ratio of profile drag to induced drag. GRA

N72-33001 Engineering Sciences Data Unit, London (England).
FRICTIONAL AND RETARDING FORCES ON AIRCRAFT TYRES. PART 1: INTRODUCTION
Oct. 1971 42 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-71025-Pt-1) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The frictional and retarding forces that can be developed when aircraft tires are operated on prepared, hard runway surfaces are examined. The mechanisms for generating forces in the tire-ground contact area are described. Consideration is given to the effects on braking force of changes in tire, runway surface, and aircraft design operational factors. Mathematical models are included to amplify the theoretical aspects. Author

N72-33002 Engineering Sciences Data Unit, London (England).
AIRSPEED DATA FOR PERFORMANCE CALCULATIONS
Oct. 1969 34 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-69026) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Methods for obtaining airspeed and kinetic pressure information for application to aircraft performance estimation and data reduction purposes are presented. The data apply to pressure heights from minus 2,000 feet to 105,000 feet, Mach number from zero to 3, and ranges of equivalent airspeeds and calibrated airspeed up to 1,000 knots. Numerical representations and semi-graphical presentations of airspeed and kinetic pressure data are provided. The approach uses the basic relationships connecting parameters such as pitot pressure, ambient pressure, total temperature, and ambient temperature with airspeed and pressure height. Author

N72-33003 Engineering Sciences Data Unit, London (England).
NON-DIMENSIONAL APPROACH TO ENGINE THRUST AND AIRFRAME DRAG FOR THE ANALYSIS OF MEASURED PERFORMANCE DATA: AIRCRAFT WITH TURBO-JET AND TURBO-FAN ENGINES
Sep. 1970 10 p refs Supersedes ESDU-Perf-RJ-1/0 Sponsored by Roy. Aeron. Soc.
(ESDU-70020; ESDU-Perf-RJ-1/0) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A procedure is presented by which the engine and airframe characteristics used in the analysis and calculation of aircraft performance may be expressed in terms of a few compound parameters. The limitations of the method are discussed. Various additional factors which affect the analysis of measured performance are explained. The full theoretical treatment involves

the derivation by dimensional analysis of nondimensional quantities relating to thrust, fuel flow, and drag. Author

N72-33004 Engineering Sciences Data Unit, London (England).
INTRODUCTION TO ITEMS ON THE ANALYSIS OF MEASURED PERFORMANCE DATA: AIRCRAFT WITH TURBO-JET AND TURBO-FAN ENGINES
Nov. 1970 7 p Sponsored by Roy. Aeron. Soc.
(ESDU-70019) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Procedures for reducing aircraft performance to compensate for atmospheric conditions and variations in aircraft configurations are presented. Information on the reduction of level speed data, climb data, range and endurance data, and take off and landing data is discussed. The performance characteristics of the engine and airframe are submitted as curves of various compound parameters and are suitable where a large number of points are available to establish the curves with a reasonable degree of accuracy. Author

N72-33005 Engineering Sciences Data Unit, London (England).
GRAPHICAL METHOD FOR THE ANALYSIS OF MEASURED PERFORMANCE DATA USING DRAG DETERMINATION: AIRCRAFT WITH TURBO-JET AND TURBO-FAN ENGINES
Sep. 1970 16 p Sponsored by Roy. Aeron. Soc.
(ESDU-70021) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A method of aircraft performance analysis used when drag is determined from a knowledge of thrust is presented. The performance characteristics of a subsonic interceptor aircraft with a fixed geometry engine without reheat are used as an example. Mathematical models are included to explain the conditions for level speed, fuel consumption, and minimum time to height. Author

N72-33006 Engineering Sciences Data Unit, London (England).
NON-DIMENSIONAL GRAPHICAL METHOD FOR THE ANALYSIS OF MEASUREMENTS OF STEADY LEVEL SPEED, RANGE AND ENDURANCE: AIRCRAFT WITH TURBOJET AND TURBOFAN ENGINES
Nov. 1970 12 p ref Supersedes ESDU-Perf-RJ-1/1 and ESDU-Perf-RJ-1/3 Sponsored by Roy. Aeron. Soc.
(ESDU-70022; ESDU-Perf-RJ-1/1; ESDU-Perf-RJ-1/3) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A nondimensional graphical method for analyzing measurements of level speed, range, and endurance of aircraft with turbojet and turbofan engines is presented. The method is applicable to aircraft operating at subsonic and supersonic speeds. The approach is to substitute expressions for thrust and drag in the force equation for steady level flight. Mathematical models, graphs, and table are provided to support the theoretical considerations. Author

N72-33007 Engineering Sciences Data Unit, London (England).
THE MEASUREMENT AND ANALYSIS OF CLIMB PERFORMANCE
Sep. 1970 16 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-70023) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Equations for determining the climb performance of aircraft are presented. The equations are based on the kinetic and potential energies of the aircraft of a given weight, flying at a definite airspeed, and prescribed altitude. Other relevant properties of the aircraft and engines are introduced by equating the rate of change of the total energy to the rate at which work is done on the aircraft by thrust and drag. Mathematical models and graphs are included to support the theoretical presentation. Author

N72-33008 Engineering Sciences Data Unit, London (England).
HEAT BALANCE FOR FLIGHT VEHICLES
Oct. 1969 12 p refs Supersedes ESDU-Aero-S.00.03.17 Sponsored by Roy. Aeron. Soc.
(ESDU-69009; ESDU-Aero-S.00.03.17) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Factors affecting skin temperature and heat transfer in high speed flight vehicles are outlined. Data are investigated with reference to structural design, structural strengths, and insulation requirements. E.H.W.

N72-33009 Engineering Sciences Data Unit, London (England).
THE ESTIMATION OF NEAR-FIELD SOUND PRESSURE LEVELS DUE TO JET NOISE
Jan. 1972 14 p refs Supersedes ESDU-67027 Sponsored by Roy. Aeron. Soc.
(ESDU-72002; ESDU-67027) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Methods for estimating the near field sound pressure levels created by jet noise are presented. The numerical calculation procedure is outined to show evaluation of the overall sound pressure level and the conversion of this level to a pressure loading. Corrections for local effects to improve the accuracy of the data are described. The theoretical considerations are supported by curves of the data. Author

N72-33010 Engineering Sciences Data Unit, London (England).
FRICTIONAL AND RETARDING FORCES ON AIRCRAFT TYRES. PART 3: PLANING
May 1972 22 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-72008-Pt-3) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Planing of aircraft tires on wet runways is discussed in terms of the observable characteristics and the mechanisms which produce it. Available data relating to planing are presented along with the application of these data for predicting and analyzing planing. F.O.S.

N72-33011*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COOPERATIVE PROGRAM FOR DESIGN, FABRICATION, AND TESTING OF GRAPHITE/EPOXY COMPOSITE HELICOPTER SHAFTING Progress Report
Charles C. Wright (Picatinny Arsenal), Donald J. Baker, N. Corvelli, L. Thurston, R. Clary, and W. Illg Oct. 1971 84 p Prepared in cooperation with Picatinny Arsenal
(NASA-TM-X-67739; AD-732866; PA-TR-4240) Avail: NTIS HC $6.25 CSCL 01C

The fabrication of UH-1 helicopter tail rotor drive shafts from graphite/epoxy composite materials is discussed. Procedures for eliminating wrinkles caused by lack of precure compaction are described. The development of the adhesive bond between aluminum end couplings and the composite tube is analyzed. Performance tests to validate the superiority of the composite materials are reported. Author

N72-33012# Cranfield Inst. of Technology (England).
AIRCRAFT DESIGN STUDIES: VERTICAL TAKE OFF AND LANDING AIRLINER
D. Howe May 1972 53 p refs
(Cranfield-Aero-10) Avail: NTIS HC $4.75

The aerodynamic configuration of a vertical takeoff transport aircraft with fan lift propulsion system is discussed. Specifications of the geometry, inertia, and aerodynamic characteristics are presented. The composition and performance of the propulsion system are analyzed. Tables of data are included to show dimensions and predicted performance. P.N.F.

N72-33013*# LTV Aerospace Corp., Hampton, Va. Technical Center.
AIRCRAFT SYSTEMS DESIGN STUDIES EMPLOYING ADVANCED TRANSPORT TECHNOLOGIES
B. Downie, C. Pearce, C. Quartero, and A. Taylor 5 Oct. 1972 49 p
(Contract NAS1-10900)
(NASA-CR-112181) Avail: NTIS HC $4.50 CSCL 01B

System and design integration studies are presented to define and assess the application of the advanced technology most likely to result in a superior next generation, high subsonic/sonic conventional takeoff and landing transport aircraft system. It is concluded that the new technologies can be directed toward the achievement of improved economy and performance. These benefits may be used to compensate for the penalties associated with reduced noise requirements anticipated to make future aircraft ecologically acceptable. Author

N72-33014*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
ROTOR SYSTEMS RESEARCH AIRCRAFT OF PREDESIGN STUDY. VOLUME 1: SUMMARY AND CONCLUSIONS Final Report
Arthur W. Linden et al 6 Oct. 1972 28 p
(Contract NAS1-11228)
(NASA-CR-112152; SER-50775-Vol-1) Avail: NTIS HC $3.50 CSCL 01B

The results are summarized of a study to develop a versatile research aircraft for flight testing a wide variety of advanced helicopter and compound rotor systems. The aircraft is required to accept these rotors with minimal changes in the basic vehicle. Rotors envisioned for testing include conventional rotors plus variable geometry, variable twist, variable diameter, coaxial, jet flap, circulation control, and slowed rotors. Various disc loadings would be accommodated. The aircraft must be configured to measure performance more accurately than past test vehicles. In addition, the aircraft would have a wing to off load the rotor while measuring performance during lightly loaded conditions. It would have variable drag and propulsive force so that the rotor can be tested while producing different values of horizontal force. Author

N72-33015*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
ROTOR SYSTEMS RESEARCH AIRCRAFT PREDESIGN STUDY. VOLUME 2: CONCEPTUAL STUDY REPORT Final Report
Steven A. Schmidt, Arthur W. Linden et al 6 Oct. 1972 68 p
(Contract NAS1-11228)
(NASA-CR-112153; SER-50775-Vol-2) Avail: NTIS HC $5.50 CSCL 01B

The overall feasibility of the technical requirements and concepts for a rotor system research aircraft (RSRA) was determined. The designs of two aircraft were then compared against the RSRA requirements. One of these is an all new aircraft specifically designed as an RSRA vehicle. A new main rotor, transmission, wings, and fuselage are included in this design. The second aircraft uses an existing Sikorsky S-61 main rotor, an S-61 roller gearbox, and a highly modified Sikorsky S-67 airframe. The wing for this aircraft is a new design. Both aircraft employ a fan-in-fin anti-torque/yaw control system, T58-GE-16 engines for rotor power, and TF34-GE-2 turbofans for auxiliary thrust. Each aircraft meets the basic requirements and goals of the program. The all new aircraft has inflight variable main rotor shaft tilt, a side-by-side cockpit seating arrangement, and is slightly faster in the compound mode. It is also somewhat lighter since it uses new dynamic components specifically designed for the RSRA. Preliminary development plans, including schedules and costs, were prepared for both of these aircraft. Author

N72-33016*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
ROTOR SYSTEMS RESEARCH AIRCRAFT PREDESIGN STUDY. VOLUME 3: PREDESIGN REPORT Final Report
Steven A. Schmidt, Arthur W. Linden et al 6 Oct. 1972 186 p refs
(Contract NAS1-11228)
(NASA-CR-112154; SER-50775-Vol-3) Avail: NTIS HC $11.50 CSCL 01B

The features of two aircraft designs were selected to be included in the single RSRA configuration. A study was conducted for further preliminary design and a more detailed analysis of development plans and costs. An analysis was also made of foreseeable technical problems and risks, identification of parallel research which would reduce risks and/or add to the basic capability of the aircraft, and a draft aircraft specification. Author

N72-33017*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
ROTOR SYSTEMS RESEARCH AIRCRAFT PREDESIGN STUDY. VOLUME 4: PRELIMINARY DRAFT DETAIL SPECIFICATION Final Report
Alfred N. Miller, Arthur W. Linden et al 6 Oct. 1972 83 p
(Contract NAS1-11228)
(NASA-CR-112155; SER-50775-Vol-4) Avail: NTIS HC $6.25 CSCL 01B

The RSRA requirements are presented in a detail specification format. Coverage of the requirements includes the following headings: (1) aircraft characteristics, (2) general features of design and construction, (3) aerodynamics, (4) structural design criteria, (5) flight control system, (6) propulsion subsystem, and (7) secondary power and distribution subsystem. D.L.G.

N72-33018*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF AN ACCELEROMETER CONTROLLED AUTOMATIC BRAKING SYSTEM
Robert C. Dreher, Robert K. Sleeper, and John R. Nayadley, Sr. Washington Oct. 1972 31 p refs
(NASA-TN-D-6953; L-8108) Avail: NTIS HC $3.00 CSCL 01B

An investigation was made to determine the feasibility of an automatic braking system for arresting the motion of an airplane by sensing and controlling braked wheel decelerations. The system was tested on a rotating drum dynamometer by using an automotive tire, wheel, and disk-brake assembly under conditions which included two tire loadings, wet and dry surfaces, and a range of ground speeds up to 70 knots. The controlling parameters were the rates at which brake pressure was applied and released and the Command Deceleration Level which governed the wheel deceleration by controlling the brake operation. Limited tests were also made with the automatic braking system installed on a ground vehicle in an effort to provide a more realistic proof of its feasibility. The results of this investigation indicate that a braking system which utilizes wheel decelerations as the control variable to restrict tire slip is feasible and capable of adapting to rapidly changing surface conditions. Author

N72-33019*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT INVESTIGATION OF THE ROLL REQUIREMENTS FOR TRANSPORT AIRPLANES IN THE LANDING APPROACH
Euclid C. Holleman and Bruce G. Powers Washington Oct. 1972 49 p refs
(NASA-TN-D-7062; H-711) Avail: NTIS HC $3.00 CSCL 01B

An in-flight evaluation of transport roll characteristics in the landing approach was made with a general purpose airborne simulator. The evaluation task consisted of an instrument approach with a visual correction for a (200-foot) lateral offset. Pilot evaluations and ratings were obtained for approaches made at 140 knots and 180 knots indicated airspeed with variations of wheel characteristics, maximum roll rate, and roll time constant. Author

N72-33020*# Bell Helicopter Co., Fort Worth, Tex.
PREDESIGN REPORT FOR THE ROTOR SYSTEMS RESEARCH AIRCRAFT
1972 83 p refs
(Contract NAS1-11251)
(NASA-CR-112156) Avail: NTIS HC $6.25 CSCL 01C

A conceptual predesign of a compound helicopter for conducting rotor research is presented. The aircraft was selected by the Government as the better of two concepts submitted. The helicopter is a three place vehicle in the 24,000 pound gross weight class. It has been determined that the helicopter satisfies the requirements for the rotor research mission. The model has been predesigned sufficiently to allow an assessment of its performance and stability and control characteristics. A brief treatment of these subjects is included. Author

N72-33021*# Bell Helicopter Co., Fort Worth, Tex.
A CONCEPTUAL STUDY OF THE ROTOR SYSTEMS RESEARCH AIRCRAFT
1972 197 p refs
(Contract NAS1-11251)
(NASA-CR-112157) Avail: NTIS HC $12.00 CSCL 01C

The analytical comparison of the two candidate Rotor Systems Research Aircraft (RSRA) configurations selected by the Government at the completion of Part 1 of the RSRA Conceptual Predesign Study is presented. The purpose of the comparison was to determine the relative suitability of both vehicles for the RSRA missions described in the Government Statement of Work, and to assess their versatility in the testing of new rotor concepts. The analytical comparison was performed primarily with regard to performance and stability and control. A weights, center-of-gravity, and inertia computation was performed for each iteration in the analysis process. The dynamics investigation was not concerned so much with a comparison of the two vehicles, but explored the dynamic problems attending operation of any RSRA operating with large rotor RPM and diameter ranges over large forward speed ranges. Several means of isolating in- and out-of-plane rotor vibrations were analyzed. An optimum isolation scheme was selected. Author

N72-33022# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT, TANDY, CORPORATION, GATES LEARJET MODEL 25 N658TC NEAR THE VICTORIA COUNT-FOSTER AIRPORT, VICTORIA, TEXAS, 18 JANUARY 1972
9 Aug. 1972 14 p
(NTSB-AAR-72-24) Avail: NTIS HC $3.00; National Transportation Safety Board, Administrative Operations Div., Accident Inquiries and Records Section, Washington, D. C. 20591

A Learjet Model 25 crashed on January 18, 1972 during a nonprecision instrument approach to the Victoria County-Foster Airport, Victoria, Texas. The probable cause of the accident was the lack of altitude awareness on the part of the flight crew while descending into known weather conditions which were conducive to a rapid deterioration in forward visibility. Author

N72-33023*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECT OF PICTORIAL DISPLAY CONFIGURATION ON THE FREQUENCY OF CONTROL REVERSALS DURING AIRCRAFT LANDING APPROACHES
R. Lincoln (DeAnza Coll.), E. A. Palmer, and T. Wempe Oct. 1972 18 p refs
(NASA-TM-X-62191) Avail: NTIS HC $3.00 CSCL 01B

A fixed-base simulator study to determine the effect of increased pictorial display realism on the frequency of control reversals made with an inside-out landing display was conducted. Display conditions included the effects of collimation and scale (head-up versus head-down presentation), horizon symbology (simple line versus white-black sky-ground surfaces), and ground plane realism (computer generated perspective versus a TV picture of a realistic model). The number of control reversals was moderately high on all displays. Control reversals to roll disturbances occurred nearly twice as frequently as reversals to either pitch or lateral rate disturbances. Though there were no significant differences among the numbers of small control reversals for the different displays, there was some evidence that this conclusion may not apply to large control reversals. Author

N72-33024*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NIGHT VISUAL APPROACHES: PILOT PERFORMANCE WITH AND WITHOUT A HEAD-UP DISPLAY
Everett A. Palmer Oct. 1972 23 p refs
(NASA-TM-X-62188) Avail: NTIS HC $3.25 CSCL 01B

Simulated night visual approaches were flown into two airports with and without a head up display (HUD) in a transport aircraft. The HUD featured pitch stabilized vertical scales which displayed the glide slope angle to the runway aim point and a horizontal bar which aided the pilot in his control of the aircraft flight path angle. One airport was located on flat terrain with numerous foreground lights, the second airport had no foreground lights and the terrain sloped up behind the airport. With the HUD glide slope tracking precision was equally good for either runway. With no HUD glide slope tracking was about three times worse with the flat airport and about eight times worse with the airport with no foreground lights and up-sloping terrain beyond the runway. Author

N72-33025*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HYPERSONIC TRANSPORTS: ECONOMICS AND ENVIRONMENTAL EFFECTS
R. H. Petersen and M. H. Waters Oct. 1972 13 p refs
(NASA-TM-X-62193) Avail: NTIS HC $3.00 CSCL 01B

An economic analysis of hypersonic transports is presented to show projected operating costs (direct and indirect) and return on investment. Important assumptions are varied to determine the probable range of values for operating costs and return on investment. The environmental effects of hypersonic transports are discussed and compared to current supersonic transports. Estimates of sideline and fly-over noise are made for a typical hypersonic transport, and the sonic boom problem is analyzed and discussed. Since the exhaust products from liquid hydrogen-fueled engines differ from those of kerosene-fueled aircraft, a qualitative assessment of air pollution effects is made. Author

N72-33026*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A VTOL TRANSLATIONAL RATE CONTROL SYSTEM STUDY ON A SIX DEGREES-OF-FREEDOM MOTION SIMULATOR
Lloyd D. Corliss and Daniel C. Dugan Oct. 1972 27 p refs
Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62194) Avail: NTIS HC $3.50 CSCL 01B

A linearized translational rate system for near hover flight was optimized on a large motion simulator under the constraints of no disturbances and limited control power. Both lateral and longitudinal modes were considered with the primary variables of investigation being control sensitivity and response stiffness and secondarily system damping. Yaw and height control characteristics were represented by an angular rate and acceleration system, respectively. General regions of desired sensitivity and stiffness for the longitudinal and lateral modes were determined under VFR conditions for both the rapid maneuver task and the station keeping/mild maneuver task. Author

N72-33027*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER PAYLOAD GAINS UTILIZING WATER INJECTION FOR HOT DAY POWER AUGMENTATION

Robert H. Stroub Oct. 1972 17 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62195) Avail: NTIS HC $3.00 CSCL 01B

An analytical investigation was undertaken to assess the gains in helicopter mission payload through the use of water injection to produce power augmentation in an altitude-hot day environment. Substantial gains are shown for two representative helicopters, the UH-1H and CH-47B. The UH-1H payload increased 86.7 percent for a 50 n.mi. (92.6 km) radius mission involving two out-of-ground effect (OGE) hover take-offs of 2 minutes each at 5000 ft. (1525 m) 35 C ambient conditions. The CH-47B payload increased 49.5 percent for a 50 n.mi. (92.6 km) radius mission with sling loaded cargo as the outbound payload and a 3000 lb. (1360 kg) internal cargo on the return leg. The mission included two 4 min. OGE hovers at 6000 ft. (1830 m) 35 C. An improvement in take off performance and maximum performance climb also resulted as a consequence of the OGE hover capability and higher maximum power available. Author

N72-33028*# Aerospace Corp., El Segundo, Calif.
STUDY OF LOW DENSITY AIR TRANSPORTATION CONCEPTS
H. M. Webb Washington NASA Oct. 1972 57 p refs
(Contract NAS2-6473)
(NASA-CR-2142) Avail: NTIS HC $3.00 CSCL 01B

Low density air transport refers to air service to sparsely populated regions. There are two major objectives. The first is to examine those characteristics of sparsely populated areas which pertain to air transportation. This involves determination of geographical, commercial and population trends, as well as those traveler characteristics which affect the viability of air transport in the region. The second objective is to analyze the technical, economic and operational characteristics of low density air service. Two representative, but diverse areas, West Virginia and Arizona, were selected for analysis: The results indicate that Arizona can support air service under certain assumptions whereas West Virginia cannot. Author

N72-33029*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
NOISE FROM INTERACTION OF FLOW WITH RIGID SURFACES: A REVIEW OF CURRENT STATUS OF PREDICTION TECHNIQUES
Richard E. Hayden Washington NASA Oct. 1972 65 p refs
(Contract NAS1-9559-14)
(NASA-CR-2126; BBN-2276) Avail: NTIS HC $3.00 CSCL 20D

A brief review of some fundamental aspects of sound arising from turbulent boundary layers, noise due to flow past a single discontinuity (trailing edge), noise from airfoils operating in turbulent flow, and noise due to rigid flow discontinuities (spoilers) immersed in rigid ducts is presented. Emphasis is on dipole-like sound fields associated with turbulent flow past a trailing edge, rigid bodies in turbulence and in-duct spoilers. Representative available data are reviewed and evaluated in terms of theoretical considerations and, where possible, empirical prediction techniques are given in terms of convenient aerodynamic and geometric parameters. Limitations on current knowledge are discussed. Author

N72-33030*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FIXED BASE SIMULATOR STUDY OF AN EXTERNALLY BLOWN FLAP STOL TRANSPORT AIRPLANE DURING APPROACH AND LANDING
William D. Grantham, Luat T. Nguyen, James M. Patton, Jr., Perry L. Deal, Robert A. Champine, and C. Robert Carter (Army Air Mobility R and D Lab.) Washington Oct. 1972 98 p refs
(NASA-TN-D-6898; L-8394) Avail: NTIS HC $3.00 CSCL 01B

A fixed-base simulator study was conducted to determine the flight characteristics of a representative STOL transport having a high wing and equipped with an external-flow jet flap in combination with four high-bypass-ratio fan-jet engines during the approach and landing. Real-time digital simulation techniques were used. The computer was programed with equations of motion for six degrees of freedom and the aerodynamic inputs were based on measured wind-tunnel data. A visual display of a STOL airport was provided for simulation of the flare and touchdown characteristics. The primary piloting task was an instrument approach to a breakout at a 200-ft ceiling with a visual landing. Author

N72-33031*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INSTALLATION EFFECTS ON PERFORMANCE OF MULTIPLE MODEL V/STOL LIFT FANS
J. H. Diedrich, N. Clough, and S. Lieblein 1972 15 p refs Proposed for Presentation at the 8th Propulsion Specialists Conf., New Orleans, 29 Nov. - 1 Dec. 1972; sponsored by AIAA and Soc. of Automotive Engr.
(NASA-TM-X-68138; E-7139) Avail: NTIS HC $3.00 CSCL 01B

An experimental program was performed in which the individual performance of multiple VTOL model lift fans was measured. The model tested consisted of three 5.5 in. diameter tip-turbine driven model VTOL lift fans mounted chordwise in a two-dimensional wing to simulate a pod-type array. The performance data provided significant insight into possible thrust variations and losses caused by the presence of cover doors, adjacent fuselage panels, and adjacent fans. The effect of a partial loss of drive air supply (simulated gas generator failure) on fan performance was also investigated. The results of the tests demonstrated that lift fan installation variables and hardware can have a significant effect on the thrust of the individual fans. Author

N72-33032# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENT OF AN ICE-SHEDDING COATING FOR HELICOPTER ROTOR BLADES
J. H. Sewell Dec. 1971 25 p refs
(RAE-TR-71238; BR-28616) Avail: NTIS HC $3.25

The adhesion of ice to a low energy surface film on a rigid base is greatly reduced when a flexible sponge rubber substrate is present between the surface and the base. An inexpensive coating based on readily available materials which shows promise of improving the ice-shedding characteristics of helicopter rotor blades has been proposed for practical trials; it is capable of further development to obtain optimum properties. Author (ESRO)

N72-33033# Defense Documentation Center, Alexandria, Va.
VERTICAL TAKE-OFF PLANES Bibliography Report, Jan. 1962 - Jan. 1972
Jun. 1972 271 p refs Supersedes DDC-TAS-68-64
(AD-744000; DDC-TAS-72-46) Avail: NTIS CSCL 01/3

References in this bibliography relate to design, configurations, flight testing, flight control systems, model tests, lift fans, shrouded propellers, rotary wings, aerodynamic characteristics, propulsion systems, performance engineering, capabilities and effectiveness of the Vertical Take-Off Planes. Computer generated indexes are included. Author (GRA)

N72-33034# Naval Air Propulsion Test Center, Philadelphia, Pa. Aeronautical Engine Dept.
ROTOR BURST PROTECTION PROGRAM. PHASES 6 AND 7: EXPLORATORY EXPERIMENTATION TO PROVIDE DATA FOR THE DESIGN OF ROTOR BURST FRAGMENT CONTAINMENT RINGS
Mar. 1972 48 p refs
(AD-744950; NAPTC-AED-1968) Avail: NTIS CSCL 01/3

Presented are the results of exploratory experimentation that was conducted in NAPTC Rotor Spin Facility to provide

criteria for the design of turbomachine rotor burst fragment containment rings. High-speed photography was used to study containment processes involving freely supported rings of different materials and a variety of rotor and flat disk fragments. Author (GRA)

N72-33035# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Flight Research Dept.
IN-FLIGHT INVESTIGATION OF AN UNAUGMENTED CLASS 3 AIRCRAFT IN THE LANDING APPROACH TASK, PHASE 1: LATERAL-DIRECTIONAL STUDY
Richard Wasserman, Franklin F. Eckhart, and Howard J. Ledder Wright-Patterson AFB, Ohio AFFDL Jan. 1972 273 p refs
(Contract F33615-71-C-1110; AF Proj. 684B)
(AD-744831; CAL-TB-3020-F-2; AFFDL-TR-71-164-Vol-1) Avail: NTIS CSCL 14/2

An in-flight research program on the handling qualities of Class III airplanes in the landing approach was conducted using the USAF/CAL Total In-Flight Simulator (TIFS) airplane. The Phase I research program discussed in the report consisted of an investigation of lateral-directional handling qualities. A baseline configuration was defined by a set of stability and control derivatives provided by the Air Force. The experiment was based on the evaluation of this configuration and other configurations defined by changes in stability and control derivatives from the baseline values. Seventeen different configurations were evaluated utilizing 3 different pilots. A total of thirty six evaluations was performed. GRA

N72-33036# Piasecki Aircraft Corp., Philadelphia, Pa.
MULTI-HELICOPTER HEAVY LIFT SYSTEM FEASIBILITY STUDY Final Engineering Report
Kazimierz Korsak, Kenneth R. Meenen, Donald N. Meyers, and Frank N. Piasecki Feb. 1972 178 p refs
(Contract N62269-71-C-0581)
(AD-743516; Rept-39-X-11) Avail: NTIS CSCL 01/3

A tandem nose-to-tail configuration was selected, and a detailed study of the configuration was made to assess its feasibility and identify potential problem areas. A feasible heavy-lift vehicle is postulated with a predicted payload capability up to 18.7 tons which is recommended to be carried forward to flight evaluation. Author (GRA)

N72-33038# Naval Postgraduate School, Monterey, Calif.
A PARAMETER OPTIMIZATION APPROACH TO AIRCRAFT GUST ALLEVIATION M.S. Thesis
Russell Lee Clement Mar. 1972 64 p refs
(AD-743722) Avail: NTIS CSCL 01/4

The report indicates that a knowledge of angle of attack (alpha) and/or gust perturbation angle of attack (alpha sub g) is of prime importance for a longitudinal autopilot designed to alleviate the effect of vertical gusts. However, accurate measurement of alpha and alpha sub g is extremely difficult. This research indicates that the readily measurable normal acceleration factor (n) and pitch rate (q) can be used to provide alpha and alpha sub g information indirectly. Author (GRA)

N72-33039# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
INVESTIGATION OF THE SPEED BRAKES ON THE S-67 AIRCRAFT Final Report
N. F. K. Kefford Apr. 1972 59 p refs
(Contract DAAJ02-71-C-0009)
(AD-745214; SER-67007; USAAMRDL-TR-72-22) Avail: NTIS CSCL 01/3

Flight tests and computer simulations to evaluate speed brakes for a winged helicopter were conducted. The flight test program established the effectiveness of wing-mounted speed brakes for increasing dive angle, deceleration capability, and maneuverability of the Sikorsky S-67. In the configuration tested, six brake surfaces operated together to increase aircraft drag by 155% while reducing wing lift. With these speed brakes, dive angles could be increased from 5 to 7 degrees at 140 knots dependent upon the initial dive angle. At 160 knots, the increase in dive angle varies from 8 to 9 degrees. These increases in aircraft dive angle due to speed brake extension can be further increased by allowing the aircraft to accelerate during the dive. Dive characteristics with and without speed brakes extended were obtained. A dive envelope defined by control and airframe stress limits was established that provided a broad dive envelope of forward speed and collective settings to achieve various dive angles. Author (GRA)

N72-33040# American Airlines, Inc., New York.
AIRLINE VIEW OF STOL SYSTEM REQUIREMENTS Final Report
Feb. 1972 22 p refs
(AD-745283; AAL-ER/D-56-Summary; DOT-OS-10075-Summary) Avail: NTIS CSCL 01/3

Conventional air and rail systems are incapable of providing needed short-haul service for the increased capacity requirements of the near future. Some improvements can be made but a new, integrated short-haul transportation system may be needed to supplement the present system. The complexity and magnitude of the problem require significant leadership and funding by the Federal Government. The airlines' areas of concern include the aircraft, STOLports, ATC, marketing, safety, economics, and acceptance by passengers and STOLport neighbors. The paper addresses reduced takeoff and landing (RTOL), propeller STOL transport (PST), jet STOL transport (JST), ATC, STOLport siting, route analysis, certification and safety, airline service requirements, economics, Metroflight demonstration need, STOLport acceptance, public demand stimulation and STOL development system management. Its purpose is to document an airline's views on as many STOL system implementation factors as possible at this time to provide for STOL system planners. Author (GRA)

N72-33041# Army Materials and Mechanics Research Center, Watertown, Mass.
THE HELICOPTER ROTOR
Chintakindi V. Joga Rao Dec. 1971 61 p refs
(DA Proj. 1T0-61102-B-33-A)
(AD-745124; AMMRC-MS-71-3) Avail: NTIS CSCL 01/3

Emergence of the present configurations of helicopter rotors is briefly described. Some of the highlights of operational experience on pure helicopters and compounds have been presented. Characteristics of various types of rotors have been described followed by recent rotor developments and concepts. Rotor airloads and aeroelastic instabilities receive some attention. The need for further research on airloads, certain aspects of aeroelasticity and gust loads is brought out. The Appendix deals with rotor interactions on the fuselage. The emphasis throughout is on aircraft structures, vibrations, and related areas. Considerable attention has been focused on the hingeless rotor in view of current interest. Author (GRA)

N72-33042# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: UNITED AIR LINES, INC., BOEING 737-222, N9005U, PHILADELPHIA INTERNATIONAL AIRPORT, PHILADELPHIA, PENNSYLVANIA, 19 JULY 1971
29 Dec. 1971 42 p
(PB-208664; NTSB-AAR-72-9) Avail: NTIS HC $3.00 CSCL 01B

On 19 July 1970 a Boeing 737-222, crashed shortly after taking off from the Philadelphia International Airport, Philadelphia, Pennsylvania. There were no fatalities. Among 55 passengers and six crewmembers, 17 passengers were injured, one seriously, and one crewmember received minor injuries. Examination of the left (No. 1) engine revealed that a first-stage turbine blade failed. Disassembly of the right (No. 2) engine and functional testing of its components revealed that the engine was operating in the air,

during the thrust reversing cycle, and until the engine impacted the ground. The probable cause of this accident was the termination of the takeoff, after the No. 1 engine failed, at a speed above V2 at a height of approximately 50 feet, with insufficient runway remaining to effect a safe landing.
Author (GRA)

N72-33043# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: FLYING TIGER LINE, INC., DOUGLAS DC-8-63F, N785FT, NAHA AIR BASE, OKINAWA, RYUKYU ISLANDS, 27 JULY 1970
29 Dec. 1971 50 p
(PB-208767; NTSB-AAR-72-10) Avail: NTIS HC $3.00 CSCL 01B

While in the process of executing a precision radar GCA, a DC-8-63F cargo aircraft, crashed about 2,200 feet short of the threshold of Runway 18 at Naha Air Base, July 27, 1970. The four crewmembers and only occupants died as a result of the accident. The weather conditions at Naha were good with scattered rain showers, one of which was located in the vicinity of the GCA minimum altitude position. Bright areas of sunlight existed where cloud cover was absent. The probable cause of this accident was an unarrested rate of descent due to inattention of the crew to instrument altitude references while the pilot was attempting to establish outside visual contact in meteorological conditions which precluded such contact during that segment of a precision radar approach inbound from the Decision Height. Author (GRA)

N72-33044# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: TRANS CARIBBEAN AIRWAYS, INC., BOEING 727-200, CHARLOTTE AMALIE, ST. THOMAS, VIRGIN ISLANDS, 28 DECEMBER 1970
29 Dec. 1971 56 p refs
(PB-208675; NTSB-AAR-72-8) Avail: NTIS HC $3.00 CSCL 01B

Trans Caribbean Airways Flight 505 crashed during an attempted landing, at Harry S. Truman Airport, St. Thomas, U.S. Virgin Islands. Forty-six of the 48 passengers and the entire crew of seven survived the accident and the ensuing ground fire. The flight was routine until the attempted landing. At that time, the aircraft touched down hard, bounced twice, departed the airport property, and came to rest on the slope of a nearby hill.
GRA

N72-33045# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT. U.S. CIVIL AVIATION. ISSUE NO. 3, 1970 ACCIDENTS
29 Nov. 1971 499 p
(PB-210121; NTSB-BA-71-4) Avail: NTIS HC $6.00 CSCL 01B

The publication contains selected aircraft accident reports, in brief format, occurring in U.S. Civil Aviation operations during calendar year 1970. The 898 General Aviation accidents contained in this publication represent a random selection. This publication is issued irregularly, normally six times each year. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. Author (GRA)

N72-33046# Whittaker Corp., San Diego, Calif. Research and Development Div.
FILAMENT COMPOSITE WHEEL DEVELOPMENT FOR MILITARY AIRCRAFT Final Report, 22 Oct. 1970 13 Aug. 1971
Audie L. Price Wright-Patterson AFB, Ohio AFFDL Oct. 1971 49 p
(Contract F33615-71-C-1089; AF Proj. 1369)
(AD-745130; MJO-3025; AFFDL-TR-71-144) Avail: NTIS CSCL 01/3

A program was conducted wherein a fibrous graphite/epoxy aircraft wheel was designed, fabricated and delivered to the Air Force for testing. The composite wheel was fabricated using continuous fibers laid up on a male mold with multiple autoclave staging. The material was applied in broadgood patterns by hand and in continuous forms by filament winding. The completed layup was machined to proper configuration. Author (GRA)

N72-33047# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
SIMULATION OF THE INDUCED FLOW THROUGH A ROTOR IN DESCENDING FLIGHT
N. K. Shupe Jun. 1972 31 p refs
(DA Proj. 1F1-62202-A-219)
(AD-745103; ECOM-3579) Avail: NTIS CSCL 01/2

The report outlines an emperical modification to classified momentum theory for the modeling of the induced flow through a rotor in descending flight. Consideration is also given to the computational stability of the procedure with emphasis upon the real-time representation of the system within a digital computer.
Author (GRA)

N72-33048# Army Electronics Command, Fort Monmouth, N.J.
CONTROLLED HELICOPTER DISCHARGE
Rudolf G. Buser, Helmuth M. Kaunzinger, and Irwin Gumeiner May 1972 38 p refs
(DA Proj. 1T0-61102-B-31-A)
(AD-745102; ECOM-3575) Avail: NTIS CSCL 09/1

Several new approaches, potentially capable of discharging a helicopter to an operationally safe potential against ground, have been explored. Specifically, water spray discharges have been studied under various conditions and appear promising. Other elements of a complete active discharge system, namely, field sensor and information processor/indicator, have been developed and tested also, as well as the complete system itself.
Author (GRA)

N72-33049# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
ARRESTED LANDING FATIGUE TEST OF THE MODEL A-6A AIRCRAFT Final Report
Henry D. Lystad 1 Jun. 1972 43 p refs
(AD-745300; NADC-72033-VT) Avail: NTIS CSCL 01/3

A laboratory test was performed on a model A-6A airframe to determine whether the airframe could sustain the arrestment loads associated with 2000 arrestments at an increased gross weight of 36,000 pounds. The Navy Model NEA6-A, BUNO 149935, used as a test specimen, sustained 4000 arrestment test cycles with no major failures satisfying a service life of 2000 arrestments at a gross weight of 36,000 pounds.
Author (GRA)

N72-33051# Northrop Corp., Newbury Park, Calif. Ventura Div.
RINGSAIL PARACHUTE DESIGN
Edgar G. Ewing and Jack R. Vickers Wright-Patterson AFB, Ohio AFFDL Jan. 1972 380 p refs
(Contract F33615-71-C-1815; AF Proj. 412A)
(AD-745335; AFFDL-TR-72-3) Avail: NTIS CSCL 01/3

This document is intended for use as a design handbook for the ringsail parachute. It begins with an historical review of the aerodynamic and structural development of the parachute, including the development of the modified ringsail design used in the Apollo ELS main parachute cluster. Salient characteristics of all ringsail parachutes fabricated and tested over the past 16 years are summarized. An explosion of the present status of ringsail design and operational theory, with special emphasis on a general theory of the inflation characteristics of clustered

canopies, is given. Accumulated performance and weight data are presented in tabular and graphical form. A detailed step-by-step procedure for the design of the ringsail parachute is given and illustrated by numerical example. Author (GRA)

N72-33052# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: SOUTHERN AIRWAYS, INC. DC-9, N97S TRI-STATE AIRPORT, HUNTINGTON, WEST VIRGINIA, 14 NOVEMBER 1970
14 Apr. 1972 82 p
(PB-209082; NTSB-AAR-72-11) Avail: NTIS HC $3.00 CSCL 01B

Southern Airways, Inc., DC-9, N97S, operating as charter Flight 932, crashed during a landing attempt at the Tri-State Airport, Huntington, West, Virginia, at approximately 1936 e.s.t., on November 14, 1970. All 75 occupants, including 71 passengers and four crewmembers, were fatally injured. The aircraft was destroyed. The crash occurred following impact with trees on a hill approximately 1 mile west of the runway threshold. The National Transportation Safety Board determined that the probable cause of this accident was the descent below minimum descent altitude during a nonprecision approach under adverse operating conditions, without visual contact with the runway environment. Author (GRA)

N72-33058*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
INTEGRATED ENGINE GENERATOR FOR AIRCRAFT SECONDARY POWER
Richard R. Secunde 1972 12 p refs Proposed for presentation at the 8th Propulsion Specialists Conf., New Orleans, 29 Nov. - 1 Dec. 1972; sponsored by AIAA
(NASA-TM-X-68139; E-6804) Avail: NTIS HC $3.00 CSCL 10A

An integrated engine-generator for aircraft secondary power generation is described. The concept consists of an electric generator located inside a turbojet or turbofan engine and both concentric with and driven by one of the main engine shafts. The electric power conversion equipment and generator controls are located in the aircraft. When properly rated, the generator serves as an engine starter as well as a source of electric power. This configuration reduces or eliminates the need for an external gear box on the engine and permits reduction in the nacelle diameter. Author

N72-33153# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TRANSCRIBED PILOT REPORT (PIREP) BROADCAST SYSTEM, TEST AND EVALUATION Final Report, Jan. 1971 - Jul. 1972
James G. Dong Oct. 1972 27 p
(FAA Proj. 132-221-05X)
(FAA-NA-72-62; FAA-RD-72-97) Avail: NTIS HC $3.50

The results of an automatic transcribed pilot report (PIREP) system fabricated at the National Aviation Facilities Experimental Center (NAFEC) are presented. The system utilized an off-the-shelf endless loop tape recorder which was integrated in the Flight Service Station/Very High Frequency Omnirange configuration at selected sites. Live operational tests were accomplished to determine equipment deficiencies and operational suitability for consideration of expanding the PIREP concepts to other sites. From the operational tests, the concept was not adopted because of pilot apathy to transmitting PIREPS. Author

N72-33246*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
FULL SCALE SUBSONIC WIND TUNNEL REQUIREMENTS AND DESIGN STUDIES
Mark W. Kelly, Kenneth W. Mort, and David H. Hickey Sep. 1972 50 p refs
(NASA-TM-X-62184) Avail: NTIS HC $4.50 CSCL 14B

The justification and requirements are summarized for a large subsonic wind tunnel capable of testing full-scale aircraft, rotor systems, and advanced V/STOL aircraft propulsion systems. The design considerations and constraints for such a facility are reviewed, and the trades between facility test capability and costs are discussed. The design studies showed that the structural cost of this facility is the most important cost factor. For this reason (and other considerations such as requirements for engine exhaust gas purging) an open-return wind tunnel having two test sections was selected. The major technical problem in the design of an open-return wind tunnel is maintaining good test section flow quality in the presence of external winds. This problem has been studied extensively, and inlet and exhaust systems which provide satisfactory attenuation of the effects of external winds on test section flow quality were developed. Author

N72-33255# Stanford Research Inst., Menlo Park, Calif.
AIRCRAFT GROUND FIRE SUPPRESSION AND RESCUE SYSTEMS: BASIC RELATIONSHIPS IN MILITARY FIRES Interim Report, 12 Jan. - 1 Sep. 1971
Ray S. Alger and Erwin L. Capener Apr. 1972 142 p refs
(Contract N60971-71-C-0283)
(AD-745122; AGFSRS-72-1) Avail: NTIS CSCL 13/2

Experimental pool fires of JP5 3 ft and 10 ft in diameter were instrumented to measure heat fluxes, burning rates, and suppression characteristics. Test substrates included water, sand and gravel. In these tests the extinguishment system was designed to give a uniform rate of application over the burning fuel surface. The suppressant spray was characterized as to uniformity, average drop size, and interaction kinetics with the fuel surface. Radiation fluxes at varying distances from the fire were related to wind velocity, location of measuring station, type of substrate and the water content of the substrate. Fuel burning rates were related to wind velocity and substrate characteristics. Site preparations are described for 100 ft x 100 ft fires. Author (GRA)

N72-33256# Federal Aviation Administration, Washington, D.C. Airports Service.
EFFINGHAM COUNTY MEMORIAL AIRPORT, EFFINGHAM, ILLINOIS Final Environmental Impact Statement
1 May 1972 36 p Supersedes PB-205790-D HC $3.00
(PB-205790-F; PB-205790-D; ELR-4355) Avail: NTIS CSCL 13B

A description is given of the proposal for further development of the Effingham County Memorial Airport for land reimbursement and acquisition, construction marking, and lighting of a crosswind runway. There will be no primary adverse environmental effects other than land use. Author (GRA)

N72-33258# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, SHERMAN ARMY AIRFIELD, FORT LEAVENWORTH, KANSAS
P. J. Vedros and R. D. Jackson Jun. 1972 16 p
(AD-743912; AEWES-Misc-Paper-S-72-25) Avail: NTIS

The purpose of the report is to present the results of an inspection performed at Sherman Army Airfield (SAAF) in April 1971. The inspection was limited to visual observations, and no tests were conducted on any of the pavement facilities. Author (GRA)

N72-33259# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF A FIXED BASE VISUAL APPROACH AND LANDING SIMULATOR M.S. Thesis
Richard Allen Gibson Mar. 1972 29 p refs
(AD-745200) Avail: NTIS CSCL 14/2

A fixed base visual approach and landing simulator was developed using an F-105 Canopy/Seat Cockpit Trainer, Panasonic Closed Circuit Television System, and a SMK-22 Main Attachment

Unit. Difficulties encountered in interface of the units necessitated modification of the SMK-22 Attachment Unit in both flight characteristics and operating modes. A main control console was assembled to control and coordinate the operation of the system elements and monitor the system during simulated flight. Reduction in degrees of freedom was achieved through elimination of the yaw mode. An FJ-4 control stick was modified and installed in the cockpit replacing the fabricated control stick. Longitudinal trim control was achieved with the trim switch installed in the FJ-4 control stick, modifying longitudinal circuitry by means of an additional trim assembly.
Author (GRA)

N72-33272*# Lockheed-Georgia Co., Marietta.
THREE DIMENSIONAL COMPRESSIBLE BOUNDARY-LAYER COMPUTATIONS FOR A FINITE SWEPT WING
J. F. Nash and R. M. Scruggs [1972] 120 p refs
(Contract NAS1-10823)
(NASA-CR-112158) Avail: NTIS HC $8.00 CSCL 20D

Three-dimensional, compressible turbulent boundary-layer calculations have been performed for the finite supercritical wing of the NASA modified F8 transonic research airplane. Data on the boundary-layer thickness, displacement thickness, skin friction components, and integrated streamwise skin friction are presented for points along the streamwise stations of which the pressure measurements were previously made. Representative velocity profiles are shown, and boundary-layer-thickness contour plots and skin-friction vector plots are presented. Results are given for a Reynolds number of 1.5 million per foot, and for Mach numbers of 0.50 and 0.99.
Author

N72-33286# Ohio State Univ. Research Foundation, Columbus.
INVESTIGATION OF BOUNDARY LAYERS AND TRIP FLOWS OF HELICOPTER ROTOR BLADES Final Report, 15 Apr. 1969 - 15 Jun. 1971
Henry R. Velkoff, Dwight A. Blaser, and John D. Hoffman May 1972 275 p refs
(Contract DAAJ02-69-C-0068)
(AD-745213; USAAMRDL-TR-71-73) Avail: NTIS CSCL 20/4

An experimental and analytical study was conducted on the nature of rotor blade boundary layers and flow over rotor blade tips. The experimental study of boundary layers was conducted using a model rotor and included both hovering and forward flight conditions. Flow visualization using an ammonia trace technique and hot-wire anemometry were used to determine the boundary layer flow. Both chordwise and spanwise velocity distributions were obtained through the boundary layer. Velocity profile data were obtained at selected chordwise and spanwise locations. The profiles obtained appeared to be consistent with boundary layer behavior. In hovering, the boundary layer flow in the vicinity of a separation bubble was mapped out. The analytical phase of the study was based upon a three-dimensional application of the momentum-integral techniques of handling boundary layer analysis.
Author (GRA)

N72-33379*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR CONTROLLING THE TEMPERATURE OF BALLOON BORNE EQUIPMENT Patent Application
Milton Schach and Jack J. Triolo, inventors (to NASA) Filed 14 Aug. 1972 18 p
(NASA-Case-GSC-11620-1; US-Patent-Appl-SN-280305) Avail: NTIS HC $3.00 CSCL 14B

The development of a temperature control device for use with balloon-borne equipment is discussed. The device will control the temperature of batteries and electronic instrumentation packages carried by balloons to high altitudes. The configuration of the Mylar enclosure contains the radiant energy emitted by the earth and its atmosphere and reflects the radiation emitted by the instrumentation package, thus reducing the heat loss.
NASA

N72-33386*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTATING PRESSURE MEASURING SYSTEM FOR TURBINE COOLING INVESTIGATIONS
Frank G. Pollack, Curt H. Liebert, and Victor S. Peterson Washington Oct. 1972 20 p refs
(NASA-TM-X-2621; E-7016) Avail: NTIS HC $3.00 CSCL 14B

The development of a 10-channel rotating pressure measuring system capable of operation to speeds of 9000 rpm at transducer temperatures of about 320 K (120 F) is described. Variable-reluctance pressure transducers were mounted in the rotating system for sensing pressure. Rotating performance tests on a spin rig showed that the output data from 7 of the 10 transducers tested were within a desired system error of 3 percent. However, the error of the output data from three other transducers was as large as 8 percent of 9000 rpm. It was concluded from these test results that a rotating screening method was necessary to evaluate each pressure transducer channel within a system that will be used under rotating conditions.
Author

N72-33467# Shell Development Co., Emeryville, Calif.
COKER DEPOSIT MEASUREMENT USING BETA-RAY BACKSCATTER Technical Report, Jun. 1968 - Mar. 1972
H. T. Henderson, R. M. Curtis, and A. Telfer May 1972 82 p refs
(Contract F33615-70-C-1038; AF 33(615)-3789; AF Proj. 3048)
(AD-743308; S-14126; AFAPL-TR-72-36) Avail: NTIS CSCL 14/2

The report describes the development and application of an instrument for the measurement of coker tube deposits. Operation is based on backscattered low energy beta rays and a thin window proportional detector housed in a vacuum chamber in which the tubes are examined. Hydrocarbon deposits in the range of 30 to 3000 A thickness can be measured with good accuracy. A description is given of backscatter theory, design of the instrument, and of examples of the successful application of the instrument to coker tubes of various sizes. Data from several fuel thermal stability studies are presented in terms of maximum deposit thickness and total deposit mass for each tube. It is comparable in accuracy to combustion determination and has the added advantages of being nondestructive and of providing a complete deposit profile along the tube. Sufficient detail is included so that the report may be used as an operator's manual.
Author (GRA)

N72-33498# Southwest Research Inst., San Antonio, Tex.
STUDIES WITH SYNTHETIC LUBRICANTS IN THE HOT-WALL DEPOSITION RIG Technical Report, 1 Feb. 1969 - 31 Jan. 1972
J. P. Cuellar, D. A. Montalvo, and B. B. Baber Wright-Patterson AFB, Ohio AFAPL Jun. 1972 69 p refs
(Contract F33615-69-C-1295; AF Proj. 3048)
(AD-744841; SwRI-RS-582; AFAPL-TR-72-25) Avail: NTIS CSCL 11/8

A detailed description is presented of the hot-wall deposition test method for evaluating deposit and degradation characteristics of aircraft turbine engine lubricants at various temperature severity levels. Deposition data are shown for twenty MIL-L-7808- and six MIL-L-23699-type lubricants studied at 350 F sump temperature and a range of 510 to 570 F heating fluid temperature. Concurrently with test development and lubricant evaluation, the hot-wall test was used in the interrelated studies of test precision, effects of variables, and correlation of deposit ratings with bearing deposition test results.
Author (GRA)

N72-33499# Southwest Research Inst., San Antonio, Tex.
STUDIES ON THE OXIDATION-CORROSION-DEPOSITION AND THERMAL STABILITY CHARACTERISTICS OF MIL-L-7808-TYPE LUBRICANTS Technical Report, 1 Jun. 1970 - 1 Feb. 1972

J. P. Cuellar and B. B. Baber Wright-Patterson AFB, Ohio AFAPL Jun. 1972 76 p refs
(Contract F33615-69-C-1295; AF Proj. 3048)
(AD-744840; SwRI-RS-587; AFAPL-TR-72-45) Avail: NTIS CSCL 11/8

The report describes test methods and procedures used in the study of the oxidation-corrosion-deposition (O-C-D) characteristics of aircraft turbine engine lubricants employing a glassware-type apparatus. Development and evaluation of a light meter device for quantitative measurement of glassware deposits are also discussed. An extensive experimental effort using eight MIL-L-7808-type lubricants is described. The study encompassed an investigation of the factors of time, temperature, moisture, and metal types in relation to lubricant breakdown in an oxidizing (air) atmosphere. A similar, less extensive program was conducted for four lubricants using an inert (nitrogen) atmosphere. Author (GRA)

N72-33506# Boeing Co., Philadelphia, Pa. Vertol Div.
OIL-STARVATION TEST PROGRAM: EVALUATION OF VASCO-X2 STEEL SPIRAL BEVEL GEARS Final Report, Oct. - Dec. 1971
J. P. Alberti and A. J. Lemanski Apr. 1972 61 p refs
(Contract DAAJ02-72-C-0009; DA Proj. 1F1-62205-AA-5201)
(AD-744506; D210-10384-1; USAAMRDL-TR-72-19) Avail: NTIS CSCL 13/9

The report presents the results of tests conducted to evaluate the performance of spiral bevel gears made from VASCO-X2 steel when they are operated without lubricating oil. Spiral bevel gears made from AISI 9310 steel and identical gears made, from VASCO-X2 steel were run under load in a regenerative (four-square) test stand. The purpose of this testing was to evaluate the effect of material properties on the performance of main power gears in a nonlubricated (loss-of-oil) environment. Author (GRA)

N72-33508# AiResearch Mfg. Co., Phoenix, Ariz.
EVALUATION OF GAS LUBRICATED HYDRODYNAMIC BEARINGS IN A GAS TURBINE ENVIRONMENT Final Report, Mar. 1971 - Apr. 1972
Kendall R. Swenson, Nick M. Hughes, and Don F. Heuer Wright-Patterson AFB, Ohio AFAPL Jun. 1972 60 p
(Contract F33615-71-C-1376; AF Proj. 3048)
(AD-744844; AT-6129-R; AFAPL-TR-72-41) Avail: NTIS CSCL 13/9

The report contains a summary of the design analysis, development testing, and demonstration testing performed to demonstrate the feasibility of using gas lubricated hydrodynamic bearings in a gas turbine environment. The gas generator portion of the jet fuel starter used on the A7 D aircraft was modified to incorporate compliant-foil gas bearings and subjected to varied demonstration test. In addition, engine starts were made under conditions which simulated normal starting gear loads. Results of the testing were very satisfactory. It is concluded that gas lubricated bearings can be used in a gas turbine application and further testing is encouraged. Author (GRA)

N72-33547# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
CLADDINGS OF SUPERIOR CORROSION RESISTANCE FOR HIGH STRENGTH ALUMINUM ALLOYS
Fred H. Meyer, Jr. Feb. 1972 37 p refs
(AF Proj. 7381)
(AD-743311; AFML-TR-71-244) Avail: NTIS CSCL 11/6

The report summarizes the results of an evaluation of the corrosion performance of various experimental claddings on 7075-T6 aluminum alloys, in certain natural environments for periods up to 24 months. Claddings tested were 1199, 5457, 7004, 7472, 7072, and 7039 aluminum alloys. The superiority of 1199 and 5457 alloy cladding from the corrosion standpoint in tropical, semitropical, and temperate climates was confirmed. Corrosion related blistering of the clad layer indicate some modification of composition of 1199 and 5457 alloys might be desirable for long-term corrosion performance. Alloys 7004 and 7472 also were found to be superior to 7072 cladding from the corrosion standpoint but not equal to 1199 or 5457 alloys. Author (GRA)

N72-33554# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
EFFECT OF GRAIN ORIENTATION ON SUSCEPTIBILITY OF TWO TITANIUM PLATE ALLOYS TO STRESS CORROSION
Charles Edwin Neu 15 Jun. 1972 16 p refs
(AD-745293; NADC-72108-VT) Avail: NTIS CSCL 11/6

The susceptibility to stress corrosion cracking in 3.5 percent sodium chloride solution of Ti-6Al-4V and Ti-6Al-6V-2Sn alloy plates in the annealed and solution treated and aged conditions was determined by tests of notched C-ring specimens with longitudinal, long transverse, and short transverse orientations. Test results indicated that the annealed material of both alloys was more susceptible to cracking in the long transverse direction than in the longitudinal and short transverse directions. In the solution treated and aged material of both alloys the short transverse direction showed slightly less susceptibility to cracking than did the longitudinal and long transverse directions, but the differences were not considered significant. Based on these results a recommendation was made that for plate material of both alloys in air frame design maximum allowable stress be 60% of yield strength in all directions. Author (GRA)

N72-33557# Battelle Columbus Labs., Ohio. Metals and Ceramics Information Center.
HOT CORROSION IN GAS TURBINES
J. Stringer Jun. 1972 61 p refs
(Contract F33615-71-C-1067)
(AD-745474; MCIC-72-08) Avail: NTIS HC $10.75/MF $10.75. Also available from NTIS HC $18.95/MF $18.95, set of 2 reports as AD-745473-SET CSCL 11/6

The problem of accelerated corrosion of high-temperature gas-turbine alloys in circumstances where sodium chloride or other salts are ingested with the combustion air or in the fuel has been known for many years, and is usually attributed largely to the presence of sodium sulfate, which is either present in the ingested salts or formed by reaction between sodium chloride and sulfur in the fuel. The problem has become more important because of two related developments: the increase in turbine inlet temperatures and the reduction of chromium content in modern superalloys. In the report, a brief outline of the early research is presented, to elucidate the nature of the problem. The thermochemistry of the more important reactions involved is then described. The incidence of the attack in the engine is difficult to predict, and depends very much on the particular alloy. Since a complete fundamental characterization of the process is impossible, there has been considerable interest in testing procedures, and the more important methods are described in the next section. For the same reason, research in the last few years has followed two separate paths: one concerned with phenomenological testing of alloys and the other concerned with the determination of the reaction mechanism. These two types of research are described separately. Author (GRA)

N72-33561*# Boeing Co., Seattle, Wash.
APPLICATION STUDY OF FILAMENTARY COMPOSITES IN A COMMERCIAL JET AIRCRAFT FUSELAGE Final Report, Oct. 1971 - Jun. 1972
R. W. Johnson and R. R. June Jun. 1972 123 p refs
(Contract NAS1-11162)
(NASA-CR-112110) Avail: NTIS HC $8.25 CSCL 11D

A study of applications of filamentary composite materials to aircraft fuselage structure was performed. General design criteria were established and material studies conducted using the 727-200 forebody as the primary structural component. Three design approaches to the use of composites were investigated: uniaxial reinforcement of metal structure, uniaxial

and biaxial reinforcement of metal structure, and an all-composite design. Materials application studies for all three concepts were conducted on fuselage shell panels, keel beam, floor beams, floor panels, body frames, fail-safe straps, and window frames. Cost benefit studies were conducted and developmental program costs estimated. On the basis of weight savings, cost effectiveness, developmental program costs, and potential for early application on commercial aircraft, the unaxial design is recommended for a 5-year flight service evaluation program. Author

N72-33616# Naval Postgraduate School, Monterey, Calif.
COMPATIBILITY OF AN AIRCRAFT AND RAWINSONDE MEASUREMENTS M.S. Thesis
Denis G. Taipale Mar. 1972 93 p refs
(AD-743710) Avail: NTIS CSCL 04/2

Investigation of data obtained by aircraft during Project Rough Rider '71 reveals that aircraft navigation is unsatisfactory for mesoscale research on the convective cell scale. The established method for re-navigating the flights is modified to yield navigation errors of less than 0.1 nautical mile for most tracks when compared with entries in the navigator's log. It is shown that the corrections required are dependent on the height of the aircraft above the terrain, terrain slope and wind. Meteorological parameters obtained from aircraft measurements are compared with rawinsonde measurements. These comparisons show that if appropriate corrections are applied, the data are useful for extending rawinsonde networks and defining spatial gradients of parameters between stations. Recommendations for determination of correction factors and suggestions for further research are made. Author (GRA)

N72-33623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PHYSICAL MODEL OF CLEAR-AIR TURBULENCE
N. Z. Pinus 4 Feb. 1972 20 p refs Transl. into ENGLISH from Meteorol. Gidrol. (USSR), no. 6, 1971 p 57-66
(AD-743691; FTD-MT-24-1726-71) Avail: NTIS CSCL 04/2

A physical model of clear-air turbulence is proposed which is created on the basis of the results of summer investigations of the space characteristics of turbulent zones, hydrodynamic and thermodynamic parameters of these zones, the energy spectra of pulsations of vertical and horizontal components of wind velocity, and the spectral rate of turbulent exchange. The quantitative values of the physical characteristics of the model are given and the mechanism for the formation of clearair turbulence is examined. Author (GRA)

N72-33624# Northern Research and Engineering Corp., London (England).
THE POTENTIAL IMPACT OF AIRCRAFT EMISSIONS UPON AIR QUALITY
M. Platt, R. C. Baker, E. K. Bastress, K. M. Chng, and R. D. Siegel 29 Dec. 1971 330 p refs
(Contract DI-68-02-0085)
(PB-208950; NREC-1167-1) Avail: NTIS HC $9.00 CSCL 13B

The specific objectives were: to select representative airports for which detailed studies would be made of emissions and impact to determine aircraft emission factors and activity levels for the selected airports, to develop future projections of emission rates and their impact at the selected airports, and to determine emission rates and impact of unburned fuel resulting from fuel venting and other practices directly associated with aircraft operating cycles. The survey gives data on hydrocarbons, carbon monoxide, nitrogen oxides, particulates, SO2, and lead; all were in significant concentrations. Large reductions in concentrations of carbon monoxide, total hydrocarbons, nitrogen oxides, and particulates due to emissions of turbine-engine aircraft may be achieved by various control methods. However if this is not done, predictions presented show major pollution increases. Author (GRA)

N72-33633*# National Aeronautics and Space Administration, Washington, D.C.
NATIONAL PLAN FOR DEVELOPMENT OF THE MICROWAVE LANDING SYSTEM
Jul. 1971 113 p refs Prepared in cooperation with FAA
(NASA-TM-X-68637; AD-733268) Avail: NTIS HC $7.75 CSCL 17G

A plan for the development of a new civil/military microwave landing system (MLS) is presented. It delineates the five year program of integrated activity deemed necessary to provide a MLS that meets the wide range of user operational requirements set down by RTCA SC-117. Included in the plan are two interdependent and complementary activities: (1) an industry oriented systems development program designed to produce prototype equipment for flight test and evaluation and, finally, production specifications at the earliest possible date; and (2) a concurrent series of supporting government programs, to be undertaken by DOT/DOD/NASA, which will include validation efforts independent of the industry program, investigations of sub-system concepts and techniques, performance of flight tests and system evaluation efforts, and application of the microwave guidance system to the requirements of the individual users. Author

N72-33641# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TEST AND EVALUATION OF CATEGORY 3 ILS GROUND GUIDANCE EQUIPMENT STAN-38 GLIDE SLOPE TESTS AT NAFEC ON RUNWAY 4 Final Report, Aug. 1969 May 1971
Edmund A. Zyzys Sep. 1972 70 p
(FAA Proj. 073-318-01X)
(FAA-NA-72-13; FAA-RD-72-105) Avail: NTIS HC $5.50

A STAN-38 glide slope system in an M-array without clearance configuration was installed on runway 4 at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey. The system was tested for conformance to ICAO Annex 10 Category 3 ILS specifications for system performance and stability, and for monitor performance with amplitude and phase errors in the antenna system. The effects of prevailing weather conditions on the executive monitor system were recorded. It was concluded that the primary performance characteristics met ICAO specifications, and that the executive monitor system using specified alarm limits for the test provided satisfactory alarms during degraded performance conditions except in the dephased upper antenna fault condition. Author

N72-33642*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT OF STOLAND, A VERSATILE NAVIGATION, GUIDANCE AND CONTROL SYSTEM
L. S. Young, Q. M. Hansen, W. E Rouse (Sperry Flight Systems Div.), and S. S. Osder (Sperry Flight Systems Div.) Oct. 1972 13 p
(NASA-TM-X-62183) Avail: NTIS HC $3.00 CSCL 17G

STOLAND has been developed to perform navigation, guidance, control, and flight management experiments in advanced V/STOL aircraft. The experiments have broad requirements and have dictated that STOLAND be capable of providing performance that would be realistic and equivalent to a wide range of current and future avionics systems. An integrated digital concept using modern avionics components was selected as the simplest approach to maximizing versatility and growth potential. Unique flexibility has been obtained by use of a single, general-purpose digital computer for all navigation, guidance, control, and displays computation. Author

N72-33644*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDY OF AIRCRAFT CENTERED NAVIGATION, GUIDANCE, AND TRAFFIC SITUATION SYSTEM CONCEPT FOR TERMINAL AREA OPERATION

Willard W. Anderson, Ralph W. Will, and Carolyn Grantham Washington Nov. 1972 53 p refs
(NASA-TN-D-6992; L-8168) Avail: NTIS HC $3.00 CSCL 17G

A concept for automating the control of air traffic in the terminal area in which the primary man-machine interface is the cockpit is described. The ground and airborne inputs required for implementing this concept are discussed. Digital data link requirements of 10,000 bits per second are explained. A particular implementation of this concept including a sequencing and separation algorithm which generates flight paths and implements a natural order landing sequence is presented. Onboard computer/display avionics utilizing a traffic situation display is described. A preliminary simulation of this concept has been developed which includes a simple, efficient sequencing algorithm and a complete aircraft dynamics model. This simulated jet transport was flown through automated terminal-area traffic situations by pilots using relatively sophisticated displays, and pilot performance and observations are discussed. Author

N72-33645# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIR TRAFFIC CONTROL Quarterly Technical Summary, 1 Feb. - 30 Apr. 1972
Herbert G. Weiss 15 May 1972 17 p refs
(Contract F19628-70-C-0230; AF Proj. 649L)
(AD-744826; ESD-TR-72-86) Avail: NTIS CSCL 17/7

The report summarizes the progress on the Air Traffic Control tasks. The principal effort was directed toward reaching a status which will permit the presentation of tentative conclusions and reports because several of the tasks must be terminated in FY 72. The radar MTI study effort will continue under FAA sponsorship, and the analysis of microwave landing guidance systems will be maintained for the Air Force. Discussions are under way concerning the scope and level of future Air Force-supported effort on airborne graphical displays and CNI system performance analysis. Author (GRA)

N72-33743*# General Electric Co., Lynn, Mass. Aircraft Engine Group.
TF-34 TURBOFAN QUIET ENGINE STUDY Final Report
D. P. Edkins, R. Hirschkron, and R. Lee 1972 98 p ref
(Contract NAS3-14338)
(NASA-CR-120914) Avail: NTIS HC $7.00 CSCL 21E

A study of high bypass turbofan engines in heavily sound-suppressed nacelles based on the TF-34 engine. The four-engine noise objective was 95 PNdb at four locations typical of takeoff and landing. Three engines were studied; these had fan pressure ratios, bypass ratios, and fan tip speeds respectively of 1.48/6.5/404 m/sec (1327 ft/sec), 1.25/13/305 (1000), 1.25/13/366(1200). The bypass 13 engines had a variable pitch fan, direct- and gear-driven. Noise suppressive treatment was identified which met 95 PNdb objective except for sideline liftoff at 6.5 bypass, full power, which was 2 PNdb noisier; at 90% power, 95 PNdb was achieved. Author

N72-33750# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
COMPARISON OF TURBOJET, TURBOROCKET AND RAMJET AS A PROPULSION SYSTEM FOR LONG RANGE AIRPLANES AT MACH NUMBERS BETWEEN 2 AND 4 [VERGLEICH VON TURBOTRIEBWERK, TURBORAKETE UND STAUSTRAHLTRIEBWERK ALS ANTRIEB FUER FLUGZEUGE GROSSER REICHWEITE BEI MACHZAHLEN ZWISCHEN 2 UND 4]
Egbert Riester Jun. 1972 38 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-38) Avail: NTIS HC $4.00; DFVLR, Porz: 10,50 DM

Turbojet, turborocket, and ramjet engines are compared for long distance cruising flight in the Mach number range from 2 to 4. The additional drag of engines with air flow rates of the same cross section area at the undisturbed flow in front of the engine, was compared. It is shown that even with modern component technology the turbojet is the optimum propulsion system up to Mach 3.5. Above this Mach number the ramjet becomes more effective. The turborocket is advantageous at high Mach numbers because of its high thrust density, although its specific impulse is somewhat lower. Author (ESRO)

N72-33752# Naval Postgraduate School, Monterey, Calif.
INLET DISTORTION, VORTICITY, AND STALL IN AN AXIAL-FLOW COMPRESSOR M.S. Thesis
Clinton Jefferson Farmer Mar. 1972 124 p refs
(AD-743725) Avail: NTIS CSCL 21/5

A new approach to defining inlet distortion factors for axial-flow compressors is presented. A summary of past analyses of inlet distortion, along with a brief review of flow-distortion definition and compressor performance, provides a background for the proposed theory. Inlet flow-distortion in terms of total-pressure fluctuations at the compressor face is converted to vorticity. The effects of vorticity on the internal aerodynamics of the compressor are investigated with some approximate calculations included to indicate the validity of this approach. Refinements and alternate solutions to the theory which could lead to definition of a more comprehensive and reliable definition of stall-inducing inlet distortion are included. Author (GRA)

N72-33753# Bendix Corp., Teterboro, N.J. Navigation and Control Div.
AUTOMATIC THROTTLE CONTROL FOR TRANSPORT AIRCRAFT WITH MAXIMUM QUADRANT POSITION LIMITED BY ENGINE PRESSURE RATIO Final Technical Report
Stephen Skaritka Jan. 1972 27 p
(Contract F33615-69-C-1468; AF Proj. 8226)
(AD-743314; Rept-7211-361; AFFDL-TR-71-112) Avail: NTIS CSCL 21/5

The report describes an automatic throttle control system that limits maximum throttle lever position as a function of engine pressure ratio. Limit EPR is sensed by an outside air temperature gauge calibrated in EPR as based on thrust level limits contained in the aircraft operator's manual. Limit control of EPR is accomplished by stopping the throttle lever when the observed EPR equals the temperature sensed limit value. The EPR limit control was designed primarily to permit use of maximum permissible thrust during takeoff and go-around maneuvers with an automatic throttle system utilizing a single servo. Author (GRA)

N72-33759# Bureau of Mines, Washington, D.C.
A FIELD SURVEY OF EMISSIONS FROM AIRCRAFT TURBINE ENGINES
F. W. Cox, F. W. Penn, and J. O. Chase May 1972 32 p refs
(PB-210220; BM-RI-7634) Avail: NTIS HC $3.75 CSCL 13B

Exhaust emissions were measured from 25 aircraft turbine engines using Jet A fuel. Analytical apparatus, procedures, and results are described. Carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, and aldehydes were measured at engine operating modes representing power levels used in airline operation. Engines retrofitted with smoke-reducing burner cans produced less carbon monoxide, hydrocarbon, and aldehyde emissions, and slightly more oxides of nitrogen than engines with standard burner cans. Author (GRA)

N72-33882 Engineering Sciences Data Unit, London (England).
BUCKLING STRESS RATIOS FOR FLAT PLATES UNDER SHEAR AND NON-UNIFORM COMPRESSION
Jan. 1970 6 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-70002) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

During deceleration from supersonic flight, transient thermal compressive stresses are set up in an aircraft panel. The stress distribution is approximated by a parabola and the mean temperature in the middle of the plate is 100 C. The shear stress at which the panel will first buckle was determined. Author

N72-33899 Engineering Sciences Data Unit, London (England).
THE CUMULATIVE DAMAGE OF ALUMINIUM ALLOY SPECIMENS UNDER VARIABLE AMPLITUDE FATIGUE LOADING
Oct. 1969 10 p Sponsored by Roy. Aeron. Soc.
(ESDU-69024) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Results of fatigue tests on aluminum alloy specimens are given in which the applied loads are selected to simulate aircraft gust and maneuver conditions. Specimens tested comprise complete wings and riveted sections having a range of K from 3.0 to 4.0 and notched bars and plates with a range K from 1.0 to 7.0. Load cycles determining fatigue damage are based on the combination of maximum peak and maximum trough proceeding through combinations successively smaller peaks and troughs to the minimum values of each. Author

N72-33902 Engineering Sciences Data Unit, London (England).
INTRODUCTION TO DESIGN INFORMATION ON ACOUSTIC FATIGUE
Jan. 1972 8 p refs Supersedes ESDU-66012 Sponsored by Roy. Aeron. Soc.
(ESDU-72001; ESDU-66012) Copyright. Avail: On subcription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The important factors affecting acoustic fatigue failure in aircraft structures are outlined. Data cover operating conditions, noise field characteristics, stress at critical points, and structural response. E.H.W.

N72-33915# Advisory Group for Aerospace Research and Development, Paris (France).
A COMPARISON OF METHODS USED IN FLUTTER RESEARCH
H. G. Kuessner (DEVLR, Goettingen, West Germany) Aug. 1972 141 p refs
(AGARD-R-592) Avail: NTIS HC $9.25 CSCL 01C

The eigenfrequencies, modes and generalized masses of the F104G aircraft have been calculated from the drawings by the finite-element method. The idealization of the structure by different types of elements and the formation of the corresponding mass matrix by adding lumped masses are described. The structure is divided into isolated substructures. By several condensation procedures the number of symmetric and antisymmetric unknowns has been reduced stepwise from 8250 + 7948 to 170 + 162. The rigid-body modes have been eliminated by 3 + 3 supports and by a modified mass matrix. The results of the calculation of 24 modes are described and illustrated. Only 13 of them were comparable with corresponding measurements of two independent ground vibration tests. Whereas the eigenfrequencies agree within a few percent, the mode shapes and the corresponding generalized masses show large differences and suggest the need for further improvements of the calculation method. Author

N72-33916*# Blume (John A.) and Associates Research Div., San Francisco, Calif.
STUDY AND EVALUATION OF FERRO-CEMENT FOR USE IN WIND TUNNEL CONSTRUCTION
Henry J. Larsen, Jr., comp. Jul. 1972 155 p refs
(Contract NAS2-5889)
(NASA-CR-114501; JABE-ARC-07) Avail: NTIS HC $9.75 CSCL 13C

The structural suitability and cost effectiveness of ferro-cement for large subsonic wind tunnel structures is investigated. This investigation was carried out in the following four main categories: (1) a state-of-the-art survey into the uses, properties, and costs of ferro-cement; (2) an evaluation of those ferro-cement properties critical to construction of large, subsonic wind tunnels, which have not been adequately established to date; (3) a laboratory testing program to determine preliminary values for those properties; and (4) a study to establish cost factors for ferro-cement as related to a preliminary construction scheme for a nacelle and shroud unit. Author

N72-33922# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
THE FATIGUE LIFE OF SAFE LIFE STRUCTURES. AN AUSTRALIAN APPROACH
F. H. Hooke, (Aeron. Res. Labs., Melbourne) 1972 49 p
(TR-98) Avail: NTIS HC $4.50

The principles adopted in Australia to assess the fatigue life of safe life structures in aircraft design so that a comparison may be made with procedures followed in Germany is presented. Simplified assessment procedures are outlined including considerations of the degree of similarity between test and service for both loading and specimen configuration. Several methods used to relate the fatigue scatter factor to failure probability are shown which take into account number of test data, variability in loading spectra, bias, and number of critical points. Furthermore the application of reliability theory is demonstrated involving variability of crack length and extreme loads. Author (ESRO)

N72-33938 Engineering Sciences Data Unit, London (England).
EFFECTS OF KINETIC HEATING ON EQUILIBRIUM TEMPERATURE OF FLIGHT VEHICLES
Oct. 1969 13 p refs Supersedes ESDU-Aero-S.00.03.20 Sponsored by Roy. Aeron. Soc.
(ESDU-69012; ESDU-Aero-S.00.03.20) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Data are presented for estimating the equilibrium temperature distribution on flat plates, wedges, cylinders, and cones in constant velocity flight in air. The equilibrium temperature is attained when the effects of forced convection heat transfer and solar radiation to the surface are balanced by the difference between radiation from the surface and atmospheric radiation to the surface. The heat balance equations and their solutions are described, and an example is given to illustrate the method of solution. Tables are included which list the normal total emissivities and solar absorptivities of various surfaces. D.L.G.

N72-33952# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
HEAT TRANSFER RESEARCH Final Report, Jul. 1965 Jan. 1972
Max G. Scherberg May 1972 29 p refs
(AD-744830; ARL-72-0075) Avail: NTIS CSCL 20/4

The specific objective of the program was to provide improved information on selected heat transfer processes along external or internal surfaces of high speed modern aircraft. The goal was to reduce empirical methods and enhance understanding of the processes so that needed design requirements calling for either reduced or increased heat transfer could be implemented. Three task areas were investigated. Author (GRA)

N72-33961 Engineering Sciences Data Unit, London (England).
ENGINEERING SCIENCES DATA UNIT TITLES THROUGH 1972
1972 28 p Sponsored by Roy. Aeron. Soc.
Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The titles of all data items issued by Engineering Sciences Data Unit up to the end of 1971 are listed. The items appear in the following sub-series: aerodynamics, fatigue, performance, structures, and transonic aerodynamics. Author

N72-33962 Engineering Sciences Data Unit, London (England).
PROSPECTUS
[1972] 8 p Sponsored by Roy. Aeron. Soc.
Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A brief description is given of Engineering Sciences Data Unit services, the data items produced, and how to use the service, as well as the historical development of the Data Unit. The technical areas of interest are aeronautical engineering, mechanical engineering, chemical engineering, industrial fluid mechanics, and stress and strength. Author

N72-33964# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT
30 Jun. 1972 108 p refs
(DME/NAE-1972(2)) Avail: NTIS HC $7.50

Research projects conducted by the National Research Council of Canada from 1 April to 30 June 1972 are discussed. Subjects presented include: (1) performance tests of fan in wing model for range of speeds and angles of attack, (2) methods for improving the aerodynamic stability of bridge road decks, (3) aerodynamic characteristics of SC1 and P-1127 aircraft, and (4) distribution of motor vehicle accidents among drivers.

N72-33966 National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
FLOW DISTORTION AND PERFORMANCE MEASUREMENTS ON A 12 INCH FAN-IN-WING MODEL FOR A RANGE OF FORWARD SPEEDS AND ANGLE OF ATTACK SETTINGS
U. W. Schaub and R. W. Bassett *In its* Quart. Bull. of the Div. of Mechanical Eng. and the Natl. Aeron. Estab. 30 Jun. 1972 p 15-32 refs

The performance of a typical fan-in-wing model was examined under representative transition conditions. The model, comprising a 12 in. diameter fan buried in a N.A.C.A 0015 section wing with a constant chord of 40 in., was tested at various angles of attack and air speeds in the closed working section of a propulsion wind tunnel. Tunnel interference corrections were estimated. Typical corrections were indicated for the whole testing range which became limited at very low crossflow ratios as a result of uncertainty in the correction in angle of attack. Flow distortion due to crossflow occurred in both the inlet and exit planes. In the crossflow ratio range zero to 0.27, inflow distortion was observed to be velocity distortion at essentially constant total pressure, whereas outflow distortion appeared to be a distortion of the exit plane static pressure field. The fan thrust was seen to fall off with crossflow ratios greater than 0.2 and appeared to be a direct result of increasing distortion. However, it seemed to be insensitive to relatively large changes in angle of attack. Input power measurements indicated little dependence on approach air speed or angle of attack. Author

N72-33968 National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
FLYING EXPERIENCE WITH THE SC1 RESEARCH AIRCRAFT AND THE P1127 PROTOTYPE AT THE ROYAL AIRCRAFT ESTABLISHMENT, BEDFORD, ENGLAND
D. M. McGregor *In* NRC of Can. Quart. Bull. of the Div. of Mechanical Eng. and the Natl. Aeron. Estab. 30 Jun. 1972 p 43-66 refs

Flight tests carried out with the SC1 jet-research aircraft (XG 905) and the P1127 prototype aircraft (XP 381) are discussed. Eight flights were conducted in the SC1 and four with the P1127. In addition, five in a Hunter T-7 were made before flying the P1127 to gain familiarity with the characteristics of high performance swept-wing aircraft. The purpose of the flying, from the NRC point of view, was to obtain experience on these two unique vertical take-off and landing (VTOL) aircraft while obtaining further pilot evaluations of their handling qualities. The aircraft are described with particular emphasis on the control systems, the trials undertaken and the handling qualities noted during this limited duration. Author

N72-33972# Federal Aviation Administration, Washington, D.C. Office of Management Systems.
TOWARD DEVELOPING AN IMPROVED CENTRAL FLOW MANAGEMENT SYSTEM
Richard Hakkarinen Oct. 1971 268 p
Avail: NTIS HC $15.50

The development and operation of a Central Flow Control Facility (CFCF) for balancing national aircraft flow in order to minimize delays to the users without exceeding controller capacity or jeopardizing safety are discussed. The concepts of flow management are presented in terms of: (1) scope, (2) purpose, (3) objectives of flow management system, and (4) concerns of flow management system. The Central Flow Computer Model for computer-based forecasting to provide status information on sectors or routes for any time period throughout the day of any day of the week is described. Author

N72-33973# Department of Transportation, Washington, D.C.
THE 1974 NATIONAL TRANSPORTATION STUDY. MANUAL 1: GENERAL INFORMATION
May 1972 71 p refs
(OMB-04-S-72004) Avail: NTIS

General information is provided to State and local government participants regarding the 1974 National Transportation Study. The manual contains two parts: an introduction to the study which describes the study and the information requests to be made of the States, and the Development of Work Program which describes the work program requested of each State for completing the study. Author

N72-33976# Southampton Univ. (England). Inst. of Sound and Vibration Research.
[ACTIVITIES OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH] Annual Report for the year ending Mar. 1972
Mar. 1972 77 p refs
Avail: NTIS HC $6.00

The activities of the Institute of Sound and Vibration Research at the University of Southampton for the year ending March 1972, are reported. Sound and vibration measurement research was carried out in the fields of: turbomachinery, helicopter rotors, ducts and jets, buildings, automotive engineering, turbulent flow, aircraft noise, industrial aerodynamics, audiology, and structures. Author (ESRO)

N72-33980# Arctic Inst. of North America, Washington, D.C.
ARCTIC LOGISTICS SUPPORT TECHNOLOGY
Beverly F. Slocum, ed. May 1972 385 p refs Proc. of symp. held in Hershey, Pa., 1-4 Nov. 1971; sponsored by ONR and ARPA
(Contract N00014-70-A-0219-0003; NR Proj. 307-347)
(AD-744669) Avail: NTIS CSCL 15/5

The report documents the proceedings of a symposium on arctic logistics support technology held at Hershey, Pennsylvania on November 1-4, 1971. Thirty-one papers were read at the symposium, and all are included in this report. The papers fall into three broad subject areas: transportation, life support, and activity support (for special needs of field investigators). Although the papers focus on particular ARPA needs, the information they contain should prove helpful to other groups and individuals either engaged in, or planning for, research in arctic regions.
Author (GRA)

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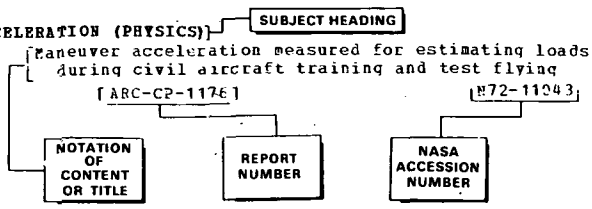

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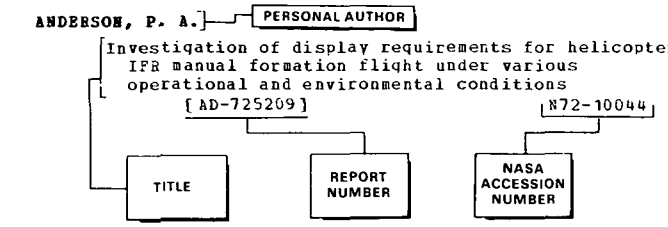

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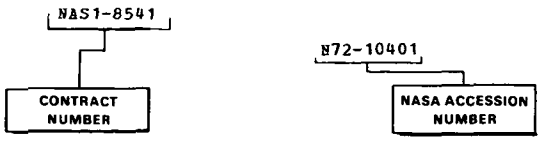

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15. Supplementary Notes

16. Abstract

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