AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 28

FEBRUARY 1973

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 28

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1973 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 308 reports, journal articles, and other documents originally announced in January 1973 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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.

Three indexes—subject, personal author, and contract number—are included.

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

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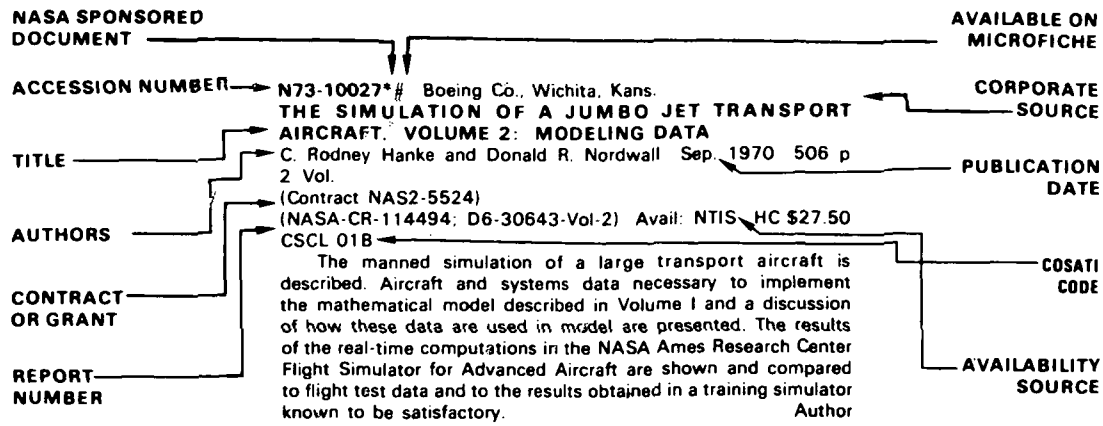

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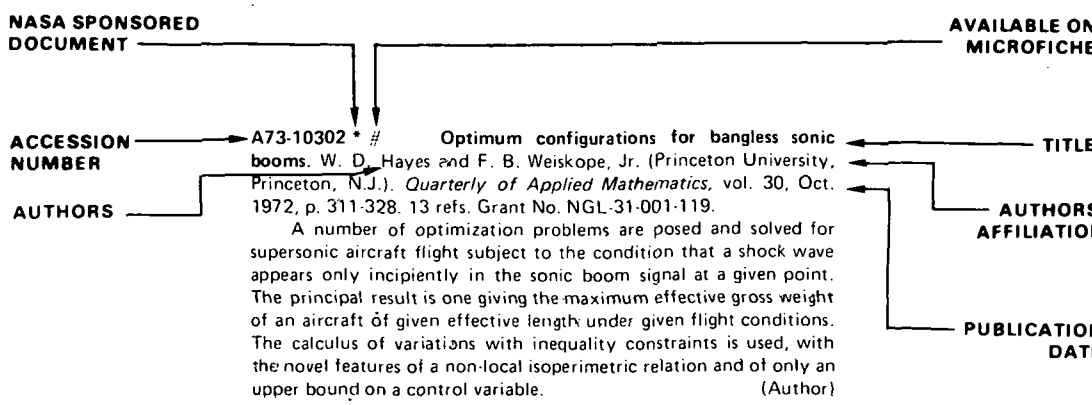

AERONAUTICAL ENGINEERING

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IAA ENTRIES

A73-10045 # **Effect of streamwise vortices on wake properties associated with sound generation.** A. M. Kuethe (Michigan, University, Ann Arbor, Mich.). *Journal of Aircraft*, vol. 9, Oct. 1972, p. 715-719. 13 refs. Research supported by the Battelle Development Corp.

Measurement of the streamwise vortices shed from vortex generators near the trailing edges of a flat plate and an airfoil, and exploration of the wake characteristics behind the airfoil. The results obtained show that two effects are generated by a relatively shallow inclined surface waviness near the trailing edge: (1) the generated streamwise vortices induce a spanwise periodicity in the wake, with the result that a following blade is subject to significantly reduced unsteady forces and noise generation; and (2) the Karman vortex street is suppressed over a large Reynolds number range including the completely turbulent regime. Both effects tend to suppress significantly the formation of sound sources. M.V.E.

A73-10046 * # **Random gust response statistics for coupled torsion-flapping rotor blade vibrations.** G. H. Gaonkar, K. H. Hohenemser, and S. K. Yin (Washington University, St. Louis, Mo.). *Journal of Aircraft*, vol. 9, Oct. 1972, p. 726-729. 11 refs. Contract No. NAS2-4151.

An analysis of coupled torsion-flapping rotor blade vibrations in response to atmospheric turbulence revealed that at high rotor advance ratios anticipated for future high speed pure or convertible rotorcraft both flapping and torsional vibrations can be severe. While appropriate feedback systems can alleviate flapping, they have little effect on torsion. Dynamic stability margins have also no substantial influence on dynamic torsion loads. The only effective means found to alleviate turbulence caused torsional vibrations and loads at high advance ratio was a substantial torsional stiffness margin with respect to local static torsional divergence of the retreating blade. (Author)

A73-10048 * # **Simplification of the wing-body interference problem.** R. E. Graham and J. L. McDowell (NASA, Manned Spacecraft Center, Houston, Tex.). *Journal of Aircraft*, vol. 9, Oct. 1972, p. 752.

A73-10140 **ADP, multiband and multiemulsion digitized photos.** R. M. Hoffer, P. E. Anuta, and T. L. Phillips (Purdue University, West Lafayette, Ind.). *(American Society of Photogrammetry, American Congress on Surveying and Mapping, Convention, San Francisco, Calif., Sept. 10, 1971.) Photogrammetric Engineering*, vol. 38, Oct. 1972, p. 989-1001. 13 refs.

Automatic data processing (ADP) techniques using a digital computer for data handling and analysis have allowed quantitative examination of aerial photography. Scanning microdensitometer techniques were utilized to digitize both multiband and multiemulsion photography. These digital density data from 1:120,000-scale aerial photos were spatially registered by computer and then analyzed, using statistical pattern recognition algorithms. The feasibility for automatic recognition of several cover types is indicated. Similar results were obtained from the digitized multiband and multiemulsion photographic data. (Author)

A73-10178 **Very wide-band phased-array antenna.** G. J. Laughlin, E. V. Byron, and T. C. Cheston (Johns Hopkins University, Silver Spring, Md.). *IEEE Transactions on Antennas and Propagation*, vol. AP-20, Nov. 1972, p. 699-704. 11 refs. Contract No. N00017-62-C-0604.

An experimental 96-element phased-array antenna is described that has been matched to operate over nearly an octave. Techniques used in designing the aperture-matching networks are discussed, and experimental results are presented. The array aperture is formed by broadband digital latching ferrite phase shifters in a closely stacked triangular configuration. For experimental convenience the array is horn fed from the rear. Matching of this antenna was accomplished by placing double-step dielectric transformers on the input and radiating apertures. Resonances caused by the dielectric transformer on the aperture are discussed. The array operates from 3.5 to 6.5 GHz with scanning to plus or minus 60 deg in all directions. The bandwidth is limited at the low end by magnetic resonance of the ferrite phase shifter and at the high end by the aperture resonance. (Author)

A73-10200 **Designing the Pegasus.** M. Wilson. *Flight International*, vol. 102, Oct. 19, 1972, p. 531-535.

The Pegasus engine is noteworthy technically because its high performance is obtained in the face of new and difficult problems. Thrust is used for control and balance as well as propulsion. The bypass ratio, about 1.35:1, was settled by the need to ensure approximately equal thrust from the front (cold) and rear (hot) nozzles. The pressure ratio, 13:1, was determined by the requirement for maximum range. The Pegasus deviates from normal turbine practice in the bleeding of quite large quantities of air for attitude-stabilization purposes. F.R.L.

A73-10227 # **A French collision-avoidance system of time-frequency type - Critical analysis of test results (Dispositif francais d'anticollision de type temps-fréquence - Analyse critique de resultats d'essais).** R. Moreau (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Réunion sur les Systèmes de Contrôle du Trafic Aérien, Edinburgh, Scotland, June 26-29, 1972.) ONERA, TP* no. 1086, 1972. 10 p. 6 refs. In French.

A collision-avoidance system of the time-frequency type, compatible with the American standards proposed by ARINC (Aeronautical Radio Inc.) was studied at ONERA (The French Aerospace Research Institute), in collaboration with an industrial firm. A prototype was built and flight-tested for eighty hours, on a DC-7 aircraft of the Brétigny French Flight Test Center. The principle of

operation is first recalled, and the device is briefly described. The means of control of the device is also outlined, and the results of flight tests are presented. The precision obtained is analyzed, both in comparison with that set by the standards, and with that which appears desirable. Modifications of the signal format are discussed. It is shown how the collision avoidance function might be fulfilled in the future as a subsystem of an integrated instrumentation designed around an onboard ultrastable oscillator. (Author)

A73-10228 # **Unstable operation and rotating stall in axial flow compressors.** J. Fabri and J. Surugue (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Japan Society of Mechanical Engineers, International Symposium, 2nd, Tokyo, Japan, Sept. 4-9, 1972.) ONERA, TP* no. 1090, 1972. 9 p. 14 refs.

Two types of flow unsteadiness in axial flow compressors are described - namely, the pressure perturbations due to the wake interaction between adjacent stages and the flow fluctuations due to rotating stall. Water table experiments are described which are used for analyzing the details of the interaction between a wake issuing from a moving linear cascade and the downstream stator blade cascade and also for studying the structure of the rotating stall cell. A theoretical analysis is made of the stall limit of an axial compressor, and the various flow configurations obtained at mass flow rates below the stall limit are given. The structure of the steady flow and of the stalled flow in an isolated rotor is analyzed by means of a hot-wire anemometer and by smoke injection in a low-speed compressor. (Author)

A73-10229 # **Test results of fatigue at elevated temperatures on aeronautical materials.** G. P. Vidal and P. L. Galmard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(American Society for Testing and Materials, Symposium on Fatigue and High Temperature, Storrs, Conn., June 18-22, 1972.) ONERA, TP* no. 1098, 1972. 13 p. 16 refs.

It is shown how fatigue tests at elevated temperatures make it possible to solve many problems pertaining to aeronautical materials. Prolonged periods (5000 or 10,000 hr) at 150 C did not diminish the fatigue limit at 150 C of the aluminum alloy 2618-T6. Consequently, the aerodynamic heating of airframes at Mach 2 does not reduce the fatigue limit of this alloy. The 'bright shot' or shot-peened surface conditions do not increase the hot fatigue limit of a heat-resistant alloy. The ONERA process for the chromaluminization of the heat-resistant alloy INCONEL 713 does not modify the fatigue limit at 700 C. Similarly, gases resulting from kerosene (0.5 per cent sulfur) combustion do not reduce the hot fatigue resistance of four heat-resistant alloys. The fatigue characteristics of various superalloys - unidirectional or composites made by the ONERA process - are at 800 C equal to or even superior to those classic heat-resistant alloys, cast or forged. A cermet of 50 per cent chromium and 50 per cent alumina retains, even at 1200 C, a resistance to fluctuating flexural stresses of 10 plus or minus 7 ksi. (Author)

A73-10230 # **Unsteady aerodynamics of wings and blades.** R. Dat (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(International Union of Theoretical and Applied Mechanics and International Association for Hydraulic Research, Symposium on Flow-induced Structural Vibrations, Karlsruhe, West Germany, Aug. 14-16, 1972.) ONERA, TP* no. 1099, 1972. 13 p. 12 refs.

The method used in flutter analysis for evaluating the unsteady aerodynamic forces on a wing subjected to harmonic vibrations of small amplitude in a uniform flow is briefly described. It is shown that the theory can be extended to a lifting surface with an arbitrary motion in still air: the linearization is based on the assumption that the velocity component normal to the lifting surface is small compared with the tangential velocity, but both components can vary arbitrarily. The generalized formulation so obtained can be used for solving aeroelastic problems more complex than the wing problem. Results obtained for a helicopter rotor with an advancing ratio of 0.3 are used to illustrate the agreement between theory and experiment. (Author)

A73-10232 # **Behaviour of boundary layers on plane or annular fixed or mobile supersonic blade cascades (Comportement de la couche limite sur grille d'aubes supersoniques planes et annulaires fixes ou mobiles).** J. Fabri and R. Sovrano (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Réunion sur les Effets des Couches Limites dans les Turbomachines, Paris, France, Apr. 18-21, 1972.) ONERA, TP* no. 1110, 1972. 12 p. 6 refs. In French.

For the fundamental study of the flow in supersonic axial compressors it is necessary to know the performance of cylindrical sections. These sections may be analyzed on plane or annular, fixed or mobile cascades. A study is made of the behavior of the boundary layer in each of these configurations, as observed experimentally, and it is concluded that, if the counterpressure is high enough for intense shock waves to develop between the blades, the action of the centrifugal force on the boundary layers cannot be neglected. (Author)

A73-10233 # **Method of calculation of the three-dimensional turbulent boundary layer up to separation - Application to a simple gas turbine case (Méthode de calcul de la couche limite turbulente tridimensionnelle jusq'à la séparation - Application à un cas simple de turbomachine).** R. Michel. *(NATO, AGARD, Réunion sur les Effets des Couches Limites dans les Turbomachines, Paris, France, Apr. 18-21, 1972.) ONERA, TP* no. 1111, 1972. 18 p. In French.

A73-10235 # **Application of ultrastable oscillators to aerospace (Application des oscillateurs ultra-stables au domaine aérospatial).** R. Moreau. *(Société des Electriciens et Electroniciens, Journée d'Etude sur les Oscillateurs, Malakoff, Hauts-de-Seine, France, May 31, 1972.) ONERA, TP* no. 1114, 1972. 28 p. 15 refs. In French.

After recalling the main characteristics of the various kinds of ultrastable oscillators, mainly atomic clocks, the uses of these oscillations in terrestrial, maritime and aerospace applications are discussed, including hyperbolic navigation, geodesy, collision avoidance systems, trajectography, in particular around remote airfields, and analysis of radio-sources. The future of the time-frequency technique seems bright, especially in the following fields - the use of geostationary satellites for worldwide precision navigation, military applications, space shuttle approach and landing, relativistic studies, and lastly airborne integrated safety and navigation systems built around an atomic clock. (Author)

A73-10240 # **Calculation and measurement of the aerodynamic forces on an oscillating airfoil profile with and without stall (Calcul et mesure des forces aérodynamiques sur un profil oscillant avec et sans décrochage).** J.-J. Philippe (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and M. Sagner (Société Bertin et Cie., La Garenne-Colombes, Hauts-de-Seine, France). *(NATO, AGARD, Groupe Dynamique des Fluides, Réunion, Marseille, France, Sept. 13-15, 1972.) ONERA, TP* no. 1132, 1972. 14 p. 22 refs. In French.

In order to know better and predict more accurately unsteady phenomena on helicopter blades, basic research work on computing and measuring aerodynamic forces on oscillating airfoil profiles was started some years ago in France. The experimental as well as theoretical methods that have been developed are critically reviewed. The problems created by unsteady stall are discussed in some detail. The results obtained to date concern a NACA 0012 profile. They are analyzed as a function of mean angle of attack, oscillation amplitude, reduced frequency, and Mach number. Future developments anticipated to improve measurements and computing methods in comparison with experimental results are also reviewed. (Author)

A73-10241 # **Measurements of helicopter noise in flight (Mesures de bruit d'hélicoptères en vol).** F. d'Ambra, J.-P. Dedieu (Société Nationale Industrielle Aérospatiale, Marseille, France), and A. Julienne (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine,

France). *(NATO, AGARD, Groupe Dynamique des Fluides, Réunion, Marseille, France, Sept. 13-15, 1972.) ONERA, TP* no. 1136, 1972. 10 p. In French.

Noise measurements have been performed on several helicopters in September 1971. These tests, prepared in close connection with ONERA, were aimed toward a complete survey of helicopters internal and external noise levels in several flight conditions. In order to satisfy the objectives of these tests, original techniques were used, in particular through precise time measuring trajectography equipment. Data analysis of flyover tests follows conventional aircrafts acoustical certification procedure. Test results are corrected to duplicate nominal flight path and standard atmosphere conditions in several noise units. A statistical analysis of maximum noise levels has been performed and results are presented with their confidence level. The use of the trajectography equipment grants in addition the exact timing of acoustical spectra from which directivity patterns of noise radiated from the complete aircraft in flight and from particular noise sources can be obtained. (Author)

A73-10276 Powder metallurgy for high-performance applications; Proceedings of the Eighteenth Sagamore Army Materials Research Conference, Raquette Lake, N.Y., August 31-September 3, 1971. Conference sponsored by the U.S. Army. Edited by J. J. Burke (U.S. Army, Army Materials and Mechanics Research Center, Watertown, Mass.) and V. Weiss (Syracuse University, Syracuse, N.Y.). Syracuse, N.Y., Syracuse University Press, 1972. 394 p. $23.

The papers discuss advances in technology of powder production, recent developments in pressing and sintering, the processing of wrought products, and high performance applications. Attention is given to the early stages of the mechanism of sintering, fundamental principles of powder preform forging, processing and properties of powder forging, hot isostatic pressing of high-performance materials, and fabrication of high-strength aluminum products from powder. Cold rolling of dispersion-strengthened metals, development of IN-100 powder-metallurgy disks for advanced jet engine application, complex superalloy shapes, potential titanium airframe applications, and the processing of high-performance alloys by powder metallurgy are considered.

F.R.L.

A73-10281 *Fabrication of high-strength aluminum products from powder.* J. P. Lyle, Jr. and W. S. Cebulak (Alcoa Technical Center, Pittsburgh, Pa.). In: Powder metallurgy for high-performance applications; Proceedings of the Eighteenth Sagamore Army Materials Research Conference, Raquette Lake, N.Y., August 31-September 3, 1971. Syracuse, N.Y., Syracuse University Press, 1972, p. 231-254. 8 refs. Research supported by the Aluminum Company of America and U.S. Army.

Better combinations of strength, resistance to stress-corrosion cracking, and resistance to exfoliation can be obtained in extrusions and forgings made from prealloyed atomized powder than in corresponding products made from ingot. Internal quality meeting ultrasonic SNT Class A Airframe standards can be consistently obtained by a process consisting of cold compacting, preheating, hot pressing, hot working, solution heat-treating, quenching, and artificial aging. Decreasing powder size tends to increase transverse ductility. Green density has no effect on properties, but 70 to 80% of theoretical density is optimum for processing. The pressure required to obtain this density varies from 15 to 65 ksi and depends on compacting method, alloy content, and time elapsed between atomizing and compacting. Preheating for about one hour at a temperature at least as high as the solution heat-treatment temperature is required to prevent porosity, blistering, and delamination during solution heat treatment of the final product, and to develop maximum ductility. (Author)

A73-10283 Development of IN-100 powder-metallurgy disks for advanced jet engine application. R. L. Athey and J. B. Moore (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). In: Powder metallurgy for high-performance applications; Proceedings of the Eighteenth Sagamore Army Materials Research Conference, Raquette Lake, N.Y., August 31-September 3, 1971. Syracuse, N.Y., Syracuse University Press, 1972, p. 281-301.

Both IN-100 and Astroloy have been forged starting with a powder product, as well as from cast ingots. Superplastic forging stock has been produced by various methods such as extrusion, hot rolling, and press forging. This controlled isothermal forging practice, which utilizes the superplastic behavior of the alloy being forged, has been given the name 'Gatorizing'. Some of the advantages of this process are that (1) the ultrahigh-strength, low-ductility nickel-base superalloys developed for cast turbine blades can be forged with extreme ease, (2) superalloys can be forged to extremely close tolerances without risk of cracking, (3) forgings of complex configuration can be forged with relative ease to provide uniform properties with the 'Gatorizing' process, and (4) forging pressures required are substantially less than those necessary in conventional forging. F.R.L.

A73-10285 Potential titanium airframe applications. R. H. Witt and O. Paul (Grumman Aerospace Corp., Bethpage, N.Y.). In: Powder metallurgy for high-performance applications; Proceedings of the Eighteenth Sagamore Army Materials Research Conference, Raquette Lake, N.Y., August 31-September 3, 1971. Syracuse, N.Y., Syracuse University Press, 1972, p. 333-349. Navy-supported research.

Isostatically pressed and vacuum-sintered titanium alloy preforms from various sources were forged using conventional, high-energy rate and isothermal forging processes. Elemental powders were primarily employed to obtain the Ti-6Al-4V composition in the preforms. Results of evaluation studies pertaining to the effects of materials and process variables on microstructure, mechanical properties, and electron-beam weldability are presented. Selection of powder composition and forging process for production of airframe-quality titanium alloy forgings has been demonstrated. Potential airframe applications, producibility, and economic considerations are discussed, based on the results of the above evaluation. (Author)

A73-10302 * # , Optimum configurations for bangless sonic booms. W. D. Hayes and F. B. Weiskope, Jr. (Princeton University, Princeton, N.J.). *Quarterly of Applied Mathematics,* vol. 30, Oct. 1972, p. 311-328. 13 refs. Grant No. NGL-31-001-119.

A number of optimization problems are posed and solved for supersonic aircraft flight subject to the condition that a shock wave appears only incipiently in the sonic boom signal at a given point. The principal result is one giving the maximum effective gross weight of an aircraft of given effective length under given flight conditions. The calculus of variations with inequality constraints is used, with the novel features of a non-local isoperimetric relation and of only an upper bound on a control variable. (Author)

A73-10304 # A note on the potential vortex in a wall jet. S. J. N. Shaw (New York University, New York, N.Y.). *Quarterly of Applied Mathematics,* vol. 30, Oct. 1972, p. 351-356. Contract No. DA-31-ARO(D)-464.

In studies of a submerged lifting airfoil near a free surface there are questions concerning the assumption that the free surface is approximately horizontal, and consequently that the free surface boundary condition may be linearized. The model of a single vortex with circulation such that the force on the vortex is upward is useful in the description of some features of the flow past a submerged lifting body. This flow is adequately described by Gurevich's (1963) solution. For the case in which the force on the vortex is downward, the solution is extended to include flows without stagnation points, but with bifurcation points on the free surface which correspond to singular points of the conformal mapping. This extension describes the flow of a vortex lowered into the fluid from above. F.R.L.

A73-10306 **Airport-internal means of transportation (Flughafeninterne Verkehrsmittel).** S. Trommer (Arbeitsgemeinschaft Deutscher Verkehrsflughäfen, Bernhausen, West Germany). *VDI-Z,* vol. 114, no. 14, Oct. 1972, p. 1022-1026. In German.

Difficulties in the use of airports for the passenger are connected with the long distances within the airport area. These difficulties can be overcome with the aid of an internal airport traffic system. The solutions proposed include means of transportation proceeding according to a rigid time table, continuous transportation devices such as escalators, and means of conveyance providing transport to individual destinations. Solutions for the transportation of the luggage of the passengers are also discussed, taking into account conditions at the Frankfurt airport. G.R.

A73-10348 # **Environmental factors for supersonic transport.** *Journal of Navigation,* vol. 25, Oct. 1972, p. 444-459.

Compared with current long-range aircraft the parameters which have a particular impact on the SST at takeoff and landing are the usual ones of temperature, wind, cloud base, and runway visual range (RVR). Problems of short-term forecasting for airports in terminal areas are expected to arise, but should not be insurmountable. Parameters for the free atmosphere, the troposphere and the stratosphere are discussed. The behavior of temperature at the SST flight level is described for the routes from Europe to North America, and from Europe and the U.S.A. to Japan. Aspects of air traffic control, the lower airspace, ground maneuvers, takeoff and landing, acceleration and initial supersonic cruise, and final cruise, deceleration and descent to lower airspace are considered. Communications requirements receive attention. F.R.L.

A73-10349 # **Manoeuvre in response to collision warning from airborne devices.** S. Ratcliffe (Royal Radar Establishment, Malvern, Worcs., England). *Journal of Navigation,* vol. 25, Oct. 1972, p. 460-466.

A73-10468 **Low-noise STOL aircraft - A solution for short-haul traffic problems (Das leise STOL-Flugzeug - Eine Lösung für die Probleme des Kurzstreckenverkehrs).** H. Flosdorff. *DGLR Mitteilungen,* vol. 5, Sept. 1972, p. 4-8. In German.

A review of the current airport capacities with a view toward developmental trends of air traffic in general and short-haul traffic in particular shows the low-noise STOL transport to be the only feasible solution for short-haul purposes over the period required to expand and modernize existing airports. It is noted that such considerations have lead to the merger of three aircraft companies - the Messerschmidt-Bölkow-Blohm GmbH, the British Aircraft Corporation, and the Saab-Scania AB with the aim of designing, manufacturing, and selling a low-noise STOL transport. V.P.

A73-10477 # **Investigation of the influence of technological factors on the endurance of gas-turbine engine rotor blades (Issledovanie vliianiia tekhnologicheskikh faktorov na vynoslivost' rabochikh lopatok GTD).** V. T. Troshchenko, B. A. Griaznov, S. S. Gorodetskii, A. B. Roitman, and Iu. S. Nalimov (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *Problemy Prochnosti,* vol. 4, Aug. 1972, p. 8-12. In Russian.

The influence of small deviations from the serial-production technology on the fatigue limit of the third stage of a gas-turbine engine is studied experimentally and theoretically. The deviations included microroughnesses, residual stresses, and microdefects. Tests on a resonance stand at 20 and 570 C showed that the fatigue limit is hardly affected by the deviations, but that the latter increase somewhat the spread of the blade test data. V.P.

A73-10498 **An airborne instrument system for atmospheric boundary-layer research.** R. M. Holmes (ERA Instruments, Ltd., Calgary, Alberta, Canada). *Boundary-Layer Meteorology,* vol. 3, Sept. 1972, p. 59-76. 12 refs.

A73-10566 **Convention of Rome - Quo vadis (Römisches Abkommen - Quo vadis).** M. Bodenschatz (Deutscher Luftpool, Munich, West Germany). *Zeitschrift für Luftrecht und Weltraumrechtsfragen,* vol. 21, Oct. 1, 1972, p. 206-212. In German.

The Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface concluded in 1952 in Rome and in effect for 25 states since Feb. 4, 1958, is critically reviewed with respect to its intrinsic soundness and relevance to present conditions. Its updating and revitalization are deemed essential, and specific recommendations toward these ends are presented. M.V.E.

A73-10568 **Monopoly, concentration, and competition in the air transportation industry of the United States (Monopol, Konzentration und Wettbewerb im Luftverkehrsgewerbe der Vereinigten Staaten).** M. A. Dauses. *Zeitschrift für Luftrecht und Weltraumrechtsfragen,* vol. 21, Oct. 1, 1972, p. 221-250. 189 refs. In German.

Discussion of the legal status of the air transportation industry of the United States, with emphasis upon some of its distinctive features. In particular, contrasts in European and American legislation on competition, such as they affect commercial aviation, are reviewed, along with American legal practices in regard to the licensing of commercial air transportation enterprises, the authorization of amalgamations and mergers, and the exercise of some supervisory or controlling influences upon the management of commercial aviation enterprises. Special attention is given to various provisions of the Civil Aeronautics Act of June 23, 1938, and the Federal Aviation Act of Aug. 23, 1958. M.V.E.

A73-10644 **Manganese additive effects on emissions from a model gas turbine combustor.** D. V. Giovanni, P. J. Pagni, R. F. Sawyer, and L. Hughes (California, University, Berkeley, Calif.). *Combustion Science and Technology,* vol. 6, Sept. 1972, p. 107-114. 26 refs. U.S. Environmental Protection Agency Grant No. AP-385-07; NSF Grant No. GK-27895.

The effect of 0.06% by volume of the additive, 2-methylcyclopentadienyl manganese tricarbonyl on particulate and gaseous emissions from a model gas turbine combustor was measured. The additive increased the total mass of particulate emissions in these combustor experiments, probably by adding manganese oxides to the exhaust. Without the additive, the smallest of the carbonaceous exhaust particles were typically 0 (0.1 micron) in diameter. These particles agglomerate into 'popcorn-like' structures of 0 (1 micron) and thus are efficient scatterers of visible radiation. With the additive, exhaust particles, composed of manganese oxides and carbon, are 0 (0.05 micron) with significant reduction in agglomeration. No effect on gaseous NO emissions and a negligible decrease in gaseous CO emissions was noted. (Author)

A73-10650 **Illegal seizure of aircraft (Capture illicite d'aéronefs).** M. Y. Lopez. *Revue Française de Droit Aérien,* vol. 26, July-Sept. 1972, p. 241-267. 110 refs. In French.

The term 'illegal seizure of aircraft' is used to define unlawful acts carried out which are prejudicial to commercial air navigation. International law and international regulations are compared. Various preventive measures are discussed, and reference is made to the exercise of authority in relation to the crime of illegal seizure. Attention is given to special considerations which arise from the political character of some seizures, and to problems of extradition of the perpetrators. Aspects of international resolutions and conventions are examined. F.R.L.

A73-10665 # **Programmed control of a two-level hierarchical system (Programmnoe upravlenie v dvukhurovnevoi ierarkhicheskoi sisteme).** E. P. Lavrinenko. *Kibernetika i Vychislitel'naia Tekhnika,*

no. 15, 1972, p. 27-31. 9 refs. In Russian.

Synthesis of programmed control for a two-level hierarchical system with random parameters is discussed. The possibility of applying stochastic programming methods to solve this control problem is considered. Discussed specifically is a two-level hierarchical system for programmed air traffic control involving a number of aircraft, each being treated as a lower-level subsystem, while the dispatcher service is treated as an upper-level subsystem. This problem is reduced to the solution of a single-step stochastic programming problem with probability constraints. V.Z.

A73-10666 # **Image transformation in visual condition simulators of aircraft training equipment (Preobrazovaniia izobrazhenii v imitatorakh vizual'noi obstanovki samoletnykh trenazherov).** M. V. Artiushenko. *Kibernetika i Vychislitel'naia Tekhnika,* no. 15, 1972, p. 31-40. 9 refs. In Russian.

A theoretical basis is given for image transformation techniques in visual environment simulators of aircraft training stands. It is shown that a Lie projection ensemble is generated in the image plane of a training stand simulator during the execution of all possible flight maneuvers by aircraft. Thence, it is possible to obtain other invariant images from an available reference image by a transformation technique. Details are given on such a transformation technique which is based on a relation between the transformation group parameters and the running parameters of aircraft flight. It is also indicated that it is possible to simulate an aircraft flight above a certain terrain on a digital computer with an image input-output device. V.Z.

A73-10673 # **A complex approach to flight vehicle control system designs (Kompleksnyi podkhod k proektirovaniiu sistem upravleniia letatel'nymi apparatami).** A. I. Garipov, O. M. Marin, and A. P. Razygraev. *Kibernetika i Vychislitel'naia Tekhnika,* no. 15, 1972, p. 90-96. In Russian.

A general philosophy is set forth for such designs to take into account the largest possible numbers and varieties of control system components and subsystems to be incorporated in the final product. The design process is treated as a sequence of three-element closed cycles, each comprising the determination of the purpose of this design cycle, a decision-making process, and the assessment of the design cycle resulting in setting an aim for the following cycle. The formulation of flight vehicle control system requirement criteria and the selection of an optimal control system version are discussed. V.Z.

A73-10700 Heaving and pitching response of a hovercraft moving over regular waves. A. J. Reynolds (Brunel University, Uxbridge, Middx., England), B. E. Brooks (Harrow College of Technology, Northwick Park, Middx., England), and R. P. West. *Journal of Mechanical Engineering Science,* vol. 14, Oct. 1972, p. 340-352.

Consideration is given to the pitching and heaving of a hovercraft whose plenum air cushion is divided into two compartments by a transverse barrier. Linearized equations of motion are developed, subject to the assumption that the skirt hem does not contact the surface beneath; the coefficients can be calculated in terms of craft geometry, weight and lift-fan characteristics, or in terms of natural frequencies and damping ratios for pitch and heave. In considering the response to regular head and following seas, particular attention is given to accelerations experienced at the bow and to the position of the pitch centre, where the vertical accelerations are least. The behaviour of a realistic craft is examined for waves of various lengths and for different craft speeds, and consideration is given to the effects of moving the mass centre and of modifying the barrier between cushion compartments. (Author)

A73-10781 Annoyance reactions from aircraft noise exposure. R. Rylander, S. Sorensen, and A. Kajland (Kungl. Karolinska Institutet; National Environment Protection Board, Dept. of Environmental Hygiene, Stockholm, Sweden). *Journal of Sound and Vibration,* vol. 24, Oct. 22, 1972, p. 419-444. 26 refs. Research supported by the Royal Traffic Noise Committee, Swedish National Bank, and the City Council of Linkoping.

Social surveys were conducted in 24 areas with well defined noise exposure characteristics around eight airports in Scandinavia. The results demonstrate that the extent of annoyance reactions in an exposed population is closely correlated to the noise level of single overflights. For areas exposed to a low number of takeoffs, the extent of 'very annoyed' in the population is below 5% provided the noise levels do not exceed 90 dB(A). For areas exposed to a high number of takeoffs, an increase in the extent of 'very annoyed' is found already when the noise level increases from 70 to 75 dB(A). The increase with noise levels up to 95 dB(A) is linear (correlation coefficient 0.99). (Author)

A73-10786 Remarks on the paper by J. M. Nicholls and B. F. James, 'The location of the ground focus line produced by a transonically accelerating aircraft.' G. T. Haglund and E. J. Kane (Boeing Co., Commercial Airplane Group, Seattle, Wash.). *Journal of Sound and Vibration,* vol. 24, Oct. 22, 1972, p. 505-509; Reply, p. 509-511. 5 refs.

A73-10823 # **Keyed joint performance under heavy load aircraft.** J. L. Rice (FAA, Airport Standards Branch, Washington, D.C.). *ASCE, Transportation Engineering Journal,* vol. 98, Nov. 1972, p. 931-939.

Results of full scale tests of pavement performance are reported under simulated C-5A traffic for rigid pavement test sections with keyed longitudinal-construction joints. The results obtained seem to indicate that poor performance can be expected from keyed joints subjected to C-5A loadings and supported on a low strength foundation. The use of doweled or thickened edge joints is recommended in lieu of keyed joints. M.V.E.

A73-10824 # **Trends in offshore airports.** R. D. Harza (Harza Engineering Co., Chicago, Ill.). *(American Society of Civil Engineers, Annual and National Environmental Engineering Meeting, New York, N.Y., Oct. 19-22, 1970, Preprint 1273.) ASCE, Transportation Engineering Journal,* vol. 98, Nov. 1972, p. 985-1003. 11 refs.

The utilization of offshore sites is discussed as a significant emerging trend in airport development. A number of secondary offshore airports already exist, and serious consideration and planning is under way in several countries on major new offshore airports. The principal planning considerations involved are examined, and each of the major new airports now being planned for offshore siting is reviewed. The major advantage of offshore airport location is shown to be the isolation or dissipation of noise zones while maintaining reasonable access proximity to the center of gravity of passenger origins and distribution in metropolitan areas. The major problems are the assurance of environmental protection and project cost. But these are also the two major problems for land sited airports. M.V.E.

A73-10825 Management system for aviation safety. H. D. Kysor and L. Benner. *Business and Commercial Aviation,* vol. 31, Oct. 1972, p. 56-59, 73.

Management procedures for determining an acceptable degree of exposure to incident or accident (level of risk) are described for the benefit of business enterprises operating corporate or executive aircraft. The procedures constitute a general plan for implementing effective methods of achieving an acceptable risk level while monitoring the operation to ensure that this level does not rise unexpectedly. Federal Aviation Regulations relating to safety requirements in maintenance and operation are evaluated, and risk identification procedures are outlined. T.M.

A73-10917 # **Theory of the motion of a rigid model of an aircraft with a vertical landing-gear strut on a runway (Do teorii rukhu zhorstkoi modeli litaka z vertikal'nim stoiakom na zl'otno-posadochnii smuzi).** L. G. Lobas (Kiivs'kii Politekhnichnii Institut, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Tekhnichni i Matematichni Nauki,* vol. 34, Aug. 1972, p. 734-739. 7 refs. In Ukrainian.

The stability of uniform rectilinear motion of an aircraft over a runway surface is examined for arbitrary longitudinal velocity components of wheel contact points in the absence of any sideslip motion of the aircraft. The equations of motion of the aircraft are derived along with expressions for the lateral response behavior. T.M.

A73-11011 **Visual Approach Monitor - A first step to head-up display.** P. A. Roitsch (Pan American World Airways, Inc., New York, N.Y.). *Shell Aviation News,* no. 411, 1972, p. 7-10.

A cockpit device, termed Visual Approach Monitor (VAM), is described which will provide visual slope guidance to any runway at any airport, and which is independent of ground power failures or other catastrophic conditions on the ground. The heart of the VAM system is an optical display, in which required information is projected on a transparent viewing lens through which the pilot may also see the 'real world'. The display is self-calibrating, and provides the pilot with two separate elements of information: angular position with respect to the runway, and command information for guidance to a three-degree glide path. The head-up display system has been certificated for unrestricted use. V.P.

A73-11015 * **On the mechanism of dynamic stall.** W. Johnson (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.) and N. D. Ham (MIT, Cambridge, Mass.). *American Helicopter Society, Journal,* vol. 17, Oct. 1972, p. 36-45. 13 refs. Army-NASA-sponsored research.

The sequence of events comprising dynamic stall of an airfoil is discussed, with emphasis on the role of the leading edge laminar separation bubble and shed vortex. A simple bubble model, based on a combination of theoretical and experimental investigations, is used to discuss the events prior to the shedding of the vortex, and provides the basis for a heuristic estimate of the delay in the occurrence of dynamic stall on a pitching airfoil. The evidence for the existence and dominant effect of the leading edge vortex on the dynamic stall required (but in most cases not presently available) for the prediction of the effects of stall on helicopter rotor blades are discussed. It is the intention of this paper to focus attention on the laminar separation bubble and the shed leading edge vortex as the dominant features of the dynamic stall mechanism in the hope of stimulating greater emphasis on these features in future dynamic stall research. (Author)

A73-11068 **Ozone appears unaltered by nitric oxide.** K. J. Stein. *Aviation Week and Space Technology,* vol. 97, Nov. 6, 1972, p. 28, 29.

Tentative data are quoted, suggesting that the combined roughly 340-megaton nuclear explosions set off by U.S. and USSR in the atmosphere between October 1961 and December 1962 might have released three times the amount of nitric oxide that would be released by 500 SST's flying 7 hr a day for a year. The absence of an observable effect of this nitric oxide injection on atmospheric ozone concentrations is indicated. V.Z.

A73-11069 **Review of the past brightens the future.** R. C. Seamans, Jr. (USAF, Washington, D.C.). *Defense Management Journal,* vol. 8, Oct. 1972, p. 60-65.

The developments and alterations in the progress of the C-5 program are reviewed in terms of defense needs, development problems, and costs. Also considered are the objectives and prospects of the F-15 and B-1 programs. Some details are given on new management policies and subsystem development in the B-1 program. V.Z.

A73-11132 **An empirical flowfield analysis technique for preliminary evaluation of inlet systems operating in a vehicle generated flowfield.** J. J. Mahoney (U.S. Naval Weapons Center, China Lake, Calif.) and R. D. Wilson (Marquardt Co., Van Nuys, Calif.). In: International Symposium on Space Technology and Science, 9th, Tokyo, Japan, May 17-22, 1971, Proceedings. Tokyo, AGNE Publishing, Inc., 1971, p. 327-338. 7 refs.

A73-11137 **The turbulent wake after a trailing edge.** V. W. Nee (Notre Dame, University, Notre Dame, Ind.), L. S. G. Kovasznay (Johns Hopkins University, Baltimore, Md.), and S.-L. Lai. In: International Symposium on Space Technology and Science, 9th, Tokyo, Japan, May 17-22, 1971, Proceedings.
Tokyo, AGNE Publishing, Inc., 1971, p. 379-390. 8 refs. Grant No. AF-AFOSR-70-1929.

The continuous development of the turbulent flow starting from the turbulent boundary layer over a two-dimensional flat plate, going through the near wake immediately after the trailing edge and moving into the fully developed turbulent wake has been investigated on a differential field theory of turbulent shear flow of Nee and Kovasznay (1969). With the establishment of a rate equation governing the variation of the turbulent viscosity, a closed system of partial differential equations is formed. A numerical calculation has been performed to integrate the system of equations in finite-difference form. The computation can be done from the upstream wall turbulent flow of boundary layer type to the downstream free turbulent flow of wake type by simply replacing the nonslip condition by a symmetrical condition after the trailing edge. Results concerning the mean velocity, turbulent viscosity, and shear stress distributions in the entire field, are obtained, as well as properties such as the variation of the center-line velocity of the turbulent wake. (Author)

A73-10201 # **Investigation of fading radio echoes from meteor trails. I (Issledovanie fedinguiushchikh radiootrazhenii ot meteornykh sledov. I).** G. M. Teptin and A. N. Fakhrutdinova (Kazanskii Gosudarstvennyi Universitet, Kazan, USSR). *Radiofizika,* vol. 15, no. 9, 1972, p. 1286-1292. 10 refs. In Russian.

A73-11239 **Deficient airfields.** M. G. Williams (Court Line Aviation, Ltd., Luton, Beds., England). *Flight International,* vol. 102, Oct. 26, 1972, p. 571, 572.

Discussion of airfield deficiency instances, hazards, and prevention measures. Lack of glideslope information, either visual or electronic, especially at night, is in the opinion of many pilots the worst deficiency. Lack of static-free radio aids, inadequate lighting for landing and taxying, ill-drained runways, absence of weather broadcasts, and ill-defined or ambiguous procedures are among the other deficiencies. The best cure for deficient airfields is believed to be strong, thoroughly enforced government legislation. A data bank on dubious airfields combined with deficiency reporting, follow-up, and checking procedures is proposed. M.V.E.

A73-11240 **Short-fibre composites.** W. E. Goff. *Flight International,* vol. 102, Oct. 26, 1972, p. 584-586.

Description of some of the properties, manufacturing procedures, and aircraft applications of discontinuous- or short-fiber reinforced composite materials. Many required shapes in the field of aircraft components often embody curvatures that cannot be moulded from continuous fiber laminates, while some high-strength fibers, such as asbestos or synthetic whiskers, are available only in discontinuous form. In response to these requirements and conditions, there have been developed methods for grading and aligning short fibers in the range of 0.01 to 10 mm in length. The properties and uses of the composite materials made of these fibers are reviewed. M.V.E.

A73-11479 **Multilateration radar.** S. Kazel (IIT Research Institute, Chicago, Ill.). *IEEE, Proceedings,* vol. 60, Oct. 1972, p. 1238, 1239.

An airborne radar concept is described which would achieve high-resolution mapping of terrain, even with wide-beam antennas, by utilizing a narrow pulsewidth. Successive high-resolution range rings, superimposed in a suitable storage medium, cause the terrain image to build up as the aircraft flies by. (Author)

A73-11510 # **PRD 49 high modulus organic fibre as aluminium replacement.** R. L. Hunter. *Aircraft Engineering,* vol. 44, Oct. 1972, p. 4-6.

A73-11511 # **Use of cycloconverters and variable speed alternators as engine starters.** D. O. Burns. *Aircraft Engineering,* vol. 44, Oct. 1972, p. 8-12.

A73-11513 # **Powder coating technology.** A. J. Koury, A. A. Conte, Jr., and M. J. Devine (U.S. Naval Air Systems Command, Washington, D.C.; U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *Aircraft Engineering,* vol. 44, Oct. 1972, p. 18-23. 25 refs.

The various powders and powder-coating techniques currently used in the industry are reviewed, with particular reference to the fluidized bed process, the electrostatic spray process, the electrostatic fluidized bed process, and the plasma spray process. The principal features of these processes are discussed. Particular attention is given to the application of powder coatings to aircraft materials. V.P.

A73-11581 # **Higher-order delta wings with flow separation at subsonic leading edges (Aripi delta de ordin superior cu separatia curentului la bordurile de atac subsonice).** S. Staicu (Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Buletinul,* vol. 33, Nov.-Dec. 1971, p. 67-78. 8 refs. In Rumanian.

Study of the supersonic flow around higher-order thin conical delta wings at a symmetrical angle of attack, taking into account air flow separation at the leading edges. A vertical velocity distribution is considered which corresponds to the real case of a thin delta wing with a variable angle of attack and finite velocities at the leading edges. It is assumed that the real thin wing is equivalent from the aerodynamic standpoint to a fictitious thin wing of variable angle of attack, decomposed into three constituent wings in order to apply the method of conical flows. The three components are a thin wing with a suitably chosen angle-of-attack variation and finite velocities at the leading edges, a wing of symmetrical thickness with a gradient equal to and of the same sign as the angle of attack of the first wing, and a wing of symmetrical thickness with a variable gradient, which when combined with wing 2 yields a zero mean gradient. By superimposing these three wings, a wing equivalent to the real delta wing is obtained. A.B.K.

A73-11593 # **A rapid matching procedure for twin-spool turbofans.** H. I. H. Saravanamuttoo (Carleton University, Ottawa, Canada). *Canadian Aeronautics and Space Journal,* vol. 18, Oct. 1972, p. 247, 248.

A simple matching procedure is presented for twin-spool turbofan engines, where the hot and cold exhaust streams are separate. The procedure is an extension of that for the twin-spool turbojet with the added complication of apportioning the total fan flow between the hot and cold streams. The principles outlined can be extended to deal with more complex configurations, if required. M.V.E.

A73-11594 # **Operational information display.** D. L. Cates (Ministry of Transport, Ottawa, Canada). *(Canadian Aeronautics and Space Institute, Aerospace Electronics Symposium, Quebec, Canada, Mar. 13, 14, 1972.) Canadian Aeronautics and Space Journal,* vol. 18, Oct. 1972, p. 249-251.

The Supplementary Aviation Display System was designed to alleviate the instrumentation requirements of modern large airports with the view of upgrading the quality and amount of data available to an air traffic controller. Data are acquired by remote sensors, teletype circuits, external monitors, and keyboard. These data are processed by a minicomputer and are displayed on television monitors to a user position. The user can select any of nine different 'pages' on his monitor. These pages consist of a primary page and a number of secondary pages. The primary page displays primary information time, wind speed and direction, barometric pressure, runway in use, runway lighting, navigational facilities, selected weather, and messages. The secondary pages provide information not frequently required, such as aircraft gate assignments, runway and field conditions, aircraft preferred routes and a complete list of weather information. (Author)

A73-11621 # **Contribution to theories of constrained torsion of turbine blades (K teoriiam stesnennogo kruchenila turbinnykh lopatok).** L. D. Magomaev (VVMIOLU, Leningrad, USSR). *Problemy Prochnosti,* vol. 4, Sept. 1972, p. 27-33. 10 refs. In Russian.

Some aspects of the application of constrained torsion theory to the investigation of the dynamics and strength of turbine blades are discussed. It is shown how linear fracture mechanics can be used to obtain a mathematical relation between the geometry of a components, the crack dimensions, the material properties, the stress field, and the plane-strain fracture toughness. V.P.

A73-11629 # **Automation of fatigue tests with full-scale structures (Avtomatizatsiia ustalostnykh ispytanii naturnykh konstruktsii).** V. I. Litvak. *Problemy Prochnosti,* vol. 4, Sept. 1972, p. 103-107. In Russian.

The principles of designing automated full-scale fatigue test stands are outlined, using an automatic loading system intended for testing aircraft power-plants as an example. The automatically implemented loading program prescribes the application of dynamic and repeated static loads (forces and moments) acting in various directions, which simulate the action of the working loads during takeoff, climb, landing, and so forth. The control circuits of the oil pump, the automatic warning and safety system, the loading system, the hydromechanical vibrator, and the power source are presented and discussed. V.P.

A73-11630 # **Nonlinear characteristics of a slender triangular wing near an interface (Nelineinye kharakteristiki tonkogo treugol'nogo kryla vblizi poverkhnosti razdela).** V. I. Kholiavko and M. A. Fefelov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 3-8. In Russian.

An approximate semiempirical method is proposed for calculating the lift coefficient of a slender small-aspect-ratio delta-wing with sharp leading edges near a solid or free (in the case of an immersed wing) surface. The method is based on the use of the linear theory of an isolated wing (determination of the potential component of the lifting force), the determination of the vortex component of the lifting forces from the analogy with the suction force, and the use of slender body theory (allowance for the interface). Analytical expressions are derived which can be used to calculate the lift coefficient of the wing over a wide range of angles of attack. V.P.

A73-11631 # **Means of suppressing suction forces acting on a VTOL turbojet (O sposobe bor'by s podsasyvaiushchimi silami na TR SVVP).** K. P. Danil'chenko and V. I. Surus. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 8-12. In Russian.

A method of suppressing suction forces during takeoff, landing,

and transition is proposed which consists in turning the wing about an axis parallel to the earth's plane so as to maintain small angles between the wing chord and the thrust vector of the engine. The physical picture of the method is described. Graphs are presented which show that the method is more effective and universal than other existing methods. The method is particularly suited for VTOL turbojets with engines mounted in the fuselage. V.P.

A73-11635 # **Device signaling unsteady modes of compressor operation (Pribor signalizatsii neustoichivykh rezhimov raboty kompressora).** G. V. Pavlenko, A. O. Bumarskov, P. I. Korzh, Iu. G. Otsechkin, A. P. Parfenov, and V. A. Zhebko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 34-36. In Russian.

The design and principles of operation of a sensor which will actuate a warning light at the onset of flutter and similar instabilities during gas-turbine compressor operation is described. The electric circuit of the device is given and discussed. V.P.

A73-11637 # **Application of electrical modeling in the analysis of the dynamic properties of temperature sensors (Primenenie elektromodelirovaniia dlia analiza dinamicheskikh svoistv datchikov temperatury).** D. F. Simbirskii, A. V. Oleinik, and V. S. Ruchko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 46-54. 5 refs. In Russian.

A73-11643 # **Investigation of the possibility for ultrasonic dispersion of certain corrosion inhibitors introduced in easily removable film coatings (Issledovanie vozmozhnosti ul'trazvukovogo dispergirovaniia nekotorykh ingibitorov korrozii, v vodimykh v legkosnimaemye plenochnye pokrytiia).** A. N. Novitskii, A. F. Zakatov, and M. A. Shluger. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 90-94. In Russian.

A73-11647 # **Classification of fitting operations in airframe assembly (Klassifikatsiia podgonochnykh rabot pri sborke planera samoleta).** N. M. Parkhomenko, V. A. Kobelev, and V. A. Samko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 115-126. In Russian.

A classifier is developed for the fitting operations required during airframe assembly. Classification is performed mainly with respect to the type and nature of the fitting operations, but also with respect to the type of joints, linking methods, and means and methods of inspection. The problem of distribution the fitting operations among the groups and subgroups of the classifier is examined. V.P.

A73-11648 # **Design and technological methods of ensuring aerodynamic coupling of moving units (Konstruktivno-tekhnologicheskie metody obespecheniia aerodinamicheskikh sopriazhenii podvizhnykh agregatov).** Iu. A. Boborykin, N. M. Parkhomenko, V. A. Samko, and E. A. Frolov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 126-129. In Russian.

Some aspects of the problem of ensuring the proper clearance between such units as a wing and aileron or an aileron and trim tab (aerodynamic coupling) are discussed. Formulas for calculating the optimum clearance and technological means of ensuring it are proposed. V.P.

A73-11649 # **Optimum position of the center of gravity of a passenger plane in cruising flight (Optimal'naia tsentrovka passazhirskogo samoleta v kreiserskom polete).** G. S. Lagasiuk, Zh. S. Chermenko, and G. N. Iun. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 27, 1972, p. 143-150. In Russian.

The influence of the position of the center of gravity on some control parameters during cruising is examined. The dynamic characteristics of an aircraft are discussed as a function of the fuel-tank switching program. An analytical model of maximum-range flight at minimum fuel consumption is developed. An algorithm for minimizing fuel consumption during cruising, based on sequential analysis of variants, is proposed. V.P.

A73-11651 # **The significance of the aerodynamic jet interference for the development and the testing of the V/STOL transport DO 31 (Die Bedeutung der aerodynamischen Strahlinterferenz bei der Entwicklung und Erprobung des V/STOL-Transportflugzeuges DO 31).** D. Welte (Dornier AG, Friedrichshafen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-106.* 24 p. In German.

A73-11655 # **Model tests regarding the characteristics of the boundary layer at effusion-cooled turbine blades (Modellversuche zum Grenzschichtverhalten an effusionsgekühlten Turbinenschaufeln).** H. Kruse (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Luftstrahlantriebe, Porz-Wahn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-059.* 19 p. 8 refs. In German.

A73-11657 **Further development and employment of the subsonic panel method (Weiterentwicklung und Anwendung des Unterschallpanelverfahrens).** W. Kraus (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-105.* 39 p. 14 refs. In German. Research supported by the Bundesministerium der Verteidigung.

The new developments considered include a study conducted by Bretthauer et al. (1970) concerning the displacement problem in compressible flow without buoyancy effects and a study by Kraus (1970) regarding the displacement problem in compressible flow in the presence of buoyancy effects. Other investigations discussed are concerned with a wing-fuselage combination in compressible flow and the three-dimensional potential theory in the case of an arbitrary multibody arrangement. The theory of the subsonic panel method is also investigated, giving attention to the basic equations and a numerical model. G.R.

A73-11658 **Effect of aircraft reliability regulations on takeoff and landing performance of QSTOL aircraft (Einfluss von Lufttüchtigkeitsvorschriften auf die Start- und Landeleistungen von QSTOL-Flugzeugen).** H. G. Klug (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-056.* 25 p. In German.

It is pointed out that there exist at present only preliminary aircraft reliability requirements for short takeoff aircraft. The decisive influence of the characteristics of requirements and assumptions for the design of QSTOL aircraft is demonstrated with the aid of a typical example. The aircraft considered requires a runway length of 500 m according to one set of rules and a runway of almost 1000 m according to another set of rules. The significant effect of the rules on the values for the lowest velocities which are permitted for the flight over an obstacle is also shown. G.R.

A73-11660 **Recent investigations in the field of meteorological icing parameters (Neuere Untersuchungen auf dem Gebiet der meteorologischen Vereisungsparameter).** W. Kleuters (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West*

Germany, Oct. 4-6, 1972, Paper 72-109. 37 p. 13 refs. In German.

Values of meteorological icing parameters were determined during a number of flights made under meteorological conditions conducive to the formation of ice on aircraft, giving attention to free water content, droplet diameter, and temperature. The device developed for the measurement of the free water content proved to be reliable even under conditions of high temperatures and high water content. The data obtained were statistically evaluated and compared with the measurements reported by NACA. Differences found in the range of high temperatures and water contents are probably due to the instrument used for the measurements during the time from 1946 to 1952. This instrument did not operate properly under conditions of high water content. G.R.

A73-11661 Multivariate analysis applied to aircraft optimisation - Some effects of research advances on the design of future subsonic transport aircraft. D. L. I. Kirkpatrick and D. H. Peckham (Royal Aircraft Establishment, Bedford, Hants., England). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-093.* 28 p. 26 refs.

The development of a computer program is described that makes it possible to optimize the design of a subsonic swept-wing jet transport and to assess rapidly the effect on such a design of advances in aerodynamic, structural, and propulsion technologies, or to determine the influence of changes in the performance specified. For the particular short-range transport considered, the main changes in wing design (i.e., sweep, aspect ratio, and wing loading) are shown to be called for an assumed improvement in airfoil section standards. Other investigated improvements result in weight savings and corresponding reductions in wing areas with only second-order effects on aircraft design characteristics. Further evolutionary development of the swept-wing theme is shown to be likely to yield substantial improvements in operating cost and noise for next-generation designs. M.V.E.

A73-11662 # VFW 624 - Market, operation, and technology (VFW 624 - Markt, Betrieb und Technik). H.-J. Höppner (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-054.* 46 p. In German.

The noise due to the air traffic to which the public is subjected can be reduced by advances in propulsion system technology and by improved performance in takeoff and landing operations involving a steep ascent and descent of the aircraft. The capacity of the airports which are threatened by congestion due to the greatly increasing air traffic can generally be enhanced by the introduction of CSTOL aircraft up to a point at which the saturation limit will not be reached before 1990. Difficulties on account of the high air traffic density can be overcome with the aid of further developments in the air traffic control system. Reduced takeoff and landing distances are obtained in the design of CSTOL aircraft by evolutionary advances involving conventional components. The design of the VFW 624 shows that at the present time it is already possible to build an aircraft which incorporates the essential features of CSTOL technology. G.R.

A73-11665 STOL aircraft with mechanical high-lift systems in comparison to STOL aircraft with wings having blown flaps (STOL-Flugzeuge mit mechanischen Hochauftriebsystemen im Vergleich zu STOL-Flugzeugen mit Blasklappenflügeln). E.-A. Bielefeldt (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-057.* 35 p. 16 refs. In German.

Approaches for obtaining high aerodynamic efficiencies with high-lift systems are discussed, giving attention also to installation problems and the effects of the weight of the high-lift devices on the lift. Lift data of complex mechanical and blown-flaps systems are determined in the case of a certain STOL configuration. It is found that mechanical high-lift devices are superior to designs using blown flaps. The selection of the high-lift system, however, can also be influenced by questions of design regulations. It is pointed out that under certain conditions wings with blown flaps have advantages compared to other wing designs. G.R.

A73-11675 Performance improvement through controller-assisted aircraft design (Leistungserhöhung durch Reglergestützten Flugzeugentwurf). G. Löbert (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-094.* 27 p. 7 refs. In German. Research supported by the Bundesministerium der Verteidigung.

Demonstration of the possibility of obtaining high potential power increases at only small additional costs by employing artificial instead of natural stabilization. It is shown that if the requirement of static aerodynamic stability is eliminated the drag polars and thus the flight performances can be significantly improved. This improvement occurs mainly in the form of an increase in the specific power reserve at high lift coefficients and in an increase in the attainable maximum lift coefficients. The dynamic flight characteristics of such aircraft can be made equal to or better than the characteristics of aerodynamically stable aircraft through an appropriate artificial stabilization. By incorporating suitable redundances and other provisions, the flight safety of conventional mechanically controlled aircraft can be achieved. A.B.K.

A73-11680 # Comparative simulator studies regarding a contact-analog channel display and conventional instrumentations (Vergleichende Simulatorstudien mit dem kontaktanalogen Kanal-Display und mit konventionellen Instrumentierungen). W. Schattenmann and V. Wilckens (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-100.* 37 p. 10 refs. In German.

A73-11687 # Contribution to the problem of suction of foreign bodies into engine intakes (Beitrag zum Problem des Einsaugens von Fremdkörpern in Triebwerkseinläufe). H. Pflugshaupt (Eidgenössisches Flugzeugwerk, Emmen, Switzerland). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-107.* 55 p. 12 refs. In German.

Results of an experimental study of an arrangement for suppressing intake vortices in the case of the AMD Mercure short-haul passenger aircraft. The AMD Mercure is a low-wing wing-mounted fanjet aircraft with a short distance between the air intake and the ground, thus giving rise to the possibility of suction of foreign bodies into the intake as a result of the formation of a vortex under the intake. After discussing the range of existence of the vortex as a function of the distance from the intake to the ground, it is recommended that the vortex be quenched with the aid of a so-called 'blow away jet' or 'vortex spoiler.' A study is made of the dependence of the vortex spoiler feed pressure required for complete quenching of the vortex on the mass flow rate and the wind velocity. A.B.K.

A73-11690 # Criteria concerning the adaptation of the rear components of a propulsion system to the subsonic and transonic altitude flight (Anpassungskriterien der Triebwerkshinterteile an den hohen Unterschall- und Transsonikflug). J. M. Hardy (SNECMA, Centre d'Essais de Villaroche, Moissy-Cramayel, Seine-et-Marne, France). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-065.* 36 p. 9 refs. In German.

Two approaches are employed in the design of propulsion system rear components for subsonic and transonic flight. One approach provides a primary central flow, while the other makes use of a circular design for guiding the flow of the gas. Design criteria based on a systematic experimental investigation of the significant geometric parameters are discussed for each of the two nozzle types involved. An optimization study concerning external forms is conducted, and the effect of the length of the internal free jet on the performance is investigated in the case of nozzles with a primary internal conduction of the gas. The significance of the angle of the flow channel is examined, together with the effects produced by the central body in the case of nozzles containing a central body. The problems are also theoretically analyzed. G.R.

A73-11691 # **The influence of the Mach number on fuselages and profiles with optimized wave resistance in the case of supersonic flow (Der Einfluss der Machzahl auf wellenwiderstandsoptimierte Rümpfe und Profile bei Überschallanströmung).** J. Wellmann (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aerodynamik, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-108.* 35 p. 43 refs. In German.

A73-11692 # **Optimum heat transfer characteristics of semicircular surfaces cooled by air impingement from airjet arrays and row of air jet nozzles.** W. Tabakoff and R. Steeneck (Cincinnati, University, Cincinnati, Ohio). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-061.* 24 p. 6 refs. Grant No. DAHC04-69-C-0016.

A73-11698 # **Problems of the integration of aircraft and flight control system in the case of new approach procedures (Probleme der Integration von Fluggerät und Flugführungssystem bei neuen Anflugverfahren).** G. Schänzer (Bodenseewerk Gerätetechnik GmbH, Überlingen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972. Paper 72-096.* 30 p. 15 refs. In German.

A73-11701 # **The ordered structure of free-jet turbulence and its significance for the free-jet noise (Über die geordnete Struktur der Freistrahlturbulenz und ihre Bedeutung für den Freistrahllärm).** A. Michalke and H. Fuchs (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Turbulenzforschung, Berlin, West Germany). *(Deutsche Arbeitsgemeinschaft für Akustik, Tagung über Akustik und Schwingungstechnik, 2nd, Universität Stuttgart, Stuttgart, West Germany, Sept. 13-15, 1972.) Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-075.* 11 p. 16 refs. In German.

A73-11702 # **The technical evolution of air transport in the seventies - European contribution to this evolution (Die technische Entwicklung des Lufttransports in den 70er - Jahren europäischer Beitrag zu dieser Entwicklung).** H. Ziegler (Société Nationale Industrielle Aérospatiale, Paris, France). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper.* 53 p. In German.

A73-11704 # **Airports in response to changing requirements (Flughäfen im Wandel der Anforderungen).** R. Lange (Flughafen Frankfurt am Main AG, Frankfurt am Main, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper.* 16 p. In German.

The rectangular or approximately round form of the airports during the first phase of aircraft development is connected with the requirement of a takeoff and landing in the direction of the wind for the early aircraft with their relatively weak engines. During the development phase of the world air traffic after World War II, the number of runways in the airports and the runway length had to be increased. The third phase of airport development began with the introduction of jet propulsion for air liners. Aspects of the enhancement of the area of the airports in connection with the growing air traffic are discussed. Various types of airport design are considered, giving attention to the transportation of the passenger to the airport and economic factors. G.R.

A73-11707 # **Influence of the boundaries of wind-tunnel flow on the flow past a small-aspect-ratio wing (Vliianie granits potoka aerodinamicheskoi truby na obtekanie kryla malogo udlineniia).** V. I. Kholiavko and Iu. F. Usik. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 3-9. In Russian.

A solution to the problem of the flow past a small-aspect-ratio plane thin-section wing in a wind tunnel of circular cross section is obtained on the basis the general relations in slender body theory and the derived relations for the virtual mass. The solution obtained yields the corrections to the lift coefficients and to the position of the center of pressure at the wing with allowance for the wall effect. V.P.

A73-11713 # **High-pressure axial fan for air-cushion vehicles (Vysokonapornyi osevoi ventiliator dlia apparatov na vozdushnoi podushke).** N. S. Berestneva, V. P. Gerasimenko, F. G. Kontsevich, and G. V. Pavlenko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 35-39. 5 refs. In Russian.

The geometrical and aerodynamic characteristics of a high-efficiency fan with a meridional flow acceleration are examined. The fan constitutes a two-element compressor stage with axial intake and exhaust. The radial distribution of the flow parameters at various cross-sections of the flow area, the pressure and efficiency characteristics, and the unsteady modes of operation are discussed. V.P.

A73-11716 # **Some problems in the substantiation and application of discrete large-element design schemes for complex zero-moment shells (Nekotorye voprosy obosnovaniia i ispol'zovaniia krupnoelementnykh diskretnykh raschetnykh skhem slozhnykh bezmomentnykh obolochek).** V. M. Riabchenko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 66-73. 5 refs. In Russian.

A73-11718 # **Stressed state of a system in the region of an applied concentrated transverse load (Napriazhennoe sostoianie sistemy v oblasti prilozheniia sosredotochennoi poperechnoi sily).** N. M. Kharun and N. A. Shelomov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 79-84. 5 refs. In Russian.

Shelomov's (1965) method for calculating composite systems is applied to the analysis of the stress-strain state of a cantilever thin-walled cylindrical shell with reinforced ends, one of which is fastened to a column. A concentrated force is applied horizontally to the free reinforcement ring. The computer solution obtained is suitable for calculating such aircraft components as fuselages, wings, and tail surfaces. V.P.

A73-11719 # **Physicomechanical properties of a structural cold-hardened fiberglass-reinforced plastic (Fiziko-mekhanicheskie svoistva konstruktsionnogo stekloplastika kholodnogo otverzhdeniia).** V. E. Gaidachuk, V. V. Kirichenko, A. F. Pil'nik, and V. I. Timoshchenko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 84-92. 5 refs. In Russian.

The results of tensile, compression, and shear tests performed

with a plastic intended as the fuselage material for the AN-2m aircraft are examined. The plastic is prepared from ASTT(b)-C(1) (MRTU6M814-61) fiberglass cloth soaked with K-153 epoxy-thiocol binder. Polyethylene-polyamine (10% of the binder weight) is used as the hardener. The plastic contains 40 vol % plus or minus 3 vol % of the binder. It is shaped in vacuum at a pressure of 0.7 atm for 10 hr, and is left to harden at room temperature for not less than a month. V.P.

A73-11723 # **Free three-dimensional vibration processing of gas-turbine engine blades (Svobodnaia ob'emnaia vibroobrabotka lopatok gazoturbinnykh dvigatelei).** A. G. Shabotenko, S. V. Khazanovich, and E. M. Koloshchuk. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 137-142. In Russian.

Experience obtained with vibration grinding and vibration polishing of turbine and compressor blades is discussed, and the design and principles of operation of a vibration polishing machine are examined. It is shown that vibration processing of blades has numerous advantages over manual mechanical working. V.P.

A73-11724 # **Automatic indicator of angles of attack and angles of sideslip (Avtomaticheskii izmeritel' uglov ataki ili skol'zheniia).** V. Ia. Fridland and Iu. K. Polishchuk. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 28, 1972, p. 143-146. In Russian.

A device is described which uses the relationship between the angle of attack and the static pressure coefficient at certain areas of the wing profile or of the vertical fin to indicate the angle of attack or angle of sideslip in the entire range of flight angles. The device can be installed on any subsonic aircraft. Wind-tunnel tests performed with the device are examined. V.P.

A73-11788 # **Method of calculating vortex-free flow around hydrodynamic cascades composed of arbitrary profiles (Metod rascheta bezvikhrevogo obtekaniia gidrodinamicheskikh reshetok, sostavlennykh iz proizvol'nykh profilei).** V. B. Avdeev and A. I. Borisenko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 29, 1972, p. 30-38. 6 refs. In Russian.

The method of singularities is extended to permit calculation of the flow through hydrodynamic blade cascades with arbitrarily shaped, thin or solid profiles of large or small curvature. Complex singularities are constructed by replacing the profiles with a vortex layer and a layer of distributed vortex sources. Components of the singularities are determined from four systems of m-order linear algebraic equations (m is a number of discrete singularities used to replace the vortex and source layers.) Solutions of these equations are used to determine the distributed and total (force and moment) aerodynamic characteristics of a plane straight cascade. T.M.

A73-11790 # **Unsteady modes of operation of a centrifugal compressor with a vaneless diffuser (Neustoichivye rezhimy raboty tsentrobezhnogo kompressora s bezlopatochnym diffuzorom).** I. Iu. Stepanov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 29, 1972, p. 53-56. 6 refs. In Russian.

A73-11791 # **Investigation of an axial-flow blower during variation of axial clearance and of blade mounting angles in the stator and rotor sections (Issledovanie osevogo ventiliatora pri izmenenii uglov ustanovki lopatok v apparatakh i osevogo zazora).** V. P. Gerasimenko. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 29, 1972, p. 57-61. In Russian.

A73-11794 # **Lifetime of Dural structural elements operating in aggressive media (Dolgovechnost' Diuralevykh elementov konstruktsii, rabotaiushchikh v agressivnykh sredakh).** V. A. Gorodetskii, V. A. Borodavko, and A. M. Vorobeikov. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 29, 1972, p. 78-86. 6 refs. In Russian.

Results of corrosion and fatigue-tests of various Dural aircraft structural elements exposed to chemically aggressive fluids typically encountered in aviation. Different stages of structural response observed in the fatigue-corrosion tests are analyzed, and tables classify corrosive media with respect to the level of damage imposed on Dural structures. T.M.

A73-11801 # **Schematic design of an automatic device for correcting aircraft takeoff and landing modes of flight (Postroenie skhemy avtomaticheskogo pribora-korrektora rezhimov vzleta-posadki samoleta).** A. I. Koroteev and Iu. K. Polishchuk. *Samoletostroenie i Tekhnika Vozdushnogo Flota,* no. 29, 1972, p. 137-140. In Russian.

A73-11827 **An airborne ac superconducting generator.** L. R. Lowry (Westinghouse Electric Corp., Aerospace Electrical Div., Lima, Ohio). In: *Applied Superconductivity Conference,* 5th, Annapolis, Md., May 1-3, 1972, Proceedings.
New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 41-46. USAF-supported research.

An ac generator utilizing a rotating superconducting field is described. The generator will produce 1000 kVA at 5000 volts, 3 phase, 400 Hz with a short time overload capability of 5000 kVA. Predicted performance, size, and weight of the superconducting generator are compared with that of a machine of similar rating using conventional airborne generator technology. It is concluded that superconducting generators will exhibit significant weight reductions for generators rated above 2 MW. (Author)

A73-11851 ***Summary of navigation aids to civil aviation* Current state and prospects (Récapitulation des aides à la navigation aérienne civile - Etat actuel et perspective).** H. S. Dodington (ITT, New York, N.Y.). *L'Onde Electrique,* vol. 52, Sept. 1972, p. 340-343. 5 refs. In French.

Existing navigation aids available or to become available to civil aviation are briefly reviewed, and some of the future trends are discussed. The degree of utilization, number of stations, and frequencies used for some current aids are listed, along with typical costs of the airborne equipment involved. It is pointed out that an improved utilization of available aids is more important than the introduction of new navigation aid systems. M.V.E.

A73-11852 **The TAM-TAM system (Système TAM-TAM).** J. Louet (Service Technique de la Navigation Aérienne, Paris, France). *L'Onde Electrique,* vol. 52, Sept. 1972, p. 344-352. In French.

The automatic transmission of air traffic messages by multiplex, called by its French acronym the TAM-TAM system, is aimed at the establishment of an air-ground-air data link to be used during flight over continental areas, the high seas, or over terminal control areas. It is shown that such recent and ongoing developments as the automation of air traffic control centers, the digital multiplexing of data, and the introduction of onboard navigation computers and cathode-ray-tube displays invite the use of a TAM-TAM-type air-ground-air data link. A program of experimental validation and design refinement of the TAM-TAM system, that could be completed by the middle of 1974, is proposed. M.V.E.

A73-11853 **A system developed for the training of air traffic controllers - 'The Cautra-ENAC simulator' (Un système développé pour la formation des contrôleurs de trafic aérien - 'Le simulateur Cautra-ENAC').** D. Legendre (Compagnie Internationale pour L'Informatique, Vélizy-Villacoublay, Yvelines, France). *L'Onde Electrique,* vol. 52, Sept. 1972, p. 353-356. In French.

An air traffic control simulator is described that has been developed for training air traffic control students for the Toulouse National School of Civil Aviation in a realistic air traffic control room atmosphere. Proposed training routines and exercises are discussed. M.V.E.

A73-11854 Meteorological Wilm radar and landing aid (Wilm-radar météorologique et aide à l'atterrissage). J. Genuist (Thomson-CSF, Malakoff, Hauts-de-Seine, France). *L'Onde Electrique,* vol. 52, Sept. 1972, p. 357-361. In French.

Brief description of the WILM system consisting of an airborne radar set designed to perform the two functions of weather surveillance and of an independent landing monitor. In addition, the system provides ground visualization and collision avoidance on the ground. The equipment is shown to meet current and future landing requirements of aircraft. M.V.E.

A73-11855 Reliability of category-III ILS onboard equipment (Fiabilité des équipements de bord ILS catégorie III). C. Lanilis and B. Durand (Thomson - CSF, Gennevilliers, Hauts-de-Seine, France). *L'Onde Electrique,* vol. 52, Sept. 1972, p. 362-366. In French.

Description of an onboard ILS subsystem that has been developed as a component part of an integrated airborne all-weather landing system. The subsystem is shown to be thoroughly compatible with the fundamental requirements of the all-weather landing system. M.V.E.

A73-11856 On sonic boom avoidance. S. B. Batdorf (Aerospace Corp., Los Angeles, Calif.). *Aeronautical Journal,* vol. 76, Sept. 1972, p. 541, 542. Comments, p. 543, 544. 5 refs.

Hilton (1971) proposed the use of maneuvers for creating 'no boom' zones as a means of protecting cities situated along the flight path of supersonic aircraft. The basic idea is that curved flight causes a local focus of shock waves and that, in regions closer to the center of curvature than this focus, shock do not form. By applying a technique, which makes it possible to plot the shock front directly, to maneuvers of the type proposed by Hilton, it is found that regions of single, double, and even tripple shocks can occur, however, no shockless regions are detected. V.P.

A73-11858 The pressure-jet helicopter propulsion system. J. B. Nichols (Aerospace Corp., Los Angeles, Calif.). *Aeronautical Journal,* vol. 76, Sept. 1972, p. 552-565.

The pressure-jet propulsion system is discussed, which delivers a driving torque to the rotor in the form of a tangential force at the tip of the rotor, rather than by twisting a shaft at the center of the rotor, as in the case of the shaft-drive system employed in most helicopter. The pressure jet propulsion system is basically a radial-outflow turbine that converts the available energy in gas discharged from a gas producer into rotor torque and rotor horsepower in fundamentally the same manner as the shaft-drive system. The aerodynamic efficiencies, mechanical efficiencies, and turbine efficiences are derived by classical methods for helicopters with conventional shaft-drive systems and pressure-jet systems. It is shown that all the properties of the radial-outflow turbine can be presented on a single chart that displays all velocity ratios, energy losses, and efficiencies. V.P.

A73-11860 Predicting design costs. D. J. Leech and D. L. Earthrowl (Swansea, University College, Swansea, Wales). *Aeronautical Journal,* vol. 76, Sept. 1972, p. 575-577.

An investigation of design procedures and the prediction of design and development costs in the aircraft component industry is discussed on the basis of 32 manufactured items for which the originally predicted man hours required for design and development and the hours actually used where known. A Monte Carlo simulation of a year's design and development work is proposed which will give a symmetric distribution of design and development costs for use in the company's development plan. V.P.

A73-11879 Design of functional pavements. N. C. Yang (Port of New York Authority, New York, N.Y.). New York, McGraw-Hill Book Co., 1972. 475 p. 184 refs. $22.50.

The basics of pavement design are discussed together with the development of design methods, the pavement support condition, quality control and construction tolerance, the material concept of pavement construction, and environmental effects on pavement systems. Other subjects examined include mathematical models for pavement systems, properties of landing gears relating to pavement design, questions of vehicle-pavement interaction, full-scale pavement tests, and systems of pavement design analysis. Problems of the redesign of existing pavement are also investigated, giving attention to the condition of existing pavement and subgrade, aspects of data acquisition, questions of design sequence, and details concerning the practical application of design analysis. G.R.

A73-11984 # Field applications for dual sensitivity penetrants. R. T. Fricker. *American Society for Nondestructive Testing, Fall Conference, Cleveland, Ohio, Oct. 16-19, 1972, Paper.* 10 p.

Description of an improved method of liquid penetrant inspection of the structural integrity of military aircraft during rework and repair. Dual sensitivity (i.e., visible-dye and fluorescent) penetrants are used for the location and identification of minute defects in critical areas of aircraft structures. The comparative advantages of dual sensitivity penetrants are discussed. M.V.E.

A73-11999 New facility tests S-3A landing gear. E. J. Bulhan. *Aviation Week and Space Technology,* vol. 97, Nov. 13, 1972, p. 38-40.

The basic components of the moving platform or shuttle system considered include the shuttle plate, the propulsion system, the holdback and release system, the track system, and the braking system. The facility was designed to handle full-size aircraft in tests for the determination of landing gear behavior during critical pulse loads generated while rolling over aircraft carrier deck obstructions. Basic task of the new landing gear test facility is a two-phase program, which engineers expect to complete next January, using the S-3A static test airframe. G.R.

A73-12005 New bearing concepts for gas turbines. E. B. Arwas, J. M. McGrew, and L. W. Winn (Mechanical Technology, Inc., Latham, N.Y.). *Society of Automotive Engineers, National Combined Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., Sept. 11-14, 1972, Paper 720739.* 19 p. 26 refs. Members, $1.25; nonmembers, $2.00.

This paper surveys two bearing approaches that may be considered for gas turbine applications. The first is the hybrid bearing which uses a fluid film in parallel or in series with the rolling-element bearing, and whose objective is to increase the L-10 life of the rolling-element bearing in high-load and/or high-speed applications. In the parallel arrangement this objective is sought by load sharing between the fluid-film and rolling-element bearing components. In the series arrangement, the objective is sought by achieving a decrease in the effective speed of the rolling-element bearing. The second approach is the use of gas bearings as a solution to problems of high-temperature operation. (Author)

A73-12006 Low-cost fluid film bearings for gas turbine engines. J. M. Ross (Gould, Inc., Chicago, Ill.). *Society of Automotive Engineers, National Combined Farm, Construction and*

Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., Sept. 11-14, 1972, Paper 720740. 21 p. 8 refs. Members, $1.25; nonmembers, $2.00.

Basic design questions are considered, giving attention to a typical bearing-journal combination with unidirectional load, a shaft in whirling orbit, and peak and mean oil-film pressure versus length-diameter ratio. Typical common high-speed bearing designs examined include axial groove bearings, three-lobe bearings, full floating bearings, tilting pad bearings, and thrust bearings. Good performance and attractive cost effectiveness are shown by some other bearing designs which are less known. Such designs are the pinned floating bearing, the floating slipper bearing, the floating segment bearing, and the three-tilted-lobe bearing. Basic practices used in fluid-film bearing fabrication are also discussed. G.R.

A73-12007 Flexible rotor balancing of a high-speed gas turbine engine. N. F. Rieger and R. H. Badgley (Mechanical Technology, Inc., Latham, N.Y.). *Society of Automotive Engineers, National Combined Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., Sept. 11-14, 1972, Paper 720741.* 12 p. 9 refs. Members, $1.25; nonmembers, $2.00.

The need for balancing a high-speed rotor in a manner that accounts for its speed-dependent deformations is discussed. The influence coefficient method of flexible rotor balancing is described with reference to the balancing of an advanced gas turbine engine rotor. This engine rotor-bearing system is then studied in detail as an application of flexible rotor balancing, using the influence coefficient method. The relative effectiveness of various combinations of balance speeds and numbers of balance planes is compared. (Author)

A73-12010 Design and test of a small, high-pressure ratio, axial compressor with tandem and swept stators. C. J. Paine (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Society of Automotive Engineers, National Combined Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., Sept. 11-14, 1972, Paper 720713.* 13 p. 8 refs. Members, $1.25; nonmembers, $2.00. Contract No. F33615-69-C-1100.

Aerodynamic design questions are discussed, giving attention to the rotor and the tandem stator. The compressor performance was evaluated in a compressor test cell. A full-stage test and a swept-stator-only test were conducted. It was found in the investigations that the scaling of a NASA rotor by 0.359 with a change in aspect ratio from 1.66 to 1.27 has only a minor effect on all rotor performance parameters. Slight contour changes in the rotor flow path do not appear to have produced any significant effect. Overall stage efficiency and flow range were adequate for the application considered. G.R.

A73-12012 Future of exclusive measurements of distances (Avenir des mesures exclusives de distances). A. Violet. *(Colloque International sur l'Electronique et l'Aviation Civile, Paris, France, June 26-30, 1972.) Navigation* (Paris), vol. 20, Oct. 1972, p. 386-394. In French.

A73-12015 Review of radio navigation of civil aircraft - Current and future outlook (Panorama de la navigation radioélectrique des avions civil - Situation actuelle et prospective). S. H. Doddington (ITT, New York, N.Y.). *(Colloque International sur l'Electronique et l'Aviation Civile, Paris, France, June 26-30, 1972.) Navigation* (Paris), vol. 20, Oct. 1972, p. 443-448. In French.

A73-12036 Dissipation and breakdown of a wing-tip vortex. A. Mager (Aerospace Corp., El Segundo, Calif.). *Journal of Fluid Mechanics,* vol. 55, Oct. 24, 1972, p. 609-628. 20 refs.

Closed-form transcendental solutions of the quasi-cylindrical momentum-integral equations for the flow in the viscous core of a wing-tip vortex are shown to have two separate branches with the same flow force deficiency. However, at the downstream infinity, where the swirling motion is completely dissipated, only one of these branches yields solutions with a uniform axial velocity equal and opposite to the velocity of the aircraft. The results obtained in the investigation show that the wing-tip vortex breakdown causes a pronounced distortion of the axial and circumferential velocity profiles, expansion of the core, large static pressure rise on the axis and some recovery of the total pressure. G.R.

A73-12116 Analytical design of quasi-terminal control systems. A. A. Krasovskii. *(Avtomatika i Telemekhanika,* Apr. 1972, p. 5-14.) *Automation and Remote Control,* vol. 33, no. 4, Sept. 1972, pt. 1, p. 527-535. 9 refs. Translation.
p. 5-14. 9 refs. In Russian.

Analysis of a control synthesis problem with the minimization of the functional as the sum of a given phase coordinate function and an integral estimate of determined phase coordinate functions. A linear homogeneous partial differential equation is solved to obtain optimal controls and corresponding signals as components of the functional when the terminal component constitutes the boundary condition. Optimal conditions for a linear plant are given through the weight functions of the plant in a finite form, showing that even for a stationary plant these conditions are nonstationary. V.Z.

A73-12199 # Model study of aircraft noise reverberation in a city street. L. Pande (MIT, Cambridge, Mass.). *Acoustical Society of America, Meeting, 83rd, Buffalo, N.Y., Apr. 18-21, 1972, Paper.* 58 p. 12 refs. U.S. Department of Transportation Contract No. TSC-93.

Experimental studies of sound propagation from a source situated above roof top level in an urban environment have indicated the amplification and shielding effects of buildings. These experiments have been supplemented by diagnostic tests with a spark source which indicate the paths of propagation and their contribution to the received sound. A criterion for reverberation in a city street due to an aircraft is developed in terms of images formed. Charts indicating the amplification or shielding of noise from low flying aircraft are presented. (Author)

A73-12200 # Further studies of the aeroacoustics of jets perturbed by screens. R. E. A. Arndt, G. Barefoot, and N. C. Tran (Pennsylvania State University, State College, Pa.). *Acoustical Society of America, Meeting, 83rd, Buffalo, N.Y., Apr. 18-21, 1972, Paper.* 34 p. 14 refs. Navy-supported research.

The results of a study conducted by Arndt (1971) indicated that a substantial attenuation of noise intensity can be realized through the insertion of a screen into the jet flow. An extension of this study is reported. The new investigation includes detailed surveys of both pressure and velocity in a large subsonic turbulent jet. Emphasis is placed on the mixing characteristics of the jet and their relation to noise radiation. Background material is discussed, giving attention to basic theory, turbulent jet aerodynamics, and the axial distribution of sound sources and characteristic power spectra. The study was confined to the region of jet flow from zero to eight diameters from the nozzle. It was found that there is a substantial reorientation of turbulence structure in the mixing region. G.R.

A73-12216 The duration of equivalent tests. M. A. Porter. *(Problemy Prochnosti,* vol. 4, Feb. 1972, p. 96-98.) *Strength of Materials,* vol. 4, no. 2, Sept. 1972, p. 224-226. 5 refs. Translation.
Feb. 1972, p. 96-98. 5 refs. In Russian.

Description of a method of determining the duration of equivalent tests of the hot part of a gas turbine engine. An analytical method of determining this duration is proposed which is based on

the principle of linear accumulation of damage and the equivalence of regimes with equal strength reserves. The method is based on the use of the Larson-Miller parametric description of the stress-rupture strength with a linear approximation of the stress-rupture strength curve. A.B.K.

A73-12217 Fatigue strength of constructional materials and components of GTD-type compressors under conditions of fretting corrosion. A. N. Petukhov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR). *(Problemy Prochnosti,* vol. 4, Feb. 1972, p. 99-103.) *Strength of Materials,* vol. 4, no. 2, Sept. 1972, p. 227-231. 5 refs. Translation.

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

A73-12447 # Influence of acceleration on tip clearances in aircraft engine turbines and compressors (Wplyw przyspieszania na zmiany luzow wierzcholkowych sprezarek i turbin silnikow lotniczych). S. Szczecinski. *Technika Lotnicza i Astronautyczna,* vol. 27, Oct. 1972, p. 6-9. 10 refs. In Polish.

A73-12448 # Analysis of fundamental flight parameters and 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, Oct. 1972, p. 10-14. In Polish.

A73-12449 # Statistical analysis of the sound-level distribution of aircraft noise as a function of time. II (Analiza statystyczna rozkladu poziomu dzwieku halasow lotniczych w funkcji czasu. II). T. Rajpert. *Technika Lotnicza i Astronautyczna,* vol. 27, Oct. 1972, p. 15-18, 41. In Polish.

A73-12450 # Attempts at using fiberglass cloth as skin for aircraft (Proby uzycia tkaniny szklanej jako poszycia samolotu). W. Poninski and A. Goledzinowski (Instytut Lotnictwa, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 27, Oct. 1972, p. 19, 20. In Polish.

A73-12501 The pressure on flat and anhedral delta wings with attached shock waves. J. Pike (Royal Aircraft Establishment, Bedford, Hants., England). *Aeronautical Quarterly,* vol. 23, Nov. 1972, p. 253-262. 14 refs.

An expression is derived which relates the pressure on a wing in a supersonic free stream to the pressure on a thin wing with the same surface shape. The expression is used to find the pressure distribution for caret wings and flat delta wings with attached flow at their leading edges. The compression surface pressure distributions found are in good agreement with existing experimental and theoretical results, except when large pressure changes occur in the flow behind the attached shock wave. Some expansion surface results are also obtained for wings with an isentropic expansion at the leading edge. The effects of flow and geometry changes on the pressure distribution are investigated. It is found that a small improvement in the lift/drag ratio of a caret wing can be obtained by halving the anhedral required for the plane shock wave condition. (Author)

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A73-12502 The caret wing at certain off-design conditions. W. H. Hui (Southampton, University, Southampton, England). *Aeronautical Quarterly,* vol. 23, Nov. 1972, p. 263-275. 18 refs.

A unified theory is given of hypersonic and supersonic flow over the lower surface of a caret wing at certain off-design conditions when the bow shock is attached to the leading edges of the wing and when there exists no internal shock. The flow field on the lower surface of a caret wing consists of uniform flow regions near the leading edges, where the cross-flow is supersonic, and a non-uniform flow in the central region, where the cross-flow is subsonic. The basic assumption is that the flow in the central region differs slightly from the two-dimensional supersonic flow over a flat plate at the same angle of incidence as that of the lower ridge of the wing. Based on this assumption, a first-order perturbation flow is first calculated and then strained and corrected so that it matches the uniform flow which is obtained exactly. Slope discontinuities of the pressure curve are found at the cross-flow sonic line. Numerical examples and comparisons with previous theories and experiments are included. (Author)

A73-12503 Response of helicopter rotor blades to random loads near hover. C. Lakshmikantham (U.S. Army, Army Materials and Mechanics Research Center, Watertown, Mass.) and C. V. Joga Rao. *Aeronautical Quarterly,* vol. 23, Nov. 1972, p. 276-284. 11 refs.

The response of a flexible helicopter rotor blade to random loading is investigated, the random input being the vertical velocity component. The model takes into account blade flexibility in bending as well as torsion, and also general root rigidity. The spectral density and the mean square value of the transverse displacement are computed for both hingeless and hinged rotor blades and the results are evaluated. (Author)

A73-12504 A three-dimensional analysis of rotor wakes. C. E. Whitfield (Loughborough University of Technology, Loughborough, Leics., England), J. C. Kelly (München, Technische Universität, Munich, West Germany), and B. Barry (Rolls-Royce, Ltd., Derby, England). *Aeronautical Quarterly,* vol. 23, Nov. 1972, p. 285-300. 23 refs.

Description of a wavefront averaging technique which uses a constant-temperature hot-wire anemometer as a probe for flow analysis in rotor wakes. Essential for three-dimensional flow measurements by this technique is a wire mounted ar 54.7 deg on a radially oriented stem. The wire can be positioned in three mutually perpendicular directions when the stem is rotated over 120-deg arcs. A complete map of a three-dimensional rotor wake can be obtained by this technique. Various forms of visual data presentation are discussed. The results obtained with a single fan rig by this technique are given. V.Z.

A73-12505 **A comparison of two prediction methods with experiment for compressible turbulent boundary layers with air injection.** G. D. Thomas, V. K. Verma, and L. C. Squire (Cambridge University, Cambridge, England). *Aeronautical Quarterly,* vol. 23, Nov. 1972, p. 301-306. 13 refs.

A73-12506 **Finite amplitude waves on aircraft trailing vortices.** D. W. Moore (Imperial College of Science and Technology, London, England). *Aeronautical Quarterly,* vol. 23, Nov. 1972, p. 307-314. 14 refs.

Numerical methods are used to study the growth of waves of finite amplitude on a pair of parallel infinite vortices. The vortices are treated as lines except in so far as the detailed structure of the core is needed to remove consistently the singularity in the line integrals for the velocities of the vortices. It is shown that the vortices eventually touch and the shape of the wave at this instant is calculated. The wave is quite distorted at this instant, but it is shown that its gross properties are given roughly by linear theory. (Author)

A73-12566 **In-flight structural failures involving general aviation aircraft.** R. G. Snyder (Michigan, University, Ann Arbor, Mich.). *Aerospace Medicine,* vol. 43, Oct. 1972, p. 1132-1140. 32 refs.

Analysis of data obtained from accident reports and from selected accidents investigated by the author in which in-flight failures resulted in high vertical impact forces on occupants, to determine the incidence, nature, biomechanics of injury, and environmental conditions related to in-flight structural failures in general aviation operations. When in-flight structural failure occurs the cabin section typically enters a flat spin or falls vertically at a high descent rate along the pattern of flight. Crash impacts of this nature differ from other accident environments in that they usually involve high vertical loadings in the +Gz vertebral axis, characteristically resulting in high onset rates, high G forces, and relatively abrupt time durations, in contrast to many crash-landing type accidents. In many cases the vertical component is so marked that there is no detectable forward motion of the aircraft at impact. This type of accident has resulted in 100% fatality when major airframe failure occurs. An increase in airframe design gust strength to reduce the incidence of this type of accident, combined with installation and use of upper torso restraint, and an increase in the strength and energy-absorbing characteristics of the seat and floor structure to more closely approach known human tolerance limits would provide greater protection when such accidents do occur. (Author)

A73-12595 # **Introducing the electrostatic autopilot.** M. L. Hill (Johns Hopkins University, Silver Spring, Md.). *Astronautics and Aeronautics,* vol. 10, Nov. 1972, p. 22-31. 15 refs.

The electrostatic autopilot consists of a patch of radioactive material mounted on each wing tip and on the nose and tail of an aircraft along with two highly sensitive differential voltmeters. The stabilization system developed appears, under the conditions investigated, equal to conventional systems employing precision mechanical gyros. The autopilot weighs about 3 oz., uses milliwatts of power, and has no moving parts. Flight tests conducted with the device are reported, giving attention to the demonstration of pitch stabilization. Ten hours of operational CAT flight of the pitch stabilizing system in early August 1972 yielded numerous quantitative telemetry records. Principles of atmospheric electricity are discussed and a simplified fair weather model for electrostatic stabilization is presented. G.R.

A73-12596 # **Dirigibles - Aerospace opportunities for the '70s and '80s.** F. Morse (Boston University, Boston, Mass.), G. J. O'Hara (U.S. Navy, Naval Research Laboratory, Washington, D.C.), J. G. Vaeth (NOAA, National Environmental Satellite Service, Washington, D.C.), V. H. Pavlecka, and K. R. Stehling. *Astronautics and Aeronautics,* vol. 10, Nov. 1972, p. 32-40. 17 refs.

The dirigible or rigid airship, a versatile and potentially ecologically 'clean' STOL with exceptional payload capability, endurance, range, flight stability, and onboard roominess, deserves renewed consideration as a useful vehicle in tomorrow's scheme of things. It is pointed out that great improvements can now be made in the structure of the rigid airship because computers and modern structural dynamics permit the analysis of the ship's structure as a whole. The history of dirigibles is reviewed and new advances for future airships are considered. An exciting picture emerges when nuclear power propels a lighter-than-air craft. Onboard radar would help avoid obstacles and detect other aircraft. It would examine the ground for accurate navigation, provide weather surveillance, and assist mast-approach control in poor visibility. G.R.

A73-12609 **Scattering of sound by an aerofoil of finite span in a compressible stream.** J. J. Adamczyk (United Aircraft Research Laboratories, East Hartford, Conn.) and R. S. Brand. *Journal of Sound and Vibration,* vol. 25, Nov. 8, 1972, p.139-156. 13 refs.

A73-12611 **Waveguides and rotating sources.** S. E. Wright (Southampton, University, Southampton, England). *(British Acoustical Society and American Society of Heating, Refrigeration and Air Conditioning Engineers, Symposium on the Acoustics of Flow Ducts, University of Southampton, Southampton, England, Jan. 10-14, 1972.) Journal of Sound and Vibration,* vol. 25, Nov. 8, 1972, p. 163-178. 16 refs.

The radiation properties of rotating sources radiating in free field and enclosed in a duct are compared. The relevance of making the comparison is in the understanding of acoustic sources produced by thrust devices; a distinction is required between free field rotors such as propeller and helicopter rotors and ducted rotors such as fans and gas turbine compressors. The source mechanisms are similar in each case, only the character is different depending on the rotor geometry and operating conditions. The purpose of this paper is therefore to consider what part the duct plays in the radiation process. A ray model is used to illustrate the differences between free field and ducted rotors for both hard and soft walls and for flow and no-flow conditions. (Author)

A73-12645 **Evaluation of the method of characteristics applied to a pressure transient analysis of the B.A.C./S.N.I.A.S. Concorde refuelling system.** T. J. Doyle (British Aircraft Corp., Ltd., Commercial Aircraft Div., Filton, Bristol, England) and J. A. Swaffield (Polytechnic of the South Bank, London, England). *Institution of Mechanical Engineers, Proceedings,* vol. 186, no. 40, 1972, p. 509-518. 9 refs. Research supported by the Science Research Council.

The pressure transient analysis of the Concorde refuelling system is designed to predict pressure variation within the aircraft system during tank inlet valve closure on completion of refuelling and during an emergency isolation of the aircraft system from the refuelling supply. The comparison between the predicted and observed pressure variations, recorded on a full scale fuel system test rig, was found to be at worst, within 10 per cent, during tank inlet valve closures, although the programme underestimated some peak pressures. Closer agreement was achieved during emergency system isolation. (Author)

A73-12647 **Experimental verification of a digital computer simulation method for predicting gas turbine dynamic behaviour.** A. J. Fawke (Gas Council, Newcastle-upon-Tyne, England), H. I. H. Saravanamuttoo (Carleton University, Ottawa, Canada), and M. Holmes (National Gas Turbine Establishment, Farnborough, Hants., England). *Institution of Mechanical Engineers, Proceedings,* vol. 186, no. 27, 1972, p. 323-329. 5 refs. Research supported by the Science Research Council.

Description of a mathematical model for simulation of the transient responses of a twin-spool gas turbine engine on a general purpose digital computer. A Rolls-Royce Olympus 320 engine was run on a test bed to validate this simulation by comparing the actual behavior of the engine with predictions by simulation. A control strategy was selected to satisfy the test requirements for a strictly controlled rate of change of the throttle angle and nozzle area. The digital control system included a speed governor, with integral and proportional compensation in the feed forward loop, to control high-pressure shaft speed by fuel flow variations. Good agreement was obtained between the simulated results and engine run results in all tests. The simulation technique is suggested with confidence for application. V.Z.

A73-12691 Study of the composition of inclusions in synthetic diamond crystals by microanalysis. G. N. Bezrukov, V. P. Butuzov, G. V. Khatelishvili, and D. B. Chernov. *(Akademiia Nauk SSSR, Doklady,* vol. 204, May 1, 1972, p. 84-87.) *Soviet Physics - Doklady,* vol. 17, Nov. 1972, p. 421-424. Translation.

A73-12792 Study of large output variations in subsonic centrifugal compressors (La recherche de grandes variations de débit dans les compresseurs centrifuges subsoniques). H. Hus and J. C. Festinger (SNECMA, Paris, France). *Entropie,* July-Aug. 1972, p. 26-34. In French. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

Review of the design and tests of a recently developed diffuser prototype having a wide range of adaptability. With this diffuser, the two functions of collection and diffusion of the gas discharged from the compressor impeller are performed by two distinct blade cascades. The separation of the collection and diffusion functions assigned to the diffuser of a subsonic centrifugal compressor is shown to make it possible to widen considerably the efficient operation range of compressor output variability. This solution has proved particularly advantageous for compressors operating at low pressure ratios. M.V.E.

A73-12793 Peripheral compressors (Les compresseurs périphériques). A. Verneau (Société Bertin et Cie., Paris, France). *Entropie,* July-Aug. 1972, p. 35-44. In French.

Discussion of the operational principle, theory, design, and performance of peripheral compressors. They are shown to be turbomachines of very low specific velocity and to occupy an intermediate position between centrifugal and volumetric compressors. Their principle of operation is based on the displacement of a blade cascade in an annular lateral channel. M.V.E.

A73-12845 * # **The NASA Quiet Engines.** C. C. Ciepluch (NASA, Lewis Research Center, Cleveland, Ohio). *Institute of Noise Control Engineering, International Conference on Noise Control Engineering, Washington, D.C., Oct. 4-6, 1972, Paper.* 11 p.

The present status of the Quiet Engine Program is reviewed, and the future prospects suggested by recent quiet engine test results are discussed. Following a brief survey of noise sources, quiet engine design features, and the major elements of the Quiet Engine Program, a review is presented of specific quiet engine test that includes the two baseline quiet engines tested and flyover noise comparison results. It is shown that the application to future aircraft of the developed and demonstrated engine noise reduction technology can bring about a substantial reduction in aircraft noise levels. The minimization of the economic penalty associated with this noise reduction technology is being studied. M.V.E.

A73-12848 * # **New technology in turbine aerodynamics.** A. J. Glassman and T. P. Moffitt (NASA, Lewis Research Center, Cleveland, Ohio). *Texas A & M University, Turbomachinery Symposium, College Station, Tex., Oct. 24-26, 1972, Paper.* 33 p.

Cursory review of some recent work that has been done in turbine aerodynamic research. Topics discussed include the aerodynamic effect of turbine coolant, high work-factor (ratio of stage work to square of blade speed) turbines, and computer methods for turbine design and performance prediction. Experimental cooled-turbine aerodynamics programs using two-dimensional cascades, full annular cascades, and cold rotating turbine stage tests are discussed with some typical results presented. Analytically predicted results for cooled blade performance are compared to experimental results. The problems and some of the current programs associated with the use of very high work factors for fan-drive turbines of high-bypass-ratio engines are discussed. Computer programs have been developed for turbine design-point performance, off-design performance, supersonic blade profile design, and the calculation of channel velocities for subsonic and transonic flowfields. The use of these programs for the design and analysis of axial and radial turbines is discussed. (Author)

STAR ENTRIES

N73-10001# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
WIND TUNNEL INVESTIGATION OF SIMULATED HOAR FROST ON A 2 DIMENSIONAL WING SECTION WITH AND WITHOUT HIGH LIFT DEVICES
Bjoern L. G. Ljungstroem Apr. 1972 32 p refs
(FFA-AU-902) Avail: NTIS HC $3.75

The effect of simulated hoar frost on the lift and drag characteristics of a two-dimensional wing section with and without high lift devices was investigated in a wind tunnel. Three wing configurations were tested. Three different grain size grinding papers were used to simulate hoar frost. The roughness was partly removed from the leading edge to simulate partial cleaning of the frost from the aircraft wing. It was determined that the maximum lift coefficient is very sensitive to distributed roughness for all three configurations. Author

N73-10002*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTIC OF A SWEPT-WING CRUISE MISSILE AT MACH NUMBERS FROM 0.50 TO 2.86
M. Leroy Spearman and Ida K. Collins Washington Nov. 1972 41 p
(NASA-TN-D-7069; L-8508) Avail: NTIS HC $3.00 CSCL 01A

An investigation has been made in the Mach number range from 0.50 to 2.86 to determine the longitudinal and lateral aerodynamic characteristics of a cruise missile having a 58 deg swept wing and conventional aft tails. Such a vehicle might be applicable to missions such as surface- or air-launched tactical or strategic missiles, unmanned reconnaissance, or countermeasure decoys. Author

N73-10004+ Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
FORCE MEASUREMENTS ON CARET AND DELTA WINGS AT HIGH INCIDENCE
G. T. Colemann Jul. 1972 28 p refs
(IC-Aero-72-16) Avail: NTIS HC $3.50

Comparative measurements were made on flat delta and caret wing models under high lift reentry conditions and compared with theoretical predictions for the normal force coefficient. Tests were carried out in the Imperial College No.2 gun tunnel at Mach 9 with nitrogen as the test gas. The distinct advantage of the caret wing over the incidence range was shown and good agreement was found between the data and Squire's theoretical curve for the caret wing. Author (ESRO)

N73-10005# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
CALCULATIONS OF THE STEADY CONICAL FLOW PAST A YAWED SLENDER DELTA WING WITH LEADING EDGE SEPARATION
D. I. Pullin Jul. 1972 73 p refs Sponsored by Sydney Univ.
(IC-Aero-72-17) Avail: NTIS HC $5.75

The Mangler and Smith vortex-sheet model of leading-edge separation is extended to the calculation of steady conical flow past a yawed slender delta wing. A Newton-Raphson iterative procedure is then used to solve the resulting set of nonlinear algebraic equations for a range of values of the incidence and yaw parameters. From the solutions, predictions are obtained for the positions of the vortex core centers and the leeward and windward separation systems; for the wing surface pressure distribution and the normal-force and rolling moment coefficient. Comparison of the variation of these quantities with incidence and yaw parameters with experimental data is fair, differences being attributed to the neglect of the secondary separation of the windward side of the wing. At lower value of the incidence parameter the Newton-Raphson procedure failed to yield solutions of the equations. Author (ESRO)

N73-10006# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Theoretische Aerodynamik.
EXPERIMENTAL INVESTIGATIONS OF THE LINEAR AND NONLINEAR PARTS OF THE AERODYNAMIC COEFFICIENTS OF A SLENDER BODY IN SUPERSONIC FLOW [EXPERIMENTELLE UNTERSUCHUNGEN UEBER DIE LINEAREN UND NICHTLINEAREN ANTEILE DER AERODYNAMISCHEN BEIWERTE EINES SCHLANKEN RUMPFES BEI UEBERSCHALLANSTROEMUNG]
Hans Koester Jun. 1972 59 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-42) Avail: NTIS HC $5.00; DFVLR, Porz 14,50 DM

An analysis is given of the aerodynamic coefficients of a slender body of revolution, the cross section distribution of which is optimized for minimum wave drag at zero incidence. The tests were carried out in a supersonic wind tunnel in the Mach number range 1.5 to 4. The results presented show the influence of incidence on the pressure distribution. The comparison of the results between force and pressure measurements shows good agreement for the linear contributions of the lift and pitching moment, whereas their nonlinear contributions and the values of the drag partly differ from each other. Author (ESRO)

N73-10007# Yale Univ., New Haven, Conn. Becton Center.
IDENTIFICATION AND OPTIMIZATION OF AIRCRAFT DYNAMICS
Kumpati S. Narendra and Shiva S. Tripathi Jul. 1972 30 p refs
(Contract N00014-67-A-0097-0020; NR Proj. 375-131)
(AD-746492; CT-50) Avail: NTIS CSCL 01/3

A technique is described for the design of an adaptive controller for multivariable systems and is based on recently developed methods for identification and optimization. An application of the method to a helicopter system with time-varying parameters is considered in detail. The response of the adaptive system is compared with the corresponding response of a system with a fixed controller and a system using optimal control. The comparison reveals the almost optimal character of the adaptive system. Author (GRA)

N73-10008# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.
CALCULATION OF THE LIFT ON AIRFOILS WITH SEPARATED BOUNDARY LAYERS
Nathan Ness, Edward H. Gibbs, and Wen-An Peter Tseng May 1972 108 p
(Contract N00014-68-A-0512; NR Proj. 215-163)
(AD-746505; TR-31) Avail: NTIS CSCL 20/4

The report contains a method for calculating the sectional lift coefficient Cl as a function of its angle of attack alpha and free stream Reynolds number Re even at large angles of attack beyond the maximum Cl. The results of the present theory are in agreement with all known experimental data, that is, (1) the theory shows that Cl increases with alpha until stall and then decreases as alpha is increased still further (keeping Re constant), (2) the theory shows that the Reynolds number effect on Cl versus alpha is insignificant at the lower angles of attack but becomes more pronounced near and beyond the stall where viscous effects and flow separation are more important, (3) the theory shows that Cl increases with Re at constant (high) values of alpha. Author (GRA)

N73-10009 Engineering Sciences Data Unit, London (England).
TITLES, 1972
1972 28 p refs
Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The titles of all Data Items issued by ESDU to the end of 1971 are listed with their date of issue and latest amendment. Items in aerodynamics, fatigue, performance, structures, and transonic aerodynamics are included. F.O.S.

N73-10010# Technische Hogeschool, Delft (Netherlands).
ANALYSIS OF DYNAMIC AIRCRAFT LANDING LOADS, AND A PROPOSAL FOR RATIONAL DESIGN LANDING LOAD REQUIREMENTS Ph.D. Thesis
Jacob Ijff 27 Jun. 1972 175 p refs
Avail: NTIS HC $10.75

The formulation of requirements for safety is investigated in designing the main landing gears to withstand design loads due to landing impacts. The physical phenomena involved in a landing impact are described along with the existing design requirements. A survey of literature, the equations for calculating wing loads, and the influence of aerodynamic variables on landing impact loads are discussed. A summary of the results is included. F.O.S.

N73-10011*# Systems Control, Inc., Palo Alto, Calif.
ANALYSIS OF INSTRUMENTATION ERROR EFFECTS ON THE IDENTIFICATION ACCURACY OF AIRCRAFT PARAMETERS Final Technical Report
John A. Sorensen May 1972 105 p refs
(Contract NAS1-10791)
(NASA-CR-112121) Avail: NTIS HC $7.25 CSCL 01B

An analytical investigation is reported 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. Output error identification algorithms that tend to minimize quadratic functions of the difference between actual and modeled aircraft trajectory measurements are studied. 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. Author

N73-10012*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SYMPOSIUM ON VEHICLE RIDE QUALITY
Washington Oct. 1972 256 p refs Symp. held at Hampton, Va., 6-7 Jul. 1972
(NASA-TM-X-2620; L-8496) Avail: NTIS HC $3.00 CSCL 01A

The proceedings of a conference on ride-quality technology in the United States is presented. Emphasis is directed toward criteria for passenger air travel. Information on ground and water modes of transportation is included. The subjects involve the present state of knowledge, results of various studies including people, vehicles, and simulators. Mechanisms underlying motion discomfort are examined.

N73-10013* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RIDE QUALITY OVERVIEW
Ralph W. Stone, Jr. *In its* Symp. on Vehicle Ride Quality Oct. 1972 p 1-22 refs
CSCL 01A

An analysis of the factors which affect riding comfort in various modes of transportation is presented. The subjects discussed are: (1) human factor elements in ride quality, (2) current knowledge of flight dynamics and relation to passenger acceptance, (3) study requirements for human factors in ride quality, and (4) possible criteria for human factor in ride quality. Author

N73-10014* Douglas Aircraft Co., Inc., Long Beach, Calif.
AN AIRCRAFT MANUFACTURER'S APPROACH TO RIDEABILITY CRITERIA
R. C. OMassey, H. Leve, and J. G. Gaume *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 23-49 refs
CSCL 01A

The approach of an aircraft manufacturer to ride quality in air transportation is presented. The subjects discussed are: (1) the external and internal environment in terms of vibration and acoustic sources and general response, (2) guidelines and criteria reflecting current practice, (3) present and future efforts to develop rideability criteria, and (4) requirements for data, criteria, and research in various rideability areas. Author

N73-10015* United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
RIDE QUALITY CRITERIA FOR LARGE COMMERCIAL HELICOPTERS
Ronald G. Schlegel, Allen M. Stave, and Alfred A. Wolf *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 51-66 refs
CSCL 01A

A review of major ride-quality criteria used in the design of commercial helicopters, some of the limitations of these criteria, research programs conducted to better define these criteria, and some recommended research programs is presented. Primary emphasis is given to the question of noise and vibration criteria for passenger acceptance and comfort. Author

N73-10016* Princeton Univ., N.J.
EXPLORATORY FLIGHT INVESTIGATION OF RIDE QUALITY IN SIMULATED STOL ENVIRONMENT
Edward Seckel and George E. Miller *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 67-89
CSCL 01A

A flight test experiment is described, in which various aspects of ride qualities were explored. Situations included simulated cruise and terminal area maneuvers, as might be typical of STOL transport operations. Various motion components were studied in isolation and in many combinations. The experiment included runs with and without turbulence, variations in airplane stability and handling qualities, and differences of pilot technique. The ride quality was strongly affected by roll, yaw, and heave motions; but very little by pitching. It was strongly affected by airplane stability and handling qualities and, in some cases, by piloting technique. Author

N73-10017* Boeing Co., Wichita, Kans.
TESTS AND ANALYSES APPLICABLE TO PASSENGER RIDE QUALITY OF LARGE TRANSPORT AIRCRAFT
Richard B. Holloway and Stanley H. Brumaghin *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 91-113 refs
CSCL 01A

A test program was undertaken to determine airline passenger reaction to vibration environments that might be encountered in a supersonic transport or other large commercial jet aircraft. The principal problem addressed was to determine accelerations of vertical and lateral vibration that people find objectionable. Further questions experimentally posed were: (1) what is the relationship between human reactions to vertical and lateral vibration, (2) to single- and combined-frequency vibration, and (3) to single- and combined-axis vibration? Interest was confined to reactions to vibration in the frequency range of 0.20 to 7.0 Hz, a range typical of the vibration environment of a large airplane. Results indicated an increasing sensitivity to vertical vibration as frequency was increased from 1.0 to 7.0 Hz. Subjects were

found most sensitive to lateral vibration in the 1.0 to 3.0 Hz range. There was a nearly linear decrease in sensitivity as frequency of lateral vibration was increased from 3.0 to 7.0 Hz. Author

N73-10018* United Aircraft Corp., East Hartford, Conn. Research Labs.
ANALYTICAL AND EXPERIMENTAL EVALUATION OF PROPOSED RIDE COMFORT CRITERIA
E. Wayne Vinje *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 115-141

CSCL 01A

An exploratory study was conducted to evaluate the effectiveness of indices proposed by different investigators to relate vehicle vibrations to passenger comfort. The indices considered included criteria for sinusoidal vibrations, unweighted and weighted amplitude exceedance counts, the integral of the unweighted and weighted power spectral density and absorbed power. These functions were initially examined analytically to determine the manner in which they each weighed vibration amplitude and frequency. Similarities among them are noted. Index values were then computed from measured vibrations and compared with the associated comfort ratings. The data for these comparisons were obtained from ride comfort evaluations of passenger trains. Author

N73-10019* Boeing Co., Philadelphia, Pa. Vertol Div.
HELICOPTER CREW/PASSENGER VIBRATION SENSITIVITY
Richard Gabel and Donald A. Reed *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 143-153 ref

CSCL 06S

Helicopter crew and passenger vibration sensitivity are presented. Pilot subjective ratings are established for discrete frequencies and the impact of combinations of harmonic frequencies is examined. A passenger long term comfort level and a short term limit are defined for discrete frequencies and compared with pilot ratings. The results show reasonable agreement between pilot and passenger. Subjective comfort levels obtained for mixed frequency environments clearly demonstrate the need for a multi-frequency criterion. Author

N73-10021* Aerospace Research Labs., Wright-Patterson AFB, Ohio.
RIDE EVALUATION IN AEROSPACE AND SURFACE VEHICLES
A. B. Broderson, H. E. VonGierke, and J. C. Guignard (Dayton Univ., Ohio) *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 175-196 refs

CSCL 01A

The vibration environment in a wide range of aerospace and surface vehicles is examined, and definitions related to ride evaluation are reviewed. Three provinces of research and application of ride data are recognized: (1) ride affecting passenger and operator comfort; (2) ride affecting human efficiency; and (3) ride affecting the health and safety of occupants occupationally or repeatedly exposed. Specific reference is made to the proposed ISO guide on human exposure to whole-body vibration. The applications as well as the advantages and limitations of this guide for evaluating vehicle ride are discussed. The derivation of the limits is reviewed with regard to the supporting data and the compromises necessary for wide applicability. Special discussions are included of the frequency and time dependence of these limits and approaches in progress for adjusting them according to different criteria of application. Author

N73-10023* Virginia Univ., Charlottesville. Center for Application of Science and Engineering to Public Affairs.
INVESTIGATION OF TRAVELER ACCEPTANCE FACTORS IN SHORT HAUL AIR CARRIER OPERATIONS
A. R. Kuhlthau and Ira D. Jacobson *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 211-228 refs

CSCL 05E

The development of a mathematical model for human reaction to variables involved in transportation systems is discussed. The techniques, activities, and results related to defining certain specific inputs to the model are presented. A general schematic diagram of the problem solution is developed. The application of the model to short haul air carrier operations is examined. Author

N73-10024* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RIDE QUALITY RESEARCH ACTIVITIES AT NASA LANGLEY RESEARCH CENTER
Andrew B. Connor, Hugh P. Bergeron, and W. Elliott Schoonover, Jr. *In its* Symp. on Vehicle Ride Quality Oct. 1972 p 229-246 refs

CSCL 05E

Ride quality research to determine criteria to describe vehicle performance characteristics which will insure passenger comfort is discussed. The manner in which disciplines of vehicle environmental dynamics, structural dynamics, and electromechanical measurements are combined to define passenger environments is described. The activities of many governmental and private agencies in the field of passenger comfort are examined. Author

N73-10025* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
NASA RIDE QUALITY PROGRAM AT THE FLIGHT RESEARCH CENTER
Shu W. Gee and Thomas D. Wolf *In its* Symp. on Vehicle Ride Quality Oct. 1972 p 247-251

CSCL 01A

A flight test program to determine the effects of low frequency vibrations on passengers in short haul aircraft is discussed. The objective of the program is to accumulate flight test data on aircraft ride quality in terms of vehicle motion and acceleration and human responses. The subjects discussed are: (1) test procedures, (2) data processing, and (3) the program schedule. Author

N73-10026# Army Air Mobility Research and Development Lab., Fort Eustis, Va. Eustis Directorate.
EVALUATION OF THE EFFECTIVENESS OF USING SONIC DATA TO DIAGNOSE THE MECHANICAL CONDITION OF ARMY HELICOPTER POWER TRAIN COMPONENTS Final Report
G. William Hogg May 1972 102 p refs
(DA Proj. 1F1-62203-A-434)
(AD-745089; USAAMRDL-TR-72-30) Avail: NTIS CSCL 14/2

The report covers work performed during an in-house program to evaluate the effectiveness of using the sound emitted from helicopter power train components as a data source for diagnosing their mechanical condition. A ground-based UH-1 helicopter sonic analyzer developed by the Curtiss-Wright Corporation under Government contracts was used in the evaluation. Sound recordings were made on 87 UH-1 helicopters that had either the transmission or a gearbox scheduled for removal for routine overhaul. The mechanical condition of the components was then noted during the overhaul process, and then results were compared with the recorded signals in an attempt to correlate the mechanical condition with the acoustical signals. The sonic analysis procedures were then revised to improve the effectiveness of detecting component malfunctions. Author (GRA)

N73-10027*# Boeing Co., Wichita, Kans.
THE SIMULATION OF A JUMBO JET TRANSPORT AIRCRAFT. VOLUME 2: MODELING DATA
C. Rodney Hanke and Donald R. Nordwall Sep. 1970 506 p 2 Vol.
(Contract NAS2-5524)

(NASA-CR-114494; D6-30643-Vol-2) Avail: NTIS HC $27.50 CSCL 01B

The manned simulation of a large transport aircraft is described. Aircraft and systems data necessary to implement the mathematical model described in Volume I and a discussion of how these data are used in model are presented. The results of the real-time computations in the NASA Ames Research Center Flight Simulator for Advanced Aircraft are shown and compared to flight test data and to the results obtained in a training simulator known to be satisfactory. Author

N73-10028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYTIC PREDICTION OF AIRPLANE EQUILIBRIUM SPIN CHARACTERISTICS

William M. Adams, Jr. Washington Nov. 1972 40 p refs (NASA-TN-D-6926; L-8319) Avail: NTIS HC $3.00 CSCL 01B

The nonlinear equations of motion are solved algebraically for conditions for which an airplane is in an equilibrium spin. Constrained minimization techniques are employed in obtaining the solution. Linear characteristics of the airplane about the equilibrium points are also presented and their significance in identifying the stability characteristics of the equilibrium points is discussed. Computer time requirements are small making the method appear potentially applicable in airplane design. Results are obtained for several configurations and are compared with other analytic-numerical methods employed in spin prediction. Correlation with experimental results is discussed for one configuration for which a rather extensive data base was available. A need is indicated for higher Reynolds number data taken under conditions which more accurately simulate a spin. Author

N73-10029*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPARISON OF FLIGHT AND WIND TUNNEL MEASUREMENTS OF JET NOISE FOR THE XV-5B AIRCRAFT

Adolph Atencio, Jr., Jerry V. Kirk, Paul T. Soderman, and Leo P. Hall Oct. 1972 53 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab.

(NASA-TM-X-62182) Avail: NTIS HC $4.75 CSCL 01B

Wind tunnel tests to determine noise data from scale model research aircraft are discussed. Comparisons are made between data obtained in wind tunnels and results of full scale flight tests. The acoustic measurements for the XV-5B V/STOL fan research aircraft are presented. Author

N73-10030*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A LARGE SCALE MODEL WITH A SWEPT WING AND AUGMENTED JET FLAP IN GROUND EFFECT

Michael D. Falarski and David G. Koenig Oct. 1972 131 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.

(NASA-TM-X-62174) Avail: NTIS HC $8.75 CSCL 01B

The investigation of the in-ground-effect, longitudinal aerodynamic characteristics of a large scale swept augmentor wing model is presented, using 40 x 80 ft wind tunnel. The investigation was conducted at three ground heights; h/c equals 2.01, 1.61, and 1.34. The induced effect of underwing nacelles, was studied with two powered nacelle configurations. One configuration used four JT-15D turbofans while the other used two J-85 turbojet engines. Two conical nozzles on each J-85 were used to deflect the thrust at angles from 0 to 120 deg. Tests were also performed without nacelles to allow comparison with previous data from ground effect. Author

N73-10031*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DEPLOYABLE FLEXIBLE VENTRAL FINS FOR USE AS AN EMERGENCY SPIN RECOVERY DEVICE IN AIRCRAFT Patent Application

Sanger M. Burk, Jr., inventor (to NASA) Filed 14 Sep. 1972 14 p

(NASA-Case-LAR-10753-1; US-Patent-Appl-SN-289018) Avail: NTIS HC $3.00 CSCL 01B

A flexible fin device for mounting on an aircraft to effect spin recovery is described. The device may be selectively deployed to provide a triangular planform of flexible material to provide spin recovery, and retracted for compact storage during nonuse. A single flexible fin may be deflected in a specific direction depending on direction of spin rotation, or two flexible fins forming an inverted V configuration may be used according to the invention. The device may be mounted on the underbody of the aircraft. NASA

N73-10033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUMMARY OF DIRECTIONAL DIVERGENCE CHARACTERISTICS OF SEVERAL HIGH PERFORMANCE AIRCRAFT CONFIGURATIONS

H. Douglas Greer Washington Nov. 1972 63 p refs (NASA-TN-D-6993; L-8489) Avail: NTIS HC $3.00 CSCL 01B

The present paper summarizes the high-angle-of-attack characteristics of a number of high-performance aircraft as determined from model force tests and free-flight model tests and correlates these characteristics with the dynamic directional-stability parameter. This correlation shows that the dynamic directional-stability parameter correlates fairly well with directional divergence. Data are also presented to show the effect of some airframe modifications on the directional divergence potential of the configuration. These results show that leading-edge slates seem to be the most effective airframe modification for reducing or eliminating the directional divergence potential of aircraft with moderately swept wings. Author

N73-10034*# Scientific Translation Service, Santa Barbara, Calif.

LATEST CIVILIAN V/STOL AIRCRAFT PROJECTS OF HAWKER SIDDELEY AVIATION, CONTINUATION FROM FR6/71

T. K. Szlenkier Washington NASA Nov. 1972 22 p Transl. into ENGLISH from Flug-Rev. Int. (West Germany), Jul. 1971 p 35-38 and 43-46

(Contract NASw-2035)

(NASA-TT-F-14629) Avail: NTIS HC $3.25 CSCL 01B

The latest civilian V/STOL aircraft are examined. It is found that such aircraft are more economical and convenient in short air flights, require lower capital investments compared with other systems, and have less influence on the environment. Author

N73-10035# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

AERODYNAMICS OF WING-SLIPSTREAM INTERACTION: A NUMERICAL STUDY

N. D. Ellis Sep. 1971 92 p refs

(Grant AF-AFOSR-1885-70; AF Proj. 9781)

(AD-743257; UTIAS-169; AFOSR-71-3086TR) Avail: NTIS CSCL 01/1

A fundamental theory of wing-slipstream interaction accounts for slipstreams of arbitrary cross-section by means of vortex sheaths. These sheaths together with the wing circulation pattern are dictated by the boundary conditions; the analysis leads to simultaneous integral equations for their determination. In a multiple lifting line approximation these are ultimately reduced to simultaneous linear algebraic equations for machine inversion. Programs for digital computer have been developed for the case of round slipstreams distributed with lateral symmetry on a rectangular wing. Author (GRA)

N73-10036# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

AIRDROP SYSTEM COMPONENTS Final Report

20 Apr. 1972 65 p refs

(AD-744811; MTP-7-2-510) Avail: NTIS CSCL 14/2

The objective of this Materiel Test Procedure is to describe the engineering procedures required to determine the operational suitability of various airdrop system components including parachutes, platforms, harness and hardware. Author (GRA)

N73-10037# Naval Postgraduate School, Monterey, Calif.
AN EVALUATION OF THE LONGITUDINAL DYNAMIC STABILITY OF AN AIRCRAFT AT STALL M.S. Thesis
John Thomas Frederiksen Jun. 1972 74 p refs
(AD-745557) Avail: NTIS CSCL 01/3

The longitudinal stability of an aircraft at or near stall was examined using the digital computer as an experimental tool to solve the longitudinal equations of motion. A linear analysis determined the effect of lift curve slope variation. An investigation was made to identify the nonlinear lift curve variations needed to create the often observed rocking-chair or porpoising stall trait. The characteristics of this limit-cycle oscillation were examined. Author (GRA)

N73-10038# Naval Postgraduate School, Monterey, Calif.
EVALUATION OF MINIMUM AIRCRAFT FLYING SPEED BY DIGITAL SIMULATION M.S. Thesis
Carlton Wayne Saul Jun. 1972 73 p refs
(AD-745861) Avail: NTIS CSCL 01/2

Aircraft minimum flying speed, as determined by actual flight test, is published in aircraft handbooks for pilot guidance. The test flight results are used to determine and confirm take-off and landing speeds, field lengths, left-hand portion of the maneuvering envelopes (V-n diagram), etc. Determination of the absolute minimum flying speed of an aircraft on the other hand, has not been of prime importance in flight test. In the present analysis digital simulation allowed by systematic study of not only the minimum flying speed as defined by Federal Aviation Regulations but also the absolute minimum flying speed attainable in steady, unaccelerated flight. The study included such effects as deceleration rate, rate of change of elevator angle, aircraft weight and pitch moment of inertia. Author (GRA)

N73-10039# Naval Postgraduate School, Monterey, Calif.
A GUIDE TO AND AN ABSTRACTED BIBLIOGRAPHY OF AIRCRAFT SIDE ARM CONTROL STICK RESEARCH M.S. Thesis
Norio Bruce Endo Jun. 1972 44 p refs
(AD-745863) Avail: NTIS CSCL 01/3

An expanding interest at the Naval Postgraduate School, Monterey, California, in research work on aircraft side-arm control sticks has necessitated the determination of the previous and ongoing projects involved with the development of side-arm control sticks. This paper presents a survey of the English language literature dealing with aircraft control sticks over the period of 1936 to 1971. The result of the survey is an abstracted bibliography of significant literature related to the design and testing of aircraft control sticks and a guide to the literature. Author (GRA)

N73-10040# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
BRIEFS OF ACCIDENTS INVOLVING CORPORATE/EXECUTIVE AIRCRAFT: US GENERAL AVIATION, 1970
1972 56 p
(PB-210247; NTSB-AMM-72-5) Avail: NTIS HC $3.00 CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving corporate executive aircraft during 1970. Author (GRA)

N73-10041# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.
INTEGRATED INFORMATION PRESENTATION AND CONTROL SYSTEM STUDY. VOLUME 3: DEGRADED MODE ANALYSIS Final Report, Jun. 1970 - Mar. 1971
S. J. Premselaar, J. F. Hatcher, R. L. Richardson, R. L. Kinnamen, and W. D. Smith Jun. 1971 162 p refs
(Contract F33615-70-C-1832; AF Proj. 6190)
(AD-740435; AFFDL-TR-70-79-Vol-3) Avail: NTIS CSCL 01/3

Integrated Information Presentation and Control System (IIPACS-1) was selected as the baseline configuration for systematic degraded mode analyses. The cockpit concept was evaluated subjectively and by means of a computerized workload analysis. The results of the analyses and evaluations, conducted to determine the control and display requirements for contingency operations, are reported. Author (GRA)

N73-10042# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
TAKEOFF AND LANDING ANALYSIS (TOLA) COMPUTER PROGRAM. PART 1: CAPABILITIES OF THE TAKEOFF AND LANDING ANALYSIS COMPUTER PROGRAM
Urban H. D. Lynch Feb. 1972 50 p refs
(AF Proj. 1431)
(AD-741942; AFFDL-TR-71-155-Pt-1) Avail: NTIS CSCL 01/2

The program provides a complete simulation of the aircraft takeoff and landing problem. Effects simulated in the program include: aircraft control and performance during glide slope, flare, landing roll, and takeoff roll, all under conditions of changing winds, engine failures, brake failures, control system failures, strut failures, runway length and control variable limits, and time lags; landing gear loads and dynamics for aircraft with up to five gears; multiple engine aircraft; engine reversing; drag chute and spoiler effects; braking; aerodynamic ground effect; takeoff from aircraft carriers; and inclined runways and runway perturbations. The program is modular so that glide slope, flare, landing, and takeoff can be studied separately or in combination. Author (GRA)

N73-10043# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.
NINETEEN RULES FOR AVIONICS DESIGN ENGINEERS
Albert Goldman May 1972 12 p
(AD-746029; AFAL-TR-72-113) Avail: NTIS CSCL 09/3

Despite the use of integrated circuits, military avionics equipment has increased in cost and complexity, so that acceptable reliability is still a problem. As an aid to designers of avionics subsystems, nineteen rules for assuring reliable products and avoiding possible pitfalls in test and evaluation activities are presented. Author (GRA)

N73-10044# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF PILOTED WEAPON DELIVERY: STRAFING PERFORMANCE OF A FOREIGN AIRCRAFT M.S. Thesis
William P. Hartmann Jun. 1972 75 p refs
(AD-745997; GGC/EE/72-4) Avail: NTIS CSCL 01/3

In order to determine whether the weapon delivery accuracy of an aircraft for which the aerodynamic stability derivatives were not known could be estimated, the strafing performance of an unspecified foreign tactical fighter was analyzed. The stability derivatives were estimated from the physical characteristics of the aircraft using standard stability and control methods. Also, by the use of classical control theory, the probable control system of the aircraft was formulated. Then, with an analytical pilot model in the aircraft's control loop, the tracking error was estimated and combined with other pilot-induced errors in a statistical model which predicts impact errors. Author (GRA)

N73-10046# Transportation Systems Center, Cambridge, Mass.
THE CALCULATION OF AIRCRAFT COLLISION PROBABILITIES Technical Report, 1971
Juan F. Bellantoni Oct. 1971 43 p refs
(AD-744722; DOT-TSC-FAA-71-27) Avail: NTIS CSCL 01/2

The paper extends the statistical-probabilistic method of collision probability calculation, which has been limited to parallel, straight line flight paths, to arbitrary flight paths and vehicle shapes. The general formula is specialized to the cases of large relative velocity, non-zero relative velocity, zero relative velocity, and spherical collision surface. The formulas are applied to independent curved landing approaches to parallel runways. Author (GRA)

N73-10047# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDY OF IMPULSIVE SOUND GENERATED BY ROTOR TIPS ACCELERATING NEAR THE SONIC SPEED Final Report, 25 Jun. 1969 - 24 Jun. 1971
Richard H. Lyon 30 Jun. 1972 6 p refs
(Contract DAHC04-69-C-0085)
(AD-746287; AROD-8705-2-E) Avail: NTIS CSCL 20/1

The report describes findings resulting from a continuing study of helicopter rotor generated noise. Noise reduction efforts are presented. GRA

N73-10049# Aeronautical Research Labs., Melbourne (Australia).
A dc TO dc CONVERTER POWER SUPPLY FOR AIRCRAFT DATA ACQUISITION SYSTEM TIME DISPLAY
V. R. Krieser Jan. 1972 24 p refs
(ARL/ME-Note-332) Avail: NTIS HC $3.25

A power supply was designed for use with a time-of-day display unit which forms part of an airborne data logger. To avoid the introduction of ground loop noise voltages the display is powered from the aircraft dc supply via a dc to dc converter of high effeciency. The design and operation of the power supply are described along with a performance evaluation of the assembled unit. Author

N73-10055# Army Foreign Science and Technology Center, Charlottesville, Va.
APPLICATIONS OF AIRCRAFT GAS TURBINE ENGINES IN INDUSTRIAL POWER PLANTS
V. Kh. Vyants 3 Apr. 1972 11 p Transl. into ENGLISH from the book "Gazovye Turbiny" Moscow, 1971 p 42-48
(AD-745832; FSTC-HT-23-1423-72) Avail: NTIS CSCL 10/2

Recently, a new branch of technology, based on the use of aircraft gas turbine engines in electric and transport power plants has been developed, using both new engines and those which have been run out for aviation purposes. The mass production of aviation engines is well tuned up in economically developed countries and their great reserve, especially at the low rate with which they are operated in industrial plants, conditions the technical and economic expedience of their use in this fashion. The basic advantages of installations with aircraft engines by comparison with specially created installations are given. Author (GRA)

N73-10242# Douglas Aircraft Co., Inc., Santa Monica, Calif.
INVESTIGATION OF AERODYNAMIC ANALYSIS PROBLEMS IN TRANSONIC MANEUVERING. VOLUME 2: AIRFOIL ANALYSIS COMPUTER PROGRAM Final Report, Jun. 1970 - Aug. 1971
Arvel E. Gentry Sep. 1971 310 p refs
(Contract N00014-70-C-0400; NR Proj. 212-199)
(AD-740124; MDC-J5264-02-Vol-2) Avail: NTIS CSCL 09/2

The report describes a computer program designed to facilitate the analysis of mono- and multi-element airfoils at subsonic flight conditions with attached flow. This program is a consolidation of several existing computer programs so that they are compatible, have standard interfaces, and operate together as one very large program. This program includes a potential flow analysis, supercritical pressure calculations, and boundary layer calculations using either a finite-difference method or an integral method. Application studies using this program are described in Volume 1 of this report. Author (GRA)

N73-10278# Aeronautical Research Inst. of Sweden, Stockholm.
A CROSS-FLEXURE STING AND MEASUREMENT OF DYNAMIC STABILITY DERIVATIVES OF TWO SCHEMATICAL MODELS AT M EQUALS 4 AND M EQUALS 7
Stig Lundgren 1972 33 p refs
(FFA-AU-637) Avail: NTIS HC $3.75

A cross-flexure sting for measurement of dynamic stability derivatives using free oscillation technique was built and shake-out tests on two schematic models were performed at Mach number 4 and 7. The models were slender bodies of revolutions with delta-wings. The wind tunnel tests were made at reduced frequencies between 0.006-0.017 using in part transient excitation and in part random excitation. The results from the two methods agreed, in those cases where they could be compared, within 15% in most cases but in one case not better than 25%. The accuracy of the transient data obtained in the tests was estimated to be better than 12% in most cases and 19% in some. Author

N73-10281# Pavement Safety Corp., Skokie, Ill.
RUNWAY FRICTION DATA FOR TEN CIVIL AIRPORTS AS MEASURED WITH A MU-METER AND DIAGONAL BRAKED VEHICLE Final Report, Nov. 1971 - Jul. 1972
Peter J. Nussbaum, William A. Hiering (Natl. Aviation Facilities Exptl. Center), and Charles R. Grisel (Natl. Aviation Facilities Exptl. Center) Jul. 1972 297 p refs Prepared in cooperation with Natl. Aviation Facilities Exptl. Center
(Contract DOT-FA72WA-2744; Proj.183-731-027/03x)
(PSC-107; FAA-RD-72-61) Avail: NTIS HC $17.00

Runway friction measurements were made on ten civil airports representative of large and medium hub airports. Wet and dry surface data were obtained with a Mu-Meter and FAA Diagonal Braked Vehicle. Pavements were wetted with sprinkler trucks. Water depth and friction data were time correlated. DBV data were normalized to 60 MPH and corrected for ambient temperature per NASA methods. Specialized supplementary equipment used and techniques and procedures developed to conduct the tests are described. Raw and processed data for each airport are tabulated in separate appendixes. Included are runway and airport traffic statistics and photographs of the pavements tested. A summary table of friction data is shown to facilitate review and analysis of information. Author

N73-10282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PREDICTION MODEL FOR LIFT-FAN SIMULATOR PERFORMANCE M.S. Thesis - Cleveland State Univ.
Joseph Alfred Yuska Aug. 1972 71 p refs
(NASA-TM-X-68788) Avail: NTIS HC $5.75 CSCL 14B

The performance characteristics of a model VTOL lift-fan simulator installed in a two-dimensional wing are presented. The lift-fan simulator consisted of a 15-inch diameter fan driven by a turbine contained in the fan hub. The performance of the lift-fan simulator was measured in two ways: (1) the calculated momentum thrust of the fan and turbine (total thrust loading), and (2) the axial-force measured on a load cell force balance (axial-force loading). Tests were conducted over a wide range of crossflow velocities, corrected tip speeds, and wing angle of attack. A prediction modeling technique was developed to help in analyzing the performance characteristics of lift-fan simulators. A multiple linear regression analysis technique is presented which calculates prediction model equations for the dependent variables. Author

N73-10291# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, CAMPBELL ARMY AIRFIELD, FORT CAMPBELL, KENTUCKY
P. J. Vedros and S. J. Alford Jun. 1972 23 p
(AD-743462; AEWES-Misc-Paper-S-72-19) Avail: NTIS CSCL 01/5

The purpose of the report is to present the results of an investigation performed at Campbell Army Airfield (CAAF) in April 1971. The inspection was limited to visual observations, and no tests were conducted on the existing runways and taxiways. Author (GRA)

N73-10292# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, FORT POLK ARMY AIRFIELD, FORT POLK, LOUISIANA

P. J. Vedros Jun. 1972 19 p ref
(AD-743858; AEWES-Misc-Paper-S-72-24) Avail: NTIS CSCL 01/5

The purpose of this report is to present the results of an investigation at Fort Polk Army Airfield (FPAA) in March 1971. The inspection was limited to visual observations and no tests were conducted on the existing runways and taxiways at that time. Author (GRA)

N73-10293# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, BUTTS ARMY AIRFIELD FORT CARSON, COLORADO
P. J. Vedros and R. D. Jackson Jun. 1972 16 p ref
(AD-743859; AEWES-Misc-Paper-S-72-26) Avail: NTIS CSCL 01/5

The purpose of this report is to present the results of an inspection performed at Butts Army Airfield (BAAF) in September 1971. The inspection was limited to visual observations, and no tests were conducted on any of the pavement facilities. Author (GRA)

N73-10294# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, FORNEY ARMY AIRFIELD, FORT LEONARD WOOD, MISSOURI
P. J. Vedros and R. D. Jackson Jun. 1972 14 p ref
(AD-743856; AEWES-Misc-Paper-S-72-22) Avail: NTIS CSCL 13/2

The purpose of the report is to present the results of an inspection performed at Forney Army Airfield (FAAF) in April 1971. The inspection was limited to visual observations, and no tests were conducted on any of the pavement facilities. A layout of the airfield is shown. Author (GRA)

N73-10295# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, REDSTONE ARMY AIRFIELD, HUNTSVILLE, ALABAMA
P. J. Vedros and S. J. Alford Jun. 1972 20 p ref
(AD-743857; AEWES-Misc-Paper-S-72-23) Avail: NTIS CSCL 13/2

The purpose of this report is to present the results of an investigation performed at Redstone Army Airfield (RAAF) in April 1971. The inspection was limited to visual observations, and no tests were conducted on the existing runway and taxiways. A layout of the airfield is shown. GRA

N73-10296# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, DAVISON ARMY AIRFIELD, FORT BELVOIR, VIRGINIA
P. J. Vedros and R. D. Jackson Jun. 1972 17 p
(AD-743463; AEWES-Misc-Paper-S-72-20) Avail: NTIS CSCL 01/5

The purpose of the report is to present the results of an inspection performed at Davison Army Airfield in August 1971. The inspection was limited to visual observations, and no tests were conducted on the existing runways and taxiways. Author (GRA)

N73-10450# Advisory Group for Aerospace Research and Development, Paris (France).
FLIGHT TEST INSTRUMENTATION
Sep. 1972 76 p refs Partly in ENGLISH and partly in FRENCH (AGARD-LS-50) Avail: NTIS HC $6.00

The impact of technological developments on improvements in the operating characteristics of flight test data systems is outlined. Special efforts were made to provide the non-engineer an outline of data acquisition/processing systems and capabilities, a look at mathematical techniques for extracting data from recorded information, and illustrate how these developments have influenced the design of flight test programs.

N73-10451 Boeing Co., Seattle, Wash. Commercial Airplane Group.
FLIGHT TEST INSTRUMENTATION SYSTEMS OF THE 70'S
Alex J. Ferkovich *In* AGARD Flight Test Instrumentation Sep. 1972 11 p

The projected equipment, techniques, and procedures used in research flight test instrumentation systems are outlined. The impact of new technology on complex aircraft systems is discussed. E.H.W.

N73-10452 Advisory Group for Aerospace Research and Development, Paris (France).
AIRBORNE DATA ACQUISITION AND PROCESSING SYSTEMS
Alain Klopfstein *In its* Flight Test Instrumentation Sep. 1972 12 p

The evolution of the in-flight measurement system concept from the mere compatibility of instruments to overall airborne data handling and processing is considered as well as its impact on system structure. Illustrations are given of various types of equipment and systems and of their utilisation according to particular requirements. Author

N73-10453 Royal Aeronautical Society, London (England).
GROUND HANDLING TECHNIQUES AND SYSTEMS
J. M. L. Thomas *In* AGARD Flight Test Instrumentation Sep. 1972 4 p

The processing of data from large civil aircraft, particularly data from the Concorde's digital recordings, is discussed. Data cover digital magnetic tape for quasi-static parameters, FM magnetic tape for dynamic parameters, and film and paper tape for take-off and landing measurements. E.H.W.

N73-10454 French Flight Test Center, Istres.
DYNAMIC DATA PROCESSING SYSTEMS
M. B. Pennacchioni *In* AGARD Flight Test Instrumentation Sep. 1972 18 p

An analysis was made of the systems used to measure in-flight, take-off runs, or landing data. Data are given for system flexibility, ease of pre- and post- processing, ease of communication between user and machine, bulk of system, and cost of using the system. Consideration is also given to measuring range, sensitivity, and accuracy of the system. E.H.W.

N73-10455 Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
THE ANALYSIS OF STEADY STATE AND RANDOM FLIGHT DATA
E. J. Durbin *In* AGARD Flight Test Instrumentation Sep. 1972 3 p

The functional dependence of test time of random and deterministic flight data analysis is investigated. The investigation covers test planning, instrumentation technology, and data analysis techniques. E.H.W.

N73-10456 Arizona State Univ., Tempe. Lab. for Measurement Systems Engineering.
A UNIFIED APPROACH TO HANDLING NOISE IN MEASURING SYSTEMS
Peter K. Stein *In* AGARD Flight Test Instrumentation Sep. 1972 11 p refs

A small portion of the new unified approach to the engineering of measuring systems is presented. The presentation and examples are selected to show the application of this approach to the determination, suppression, and documentation of noise levels in flight test measuring systems in which the initial measuring is of analog nature. A systematic methodology is developed for the determination and documentation of noise levels on any given test set-up, at any time, before, during or after a test, and without specific knowidedge of the environmental factors which cause these noise levels. A strong plea is made for the recognition of measurement systems engineering as a discipline in its own right, which can and must be incorporated into engineering curriculi. The unified approach is offered as a starting

point towards this end. The need for additional concept-research in this field is identified and the hope is expressed that united efforts among various nations will result in the production of measurement-oriented or measurement-conscious engineers of all disciplines and at all levels. Author

N73-10457 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
IMPACT OF NEW TECHNOLOGY AS ILLUSTRATED IN AN ADVANCED OPERATIONAL DATA SYSTEM
Josef Herrmann *In* AGARD Flight Test Instrumentation Sep. 1972 11 p

The impact of new technology in flight test instrumentation equipment is given for a comprehensive and advanced airborne data acquisition system and ground data processing station. This advanced operational data system is used for flight testing of the high performance MRCA aircraft involving several aircraft prototypes for different tasks at different test sites. Author

N73-10472*# Bowles Fluidics Corp., Silver Spring, Md.
DEVELOPMENT OF A THREE AXIS FLUIDIC AIRSPEED SENSOR Final Report
Vincent F. Neradka Aug. 1972 47 p refs
(Contract NAS1-11266)
(NASA-CR-112167; R-08-15-72) Avail: NTIS HC $4.50 CSCL 14B

A three axis fluidic airspeed sensor system has been fabricated and wind tunnel tested. The complete system consists of the fluidic sensor, air power supply and instrumentation and readout. The system is adapted to aircraft and requires only the standard aircraft 28V dc supply to function. Author

N73-10474# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Instrumentierung und Anthropotechnik.
ELECTRONIC AIRCRAFT DISPLAYS [ELEKTRONISCH ERZEUGTE INFORMATIONSDARSTELLUNG IN FLUGZEUGEN]
Ralf Beyer 1972 66 p refs In GERMAN; ENGLISH summary Sponsored by the Deut. Forschungsgemeinschaft
(DLR-FB-72-43) Avail: NTIS HC $5.50; DFVLR, Porz 15,50 DM

A survey of electronic cockpit displays is presented with particular emphasis on display requirements, technology, implementation, system integration, and assessment. The concepts of head-up, head-down and eyeglass displays are discussed in relation to human factors engineering. The technologies used in modern display devices, such as the CRT, shadow-mask tubes, chromatrons, color tubes with velocity modulated and intensity modulated beams, light-emitting diodes, electroluminescent readouts, laser readouts, liquid crystals, and plasma displays, are reviewed. The quality assessment is discussed based on instrument and pilot measurements. For further detailed evaluation it is necessary to use a display simulator. Author (ESRO)

N73-10481# Army Air Mobility Research and Development Lab., Fort Eustis, Va.
THE DEVELOPMENT OF A PROBE FOR MEASURING THREE DIMENSIONAL BOUNDARY LAYERS Final Report
Michael R. Smith, Charles B. Cliett, and William W. Livingston May 1972 56 p refs
(Contract DAAJ02-67-C-0016)
(AD-745215; AASE-72-57; USAAMRDL-TR-72-18) Avail: NTIS CSCL 14/2

A remotely operated boundary layer probe designed for use in three-dimensional boundary layer measurements has been developed. The probe is an adaptation of a Cobra probe. The probe has been used to measure three-dimensional boundary layer flow over a yawed wing. Design procedures and final configurations are described. The experimental investigation indicates that the probe is adequate for measuring steady, three-dimensional boundary layer profiles. Author (GRA)

N73-10483# Air Force Ballistic Missile Div., Patrick AFB, Fla.
DEVELOPMENT AND CALIBRATION OF MACH 1.5 SAND EROSION TEST APPARATUS Technical Report, Sep. 1966 - Apr. 1971
Dennis B. Pandy Mar. 1972 69 p refs
(AD-743309; AFAPL-TR-71-95) Avail: NTIS CSCL 14/2

Development of a Mach 1.5 Sand Erosion Test Apparatus is described. This rotating arm apparatus is designed to simulate the erosive environment which a turbine engine fan or compressor blade would see when operating with sand or dust ingestion. It will be used to evaluate the mechanisms of sand erosion and the relative erosion resistance of fan and compressor blade and coating materials at rotor tip speeds up to 1600 ft/sec. This report describes the design and development of the apparatus including the rotating arm, power train, test enclosure, and sand control system. Calibration and correlation experiments are also described. Author (GRA)

N73-10485# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION INTO THE CAUSES FOR THE SHORT LIFETIMES OF GEIGER-MULLER TUBES USED IN AIRCRAFT OIL GAUGING SYSTEMS M.S. Thesis
Dale E. Morin Jun. 1972 76 p refs
(AD-746267; GEP/PH/72-14) Avail: NTIS CSCL 18/4

The causes of failure of the G-M detectors used in the nucleonic oil gauging system of USAF aircraft are presented. Experimental tests performed on several tubes, in simulated aircraft environments, proved that the detectors fail because of a depletion of the halogen quench gas. A variety of surface analyses established that the halogen gas reacted with both the cathode and anode surfaces. On the cathode the halogen (bromine) attack was always co-located with lead deposits and the only known source of lead inside the counter is from the glass solder used as the tube sealant. Recommendations are made to increase the G-M tube longevity. Implementing these recommendations rzquire only minor modifications to the basic system.
Author (GRA)

N73-10519# Kaman Aerospace Corp., Bloomfield, Conn.
BOSSLER COUPLING EXPERIMENTAL FLIGHT TEST Final Report, 1 Jul. 1970 - 15 Feb. 1972
Robert B. Bossler, Jr. Mar. 1972 40 p refs
(Contract N00156-69-C-1316)
(AD-746502; R-981) Avail: NTIS CSCL 13/5

The Bossler coupling is a new flexible driveshaft coupling requiring experimental research to provide guidance for future design. Reported herein are bench tests of rotating driveshaft assemblies using Bossler couplings under combined speed, torque and misalignment, followed by an experimental flight test program in an HH-2D helicopter. The test driveshaft was designed to meet or exceed the capabilities of the existing main driveshaft on the Navy/Kaman HH-2D helicopter. Ten different couplings on two different driveshaft assemblies were bench tested under combined speed, torque and misalignment. Author (GRA)

N73-10617*# Northrop Services, Inc., Huntsville, Ala.
RUNWAY CROSSWINDS AND HEADWIND REVERSALS AT CAPE KENNEDY, FLORIDA
L. G. Lavdas Oct. 1972 51 p refs
(Contract NAS8-21810)
(NASA-CR-128995) Avail: NTIS HC $4.75 CSCL 04B

Ground level hourly peak-wind data at Cape Kennedy have been used to determine an optimal runway orientation for minimizing the frequency of critically high crosswinds. The optimum runway orientation has been found to be close to the 155 to 335 degree orientation of the proposed runway for the range of critical crosswinds considered. This proposed runway orientation was used in determining the frequency of one hour headwind to tailwind reversals resulting in critically high tailwind speeds from ground level hourly peak wind data. These reversal frequencies have been calculated for each hour period within each month. The overall frequency of a headwind to tailwind

reversal of any magnitude has been found to be just under ten percent. Considerable diurnal and monthly variations in the frequencies of reversal have been found. Errors in both the crosswind and reversal studies have arisen from computational and statistical imperfections. The nonrepresentativeness of surface hourly peak wind data as related to the problems associated with the landing operations of the space shuttle has been duly noted. Author

N73-10623# Air Weather Service, Scott AFB, Ill.
AIRCRAFT ICING CLIMATOLOGY FOR THE NORTHERN HEMISPHERE
Edward D. Heath and Luther M. Cantrell Jun. 1972 76 p *refs*
(AD-745098; AWS-TS-220) Avail: NTIS CSCL 04/2

The report is an update of the methodology used within the Air Weather Service to determine the climatological probability of aircraft icing throughout the Northern Hemisphere. It presents isopleth charts of the 1000-, 850-, 700-, and 500-mb surfaces for each of the twelve months. A station listing and locator chart gives the extensive areal coverage of the data used in the computerized calculations. Author (GRA)

N73-10629# Army Electronics Command, White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
FOGWASH 1, AN EXPERIMENT USING HELICOPTER DOWNWASH
D. H. Dickson Apr. 1972 59 p refs
(DA Proj. 1T0-62111-A-126)
(AD-744471; ECOM-5431) Avail: NTIS CSCL 04/2

The report documents Project Fogwash 1, an experimental program in which the technique of helicopter downwash for fog dissipation was used. Meteorological and microphysical data collected during the experiment are presented. Meteorological data indicated an improvement in visibility as a result of the downwash. *There were indications in the microphysical data* obtained that particulate number varies directly as relative humidity and inversely as temperature and that sulfate particles increase with increased relative humidity. Author (GRA)

N73-10641# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
ATMOSPHERIC TURBULENCE FIELD PARAMETERS DETERMINATION Final Report
Robert L. Neulieb, Jan N. Garrison, and Dennis J. Golden Apr. 1972 52 p refs
(AF Proj. 1367)
(AD-745946; AFFDL-TR-72-57) Avail: NTIS CSCL 04/1

A Newton-Raphson least squares percentage error method is developed for the determination of atmospheric turbulence field parameters. A correction function is proposed to deemphasize the effects of data points with low statistical confidence. The method is used on various sets of LO-LOCAT data to demonstrate the excellence of the curve fits obtained. Comparisons are made with other curve fits found in the literature. It is *recommended that this method be adopted as the standard method* for the determination of atmospheric turbulence field parameters. Author (GRA)

N73-10645# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATC SURVEILLANCE/COMMUNICATION ANALYSIS AND PLANNING Quarterly Technical Summary, 1 Jun. - 31 Aug. 1972
1 Sep. 1972 35 p refs
(Contracts F19628-70-C-0230; DOT-FA72WAI-242; Proj. 034-241-012)
(FAA-RD-72-107) Avail: NTIS HC $3.75

FAA funded ATC Surveillance/Communication Analysis and Planning activities during the period 1 June to 31 August 1972 are reported. Surveillance studies bearing upon possible courses of action to improve the performance of the present ATCRBS equipment and to equip present ARSR/ASR radars with state-of-the-art clutter reduction capability are discussed. An improved surveillance radar concept is formulated, and plans to implement this radar in a demonstration model are described. Communication studies just getting under way are outlined. Two preliminary flight tests performed to validate procedural and data reduction plans for the ATCRBS transponder switched antenna tests are described. Author

N73-10646# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SURVEILLANCE ASPECTS OF THE ADVANCED AIR TRAFFIC MANAGEMENT SYSTEM Project Report, Oct. 1971 - Jun. 1972
K. S. Schneider, I. G. Stiglitz, and A. E. Eckberg 22 Jun. 1972 219 p refs
(Contract DOT-TSC-241)
(PB-210378; ATC-10) Avail: NTIS HC $3.00 CSCL 17G

Three topics with impact on the performance of Air-to-Satellite-to-Ground Systems for Air Traffic Control Surveillance are addressed in detail: (1) vulnerability to intentional jamming, (2) performance degradation due to the multiple access noise which results from uncoordinated aircraft transmissions, and (3) tracking techniques for improved surveillance accuracy and reduced short-term outages. Author (GRA)

N73-10647# Transportation Systems Center, Cambridge, Mass.
PROPOSED CONTROL TOWER AND COCKPIT VISIBILITY READOUTS BASED ON AN AIRPORT-AIRCRAFT INFORMATION FLOW SYSTEM
Hector C. Ingrao and J. R. Lifsitz Jul. 1971 46 p refs
(AD-744718; DOT-TSC-FAA-71-18) Avail: NTIS CSCL 17/7

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

N73-10648# Transportation Systems Center, Cambridge, Mass.
KEYBOARD AND MESSAGE EVALUATION FOR COCKPIT INPUT DATA LINK
E. H. Hilborn Oct. 1971 48 p refs
(AD-744721; DOT-TSC-FAA-71-21) Avail: NTIS CSCL 17/7

The project studied some methods for implementation of the man-machine interface of Digital Data Link for Air Traffic Control. An analysis of information transfer requirements indicated that a vocabulary of less than 200 words could yield meaningful messages for all routine ATC transactions. Keyboard configurations suitable for one-handed operation to yield alphanumeric outputs were studied and a ten-key character selection layout based upon sequential keying of the first two letters of the phonetic alphabet was developed. Author (GRA)

N73-10671# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
HUD NOISE ASSESSMENT GUIDELINES TECHNICAL BACKGROUND (TECHNICAL BACKGROUND FOR NOISE ABATEMENT IN HUD'S OPERATING PROGRAMS) Final Report
Theodore J. Schultz Dec. 1971 264 p refs
(PB-210591; BBN-2005R) Avail: NTIS HC $4.00; SOD HC $2.00 as 2300-0190 CSCL 13M

Discussions on the need for noise abatement, the various techniques for measuring and describing noise and human responses to it along with inter-rating comparisons are presented. Criteria of acceptability are discussed along with summaries of existing legislation and recommendations in foreign countries and the United States. The technical background information for the development of site noise assessment techniques is given. Author (GRA)

N73-10672# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
HUD NOISE ASSESSMENT GUIDELINES Final Report
Theodore J. Schultz and Nancy M. McMahon Aug. 1971 36 p (Contract HUD-H-1498)
(PB-210590; BBN-2176; HUD-TE/NA-171) Avail: NTIS HC $2.70; SOD HC $0.70 as 2300-1194 CSCL 13B

An outline is made of the procedures that can be used by persons who do not have technical training in acoustics for making assessments of present and predicted noise exposure at sites proposed for new residential construction. Determinations are based upon noise produced by various transportation modes. Sophisticated acoustical measurement equipment is not required of the user. Author (GRA)

N73-10748# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
INVESTIGATIONS OF THE IGNITION AND FLAME STABILIZATION IN A RAMJET ENGINE [VERSUCHE ZUR ZUENDUNG UND FLAMMENSTABILISIERUNG IN EINEM STAUSTRAHLTRIEBWERK]
Reiner Lindemann Jun. 1972 25 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-47) Avail: NTIS HC $3.25; DFVLR, Porz: 8.50 DM

Tests were carried out in the DFVLR propulsion wind tunnel in which a kerosene ramjet was ignited by the jet of an integrated gas generator using different combustion chamber configurations. A hot gas jet of sufficient performance will affect combustion in the chamber in such a way that flameholder elements could be diminished or omitted. The chamber structure may be reduced and the resulting lower amount of chamber pressure loss may increase engine performance. The first results show a broadening of the smooth burning range. Author (ESRO)

N73-10749# Army Logistics Management Center, Fort Lee, Va.
DOD AIRCRAFT ENGINE REQUIREMENTS STUDY Final Report
W. Karl Kruse Mar. 1972 45 p refs
(AD-745396) Avail: NTIS CSCL 21/5

The report investigates two questions posed by the DOD task group on aircraft engine requirements. The first question concerned whether the Poisson distribution as used by the DOD stockage methodology was valid. Analysis of Air Force removal data indicated that it is not. The second question was whether a better stockage computation methodology than the DOD methodology existed. While no definite conclusion could be drawn, attempts to answer the question indicated the importance of recognizing and accounting for forecast error in the methodology. Author (GRA)

N73-10750# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
A REVIEW OF CURRENT AND PROJECTED ASPECTS OF TURBINE ENGINE PERFORMANCE EVALUATION Technical Report, Jul. 1968 - Dec. 1970
Robert J. May, Jr., Barry J. Brownstein, Stephen J. Przybylko, Richard L. McTasney, and Anthony T. Molisse Feb. 1972 117 p refs
(AF Proj. 3066)
(AD-744587; AFAPL-TR-71-34) Avail: NTIS CSCL 21/5

The report is a compilation of four separate papers which, in total, represent a survey of several important aspects of turbine engine performance analysis. The first paper describes a digital computer method which has become a powerful tool for simulation of steady-state engine operation. A discussion of inlet airflow distortion is the topic of the second paper. It elaborates on a theory of rotating stall generation and a unique method which was encountered for determining how this distortion propagates through the compression components and produces surge. The third paper addresses the problems associated with the engine control system and the techniques for computer simulation of transient engine operation. A discussion of the performance predictions of complex multimission aircraft weapon systems comprise the final section of this technical report. Author (GRA)

N73-10752# Army Air Mobility Research and Development Lab., Fort Eustis, Va. Eustis Directorate.
STATIC, BALLISTIC, AND IMPACT BEHAVIOR OF GLASS/GRAPHITE DRIVE SHAFTING
I. E. Figge, Sr. Jun. 1972 20 p refs
(AD-743938; USAAMRDL-TM-1) Avail: NTIS CSCL 21/5

Limited static tests on damaged scale-model HLH 4.5-inch-diameter plus or minus 45 degrees glass/plus or minus 5 degrees graphite drive shaft sections at 150F indicated that the shafts are not capable of meeting the design requirement of the HLH. Low-energy impacts (ball drops) produced catastrophic brittle failure of the graphite material. Ballistic damage was localized to the impact area but resulted in a strength reduction factor of approximately 1.75. Author (GRA)

N73-10753# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF THE DETECTION OF CHARGED METAL PARTICLES IN A JET ENGINE EXHAUST BY A CYLINDRICAL ELECTROSTATIC PROBE M.S. Thesis
Ray W. Burgess, Jr. Jun. 1972 86 p refs
(AD-745540; GEP/PH/72-2) Avail: NTIS CSCL 21/5

Charged particle detection by an electrostatic probe in a jet engine is studied from both a theoretical and an experimental approach. The charging mechanisms for a metal particle in a jet engine exhaust are presented and discussed. A theory for the waveshape expected for a charged metal particle moving perpendicular to a cylindrical electrostatic probe is developed. The theory is developed using an electronic circuit equivalent to the physical mechanisms in the jet engine. A laboratory burner is described which simulates the exhaust ion number density and lower thrust values of a jet engine. Experimental data are presented for the burner and for a scaled up system which uses a 0.44 cm diameter particle, a 7.6 cm diameter probe, and a 30 cm/sec velocity. Author (GRA)

N73-10755# Naval Postgraduate School, Monterey, Calif.
CONVERSION OF INLET TEMPERATURE DISTORTIONS TO VORTICITY FOR AN AXIAL-FLOW COMPRESSOR M.S. Thesis
Michael Martin Iverson Jun. 1972 92 p refs
(AD-745852) Avail: NTIS CSCL 21/5

A survey of the literature on pressure, temperature and foreign gas inlet distortions is made. For interpretation of the influence of inlet distortion on engine stability, a break is made with distortion methods which use temperature or pressure distortion maps. The distortion in the form of temperature contours is transformed to vorticity using appropriate equations derived for both incompressible and compressible flow. A numerical solution of Poisson's equation to describe secondary flow arising from convected vorticity is presented. Author (GRA)

N73-10756# Dayton Univ. Research Inst., Ohio.
COMPUTER PROGRAMS FOR SINGLE STAGE AXIAL COMPRESSOR TEST DATA ANALYSIS. VOLUME 1: THEORY, DESCRIPTIONS, AND USERS INSTRUCTIONS Final Technical Report, 16 Jun. 1971 - 17 Apr. 1972
Richard M. Hearsey Wright-Patterson AFB, Ohio AFAPL Jun. 1972 95 p refs
(Contract F33615-71-C-1751; AF Proj. 3066; AF Proj. 7065)
(AD-744502; UDRI-TR-72-20-Vol-1; AFAPL-TR-72-43-Vol-1) 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 temperatures. This first volume of two that describe the programs fully details the theory of the method, describes the computer programs, and gives all information necessary to use them. Author (GRA)

N73-10918 Engineering Sciences Data Unit, London (England).
GUIDE TO ITEMS AVAILABLE IN OTHER SERIES
A. G. R. Thomson Jul. 1971 16 p
(ESDU-SS2) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Items selected in the aeronautical structures sub-series deal with theoretical stress analysis of a particular configuration under given loading conditions with the analysis substantiated by tests. Considered are stress-strain and tangent modulus data of materials, sectional constants for calculating strength and buckling behavior of structural members, frames, and panels under loads, and the behavior of plate or panel structures subjected to kinetic heating arising from supersonic flight. G.G.

N73-10929# Lockheed Missiles and Space Co., Palo Alto, Calif.
RANDOM SEARCH METHOD OF ANALYZING MINIMUM WEIGHT RIB-REINFORCED CYLINDRICAL SHELLS SUBJECTED TO EXTERNAL PRESSURE
V. I. Mossakovskii and Iu. M. Pochtman 1972 4 p refs
Transl. into ENGLISH from Dopov. Akad. Nauk Ukr. RSR, Ser. A (Kiev), no. 5, 1972 p 457-460
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A method for selecting parameters of reinforcing ribs and fuselage members to assure minimum structural weight commensurate with strength and stability requirements is discussed. The problem is reduced to one of partial integral nonlinear programming and the use of a random search method. An example is given of a circular cylindrical shell which is reinforced by equidistant ribs of rectangular cross section and identical stiffness under external pressure. Mathematical models are included to define the limits imposed by a variety of conditions. Author

N73-10934*# George Washington Univ., Washington, D.C.
SCATTER FACTOR AND RELIABILITY OF AIRCRAFT STRUCTURES
G. I. Schueller and A. M. Freudenthal Washington NASA Nov. 1972 43 p refs
(Grant NGR-09-010-058)
(NASA-CR-2100) Avail: NTIS HC $3.00 CSCL 14D

The concept of time to first failure is utilized to perform a parameter study of scatter factors of aircraft structures. The Weibull distribution is used for estimation of characteristic and certifiable lives. Scatter factors for various Weibull-shaped parameters, fleet sizes and level of reliabilities are calculated. It is concluded that the currently used range of scatter factors (2 through 4) is too narrow for the estimation of a safe life and that a safe and economical design for structural materials with shape parameters less than 2 does not seem feasible except for very small fleet sizes and low levels of reliability. Author

N73-10943# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
SUMMARY OF TEST RESULTS FOR ALUMINUM ALLOY BOX BEAM FATIGUE PROGRAM, TEST PHASES 1-4 Final Report
William Breyan 8 Jun. 1972 44 p refs
(AD-744673; NADC-72056-VT) Avail: NTIS CSCL 01/3

The results of a four-phase fatigue program for bending tests of 7075-T6 aluminum alloy box beams for positive loads only and for positive and negative loads for both constant-and variable-load amplitudes are presented. The relative damaging effect of four airplane flight-maneuver-loads spectra was determined, and the effects on fatigue life for variations in spectrum block size, stress level, stress direction, and load sequence were established and the results are discussed. When compared to full-scale aircraft structures of like material under constant-amplitude unidirectional loading on a percent of ultimate strength basis the beams represented the upper bound of those data for full-scale structures and exhibited similar fatigue characteristics. The beams were thus established as a suitable idealized structure for the investigation of those parameters which affect the structural fatigue life. Author (GRA)

N73-10989# Committee on Appropriations (U. S. House).
DEPARTMENT OF TRANSPORTATION AND RELATED AGENCIES APPROPRIATIONS FOR 1973. PART 3: DEPARTMENT OF TRANSPORTATION: FEDERAL AVIATION ADMINISTRATION, FEDERAL RAILROAD ADMINISTRATION, OFFICE OF THE SECRETARY; TESTIMONY OF MEMBERS OF CONGRESS AND OTHER INDIVIDUALS AND ORGANIZATIONS
Washington GPO 1972 1454 p refs Hearings before Comm. on Appropriations, 92d Congr., 2d Sess., 13-24 Apr. 1972
Avail: Subcommittee on Dept. of Transportation and Related Agencies Appropriations

Department of Transportation and related agencies appropriations for the fiscal year 1973 are considered. Budget estimates are presented for the Federal Aviation Administration, the Federal Railroad Adminstration, and the Office of the Secretary. G.G.

N73-10990*# Aerospace Corp., El Segundo, Calif. Air Transportation Group.
STUDY OF SHORT HAUL HIGH-DENSITY V/STOL TRANSPORTATION SYSTEMS, VOLUME 1 *Interim Report*
H. L. Solomon Jul. 1972 263 p refs
(Contract NAS2-6473)
(NASA-CR-114466; ATR-72(7301)-1-Vol-1) Avail: NTIS HC $15.25 CSCL 01C

The relative advantages of STOL aircraft concepts were examined by simulating the operations of a short haul high-density intercity STOL system set in two arenas, the California corridor and the Chicago-Detroit-Cleveland triangle, during the 1980 time period. The study was constrained to the use of three aircraft concepts designated as the deflected slipstream turboprop, externally blown flap, and augmentor wing turbofan configurations. The projected demographic, economic, travel demand, and travel characteristics of the representative arenas were identified. The STOL airline operating scenarios were then formulated and through the use of the aerospace modal split simulation program, the traveler modal choices involving alternative STOL concepts were estimated in the context of the total transportation environment for 1980. System combinations that presented the best potential for economic return and traveler acceptance were then identified for each STOL concept. Author

N73-10991*# Aerospace Corp., El Segundo, Calif. Air Transportation Group.
STUDY OF SHORT HAUL HIGH-DENSITY V/STOL TRANSPORTATION SYSTEMS. VOLUME 2: APPENDICES Interim Report
H. L. Solomon Jul. 1972 209 p refs
(Contract NAS2-6473)
(NASA-CR-114467; ATR-72(7301)-1-Vol-2-App) Avail: NTIS HC $12.50 CSCL 01C

Essential supporting data to the short haul transportation study are presented. The specific appendices are arena characteristics, aerospace transportation analysis computer program, economics, model calibration, STOLport siting and services path selection, STOL schedule definition, tabulated California corridor results, and tabulated Midwest arena results. N.E.N.

N73-11002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A SINGLE-STAGE TRANSONIC COMPRESSOR WITH A BLADE-TIP SOLIDITY OF 1.3
Donald C. Urasek and Royce D. Moore Washington Nov. 1972 107 p refs
(NASA-TM-X-2645; E-6763) Avail: NTIS HC $3.00 CSCL 01A

The design and experimental performance of a 50-centimeter-diameter, single stage, axial flow, transonic compressor with a blade tip solidity of 1.3 are presented. Radial surveys were made of the flow conditions for both the rotor and stator. At design speed, peak efficiencies for both rotor and stage were 0.87 and 0.82, respectively, and occurred at an equivalent weight flow of 29.6 kilograms per second (202 kg/sec/sq m of annulus area). At peak efficiency, the total pressure ratios for both rotor and stage were 1.79 and 1.73, respectively. Stall margin for the stage was 17 percent. Author

N73-11006*# 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 2: PROGRAM LISTINGS
S. Gene Sadler Washington Sep. 1972 164 p ref
(Contract NAS1-8448)
(NASA-CR-2111; RASA-71-13-Vol-2) Avail: NTIS HC $10.25 CSCL 01B

A mathematical model and computer program was implemented to study the main rotor free wake geometry effects on helicopter rotor blade air loads and response in steady maneuvers. Volume 1 (NASA CR-2110) contains the theoretical formulation and analysis of results. Volume 2 contains the computer program listing. Author

N73-11007*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT AND WIND TUNNEL INVESTIGATION OF THE EFFECTS OF REYNOLDS NUMBER ON INSTALLED BOATTAIL DRAG AT SUBSONIC SPEEDS
Roger Chamberlin and Bernard J. Blaha 1972 16 p refs Proposed for presentation at 11th Aerospace Sci. Meeting and Tech. Display, Washington, D. C., 10-12 Jan. 1973; sponsored by AIAA
(NASA-TM-X-68162; E-7221) Avail: NTIS HC $3.00 CSCL 01A

A flight and wind tunnel investigation was conducted to determine the effects of Reynolds number on the installed boattail drag of an underwing nacelle. Tests were run on a modified F-106B aircraft and 0.05 and 0.22 scale wind tunnel models. Tests were conducted at Mach numbers of 0.6 and 0.9 and over a 16 to 1 range of Reynolds numbers. Highest drag was obtained at intermediate Reynolds numbers corresponding to about the lowest flight values and that of the 0.22 scale model. Significantly lower drag was obtained at both higher and lower Reynolds numbers. Author

N73-11008# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
LOW SPEED AERODYNAMICS OF WINGS, BODIES AND PROPULSION SYSTEMS, 2 Final Progress Report, 10 May 1966 - 9 May 1972
Antonio Ferri and Lu Ting 9 May 1972 9 p refs
(Contract DA-31-124-ARO(D)-464)
(AD-745916; AROD-6291-11-E) Avail: NTIS CSCL 20/4

The problem of the interference of wing and propeller streams was investigated. The assumptions in classical analysis were critically examined. The importance of the nonuniformity and of the finite thickness of the propeller streams on the sectional aerodynamic characteristics of the wing were substantiated. Numerical programs were developed to carry out the two-dimensional sectional analysis of an airfoil in a nonuniform parallel stream. The classical analysis for wing and a single propeller was modified by the use of sectional analysis from the numerical program. For a wing and multipropellers, a new systematic scheme was developed. Author (GRA)

N73-11009# Picatinny Arsenal, Dover, N.J. Engineering Sciences Div.
AERODYNAMIC CHARACTERISTICS AND SUBSONIC FLIGHT PERFORMANCE OF THE SPIN STABILIZED, 4.2 INCH M329A1E1 MORTAR PROJECTILE
R. Kline and W. Gazdayka Jun. 1972 437 p refs
(AD-746977; PA-TR-4300) Avail: NTIS CSCL 19/1

An extensive study of the aerodynamic characteristics of the 4.2 in. M329A1E1 Mortar Projectile has been conducted. A spectrum of yaw levels up to 40 degrees and Mach numbers from 0.55 to 1.025 were covered in the Ballistic Research Laboratories (BRL) Transonic Range Facility. A Magnus wind tunnel test in the Ames 12 ft. Pressure Wind Tunnel involved boom and boattail effects on Magnus as well as static forces from moments. Mach numbers from 0.3 to 0.95 and angles of attack from 0 to 30 degrees (for a Mach number of 0.3) and 0 degrees to 20 degrees (for the higher Mach numbers) were considered. Shells instrumented with yaw sondes were fired at Wallops Island Facility of NASA. The theoretical differential equation of motion then was fitted to the resulting single plane angular motion data. Author (GRA)

N73-11010 Engineering Sciences Data Unit, London (England).
LONGITUDINAL STABILITY DEFINITIONS AND DISCUSSION OF THE PRINCIPAL TERMS USED
Dec. 1970 7 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-00.00.03) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Definitions of aircraft longitudinal stability are developed to account for effects caused by distortion of the aircraft structure and compressibility effects. The stick fixed and stick free conditions are analyzed for static stability and dynamic stability and dynamic stability response. The theory of static stability is expressed with respect to the neutral point and static margin. Mathematical models are included to clarify the theoretical aspects. Author

N73-11011 Engineering Sciences Data Unit, London (England).
PERFORMANCE ANALYSIS FOR AIRCRAFT WITH TURBOJETS "NON-DIMENSIONAL" GRAPHICAL METHOD RATE OF CLIMB
Jan. 1971 3 p Revised Sponsored by Roy. Aeron. Soc.
(ESDU-RJ1/2-Amend-A; ESDU-RJ1/2-Amend-B) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Curves for determining climb performance of aircraft under standard conditions are presented. A solution to an example problem demonstrating the procedures is included. F.O.S.

N73-11012*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SMALL-SCALE TESTS OF THE MIXER NOZZLE CONCEPT FOR REDUCING BLOWN-FLAP NOISE
Jack H. Goodykoontz, William A. Olsen, and Robert G. Dorsch Washington Nov. 1972 34 p refs
(NASA-TM-X-2638; E-6999) Avail: NTIS HC $3.00 CSCL 01B

Noise tests were conducted using simulated mixer-type nozzles and a small scale model of an externally blown flap, lift augmentation system. The mixer nozzles were simulated with orifice plates. Author

N73-11013*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT INVESTIGATION OF 24 DEG BOATTAIL NOZZLE DRAG AT VARYING SUBSONIC FLIGHT CONDITIONS
Roger Chamberlin Washington Nov. 1972 69 p refs
(NASA-TM-X-2626; E-6846) Avail: NTIS HC $3.00 CSCL 01A

Four configurations of rounded shoulder boattail nozzles were tested on an underwing nacelle mounted on an F-106B aircraft. The effects of various parameters on boattail drag were investigated at Mach numbers of 0.6 and 0.9. The parameters studied were Reynolds number, angle-of-attack, nozzle pressure ratio, nozzle geometry, and nozzle axial location with respect to the wing. These nozzles simulated nonafterburning configurations appropriate for turbofan powered aircraft with supersonic dash capability. Increasing Reynolds number significantly lowered the boattail drag coefficient of all the nozzles at both M sub 0 = 0.6 and M sub 0 = 0.9. Author

N73-11014*# Whittaker Corp., San Diego, Calif. Research and Development Div.

METAL AIRCRAFT STRUCTURAL ELEMENTS REINFORCED WITH GRAPHITE FILAMENTARY COMPOSITES Final Report

K. R. Berg and J. Ramsey Aug. 1972 85 p refs
(Contract NAS1-10507)
(NASA-CR-112162) Avail: NTIS HC $6.25 CSCL 01C

Strain compatibility equations are used to evaluate the thermal stresses existing when unidirectional graphite composites are bonded to aluminum structures. Based on thermal stresses and optimum placement of the composite, skin-stringer aluminum panels are optimized for minimum weight compression panels with selective composite reinforcement. Composite reinforced skin-stringer panels are thermal cycled to determine the effect of thermal fatigue on structural integrity. Both cycled and uncycled panels are tested in compression and tension. Test results are correlated with predicted loads. Use of filamentary graphite composites is an efficient method of reinforcing metal structures, but care must be taken to minimize thermal stresses. Author

N73-11015*# Kansas Univ./Center for Research, Inc., Lawrence. Engineering Sciences Div.

A SIMULATOR EVALUATION OF THE USE OF SPOILERS ON A LIGHT AIRCRAFT

Carl H. Brainerd and David L. Kohlman Washington NASA Oct. 1972 126 p refs
(Grant NGR-17-002-072)
(NASA-CR-2121) Avail: NTIS HC $3.00 CSCL 01B

A fixed-base flight simulator was used to evaluate wing spoilers for longitudinal flight path control on a modified Cessna Cardinal aircraft. Spoilers which generated the proper pitching moment to maintain aircraft trim C sub L constant could be used as an effective descent rate control. More than 100 simulated ILS approaches were flown by evaluation pilots using both conventional methods and spoiler descent rate control. Three spoiler control schemes were evaluated during the ILS approaches. Using the spoilers for control, instrument approaches could be flown smoothly and precisely with constant airspeed and pitch attitude. While the spoilers could adequately control ILS approaches, a spoiler system with greater authority would be desirable for use in visual approaches. Author

N73-11016*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS OF LIGHT, TWIN-ENGINE, PROPELLER DRIVEN AIRPLANES

Chester H. Wolowicz and Roxanah B. Yancey Washington Oct. 1972 294 p refs
(NASA-TN-D-6946; H-694) Avail: NTIS HC $3.00 CSCL 01B

Analytical procedures and design data for predicting the lateral-directional static and dynamic stability and control characteristics of light, twin engine, propeller driven airplanes for propeller-off and power-on conditions are reported. Although the consideration of power effects is limited to twin engine airplanes, the propeller-off considerations are applicable to single engine airplanes as well. The procedures are applied to a twin engine, propeller driven, semi-low-wing airplane in the clean configuration through the linear lift range. The calculated derivative characteristics are compared with wind tunnel and flight data. Included in the calculated characteristics are the spiral mode, roll mode, and Dutch roll mode over the speed range of the airplane. Author

N73-11017# National Aviation Facilities Experimental Center, Atlantic City, N.J.

WING LEADING EDGE FUEL TANK IMPACT TESTS Final Report, Jul. 1970 - Jun. 1971

Larry W. Hacker Oct. 1972 56 p
(FAA Proj. 503-101-05X)
(FAA-NA-72-21; FAA-RD-72-83) Avail: NTIS HC $5.00

A typical jet transport wing with integral leading edge fuel tanks was subjected to impacts similar to those which could occur in the vicinity of an airport in an aborted takeoff or an abnormal landing. The problems with the test setup are discussed, also suggestions for improvement are included. The same wing was impacted with several birds to simulate bird strikes. Author

N73-11018*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

ACOUSTIC RESULTS OBTAINED WITH UPPER-SURFACE-BLOWING LIFT AUGMENTATION SYSTEMS

U. VonGlahn, M. Reshotko, and R. G. Dorsch 1972 26 p refs Presented at 84th Meeting of the Acoust. Soc. of Am., Miami Beach, Fla., 28 Nov. - 1 Dec. 1972
(NASA-TM-X-68159; E-7215) Avail: NTIS HC $3.00 CSCL 01B

The noise caused by the interaction of the jet exhaust and a wing was measured under static conditions for several versions of a small-scale STOL engine-over-the-wing configuration. Three basic nozzles were used in the tests; a circular nozzle, a 5:1 aspect ratio slot nozzle and a 10:1 aspect ratio slot nozzle. Various flow attachment devices were included in the study. The wing included a flap that could be positioned for nominal takeoff or approach flap settings. Far field noise data are presented for the flyover mode. The data are discussed in terms of sound power and sound pressure spectra. Implications of extending the small-scale model acoustic data to full-scale aircraft are discussed briefly and indicate a sizeable flyover noise attenuation may be achieved due to shielding by the wing. Author

N73-11019*# LTV Aerospace Corp., Hampton, Va. Hampton Technical Center.

A FUEL CONSERVATION STUDY FOR TRANSPORT AIRCRAFT UTILIZING ADVANCED TECHNOLOGY AND HYDROGEN FUEL

W. Berry, R. Calleson, J. Espil, C. Quartero, and E. Swanson 10 Nov. 1972 33 p refs
(Contract NAS1-10900)
(NASA-CR-112204) Avail: NTIS HC $3.75 CSCL 01B

The conservation of fossil fuels in commercial aviation was investigated. Four categories of aircraft were selected for investigation: (1) conventional, medium range, low take-off gross weight; (2) conventional, long range, high take-off gross weights; (3) large take-off gross weight aircraft that might find future applications using both conventional and advanced technology; and (4) advanced technology aircraft of the future powered with liquid hydrogen fuel. It is concluded that the hydrogen fueled aircraft can perform at reduced size and gross weight the same payload/range mission as conventionally fueled aircraft. F.O.S.

N73-11020# Advisory Group for Aerospace Research and Development, Paris (France).

INTERACTION OF HANDLING QUALITIES, STABILITY, CONTROL AND LOAD ALLEVIATION DEVICES ON STRUCTURAL LOADS Summary Report

Clifford F. Newberry (Boeing Co., Wichita, Kan.) Jul. 1972 17 p refs
(AGARD-R-593) Avail: NTIS HC $3.00

A questionnaire was forwarded to working group members, soliciting answers from their respective countries on techniques used in considering the various interactions. The questionnaire discusses possible effects of load alleviation devices from both

static and fatigue loads. Interactions between stability, control, and structural loads when structural modes coalesce with rigid body short period modes are also addressed. The replies received are summarized. The replies generally agree, although differences between manufacturers of fighter and transport aircraft are evident. Author

N73-11021*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WEAR AND RELATED CHARACTERISTICS OF AN AIRCRAFT TIRE DURING BRAKING
John Locke McCarty Washington Nov. 1972 28 p refs
(NASA-TN-D-6963; L-8107) Avail: NTIS HC $3.00 CSCL 11J

Wear and related characteristics of friction and temperature developed during braking of size 22 x 5.5, type aircraft tires are studied. The testing technique involved gearing the tire to a driving wheel of a ground vehicle to provide operations at constant slip ratios on asphalt, concrete, and slurry-seal surfaces. Data were obtained over the range of slip ratios generally attributed to an aircraft braking system during dry runway operations. The results show that the cumulative tire wear varies linearly with distance traveled and the wear rate increases with increasing slip ratio and is influenced by the runway-surface character. Differences in the wear rates associated with the various surfaces suggest that runways can be rated on the basis of tire wear. The results also show that the friction coefficients developed during fixed-slip-ratio operations are in good agreement with those obtained by other investigators during cyclic braking, in that the dry friction is insensitive to the tire tread temperature is shown to increase with increasing slip ratio and, at the higher ratios, to be greater during braking on asphalt and slurry seal than on concrete. Author

N73-11022# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SUPERSONIC TURNS WITHOUT SUPERBOOMS
H. S. Ribner Feb. 1972 26 p refs
(Grant AF-AFOSR-1885-70; AF Proj. 9781)
(AD-744859; UTIAS-TN-174; AFOSR-72-0239TR) Avail: NTIS CSCL 01/2

It is shown that focussed 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 focussing. Specifically, the tangential deceleration resolved along the normal to the wave front 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 focussed 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 (GRA)

N73-11023# General Dynamics/Fort Worth, Tex.
COMPOSITE WING FOR TRANSONIC IMPROVEMENT. VOLUME 2: ADVANCED ANALYSIS EVALUATION
M. E. Waddoups, L. A. McCullers, and J. D. Naberhaus Nov. 1971 176 p refs
(Contract F33615-70-C-1242)
(AD-745129; AFFDL-TR-71-24-Vol-2) Avail: NTIS CSCL 01/3

The program to provide technical support leading to a composite wing for an aircraft transonic improvement program included technology investigations to establish the feasibility of aeroelastic synthesis for composite wing structures. Modifications were made to an existing direct Rayleigh-Ritz anisotropic plate analysis procedure and the resulting procedure was compared with the finite element method for the analysis of wing structures and correlated with experimental data. The results of this investigation and a preliminary formulation of an aeroelastic synthesis procedure are documented in this volume for future systems support reference. Author (GRA)

N73-11024# Lockheed-Georgia Co., Marietta.
IMPLEMENTATION STUDIES FOR A RELIABILITY-BASED STATIC STRENGTH CRITERIA SYSTEM. VOLUME 1: EVALUATION Final Report, Feb. - Nov. 1971
M. C. Campion, L. C. Hanson, and D. S. Morcock Wright-Patterson AFB, Ohio AFFDL Feb. 1972 191 p refs
(Contract F33615-71-C-1129; AF Proj. 1367)
(AD-742260; LGC-SMN-311-Vol-1; AFFDL-TR-71-178-Vol-1) Avail: NTIS CSCL 01/3

The proposed reliability-based static strength criteria system described in AFFDL-TR-67-107, Volumes I-III, was reviewed to determine the data requirements and availability, the implications of such an approach on the structural design process, methods by which implementation can be achieved without discontinuity, and necessary changes to specification and handbooks. Volume I describes the studies made using data for the C-141 cargo transport. Author (GRA)

N73-11025# Lockheed-Georgia Co., Marietta.
IMPLEMENTATION STUDIES FOR A RELIABILITY-BASED STATIC STRENGTH CRITERIA SYSTEM. VOLUME 2: IMPLEMENTATION Final Report, Feb. - Nov. 1971
M. C. Campion, W. D. Campbell, and J. W. Chapman Wright-Patterson AFB, Ohio AFFDL Feb. 1972 244 p refs
(Contract F33615-71-C-1129; AF Proj. 1367)
(AD-742261; LGC-SMN-311-Vol-2; AFFDL-TR-71-178-Vol-2) Avail: NTIS CSCL 01/3

The proposed reliability-based static strength criteria system described in AFFDL-TR-67-107, Volumes I-III, was reviewed to determine the data requirements and available, the implications of such an approach on the structural design process, methods by which implementation can be achieved without discontinuity, and necessary changes to specification and handbooks. Volume II describes the findings and includes five appendices. The principal conclusions are that insufficient data exists for the imminent implementation, but that studies of the relative reliability of different configurations and components or of different conditions at the same location would provide a short term means of using the system to gain familiarity and confidence. Author (GRA)

N73-11027# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF PILOTED WEAPON DELIVERY: F-4C STRAFING WITH STICK-TO-RUDDER INTERCONNECT M.S. Thesis
Thomas Gayle Minnich Jun. 1972 78 p refs
(AD-746000; GGC/EE/72-9) Avail: NTIS CSCL 19/5

An analysis of the pilot-aircraft system is undertaken in order to investigate weapon delivery accuracy of the McDonnell-Douglas F-4 equipment with an experimental stick-to-rudder interconnect. Pilot-vehicle analysis is used to predict the probable tracking errors in a strafing pass. These tracking errors are combined with other pilot-induced errors in a statistical model of weapon delivery in order to predict impact accuracy. The predicted errors were found to exceed those of the standard F-4. The interconnect was redesigned to minimize lateral tracking error. This redesign resulted in reduced lateral tracking error to the noise threshold level. Single-shot, gun-firing pass accuracy of the F-4 with the redesigned interconnect is compared to previously predicted and measured weapon delivery accuracy of the standard F-4. Author (GRA)

N73-11028# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF PILOTED WEAPON DELIVERY: F-4C STRAFING WITH HIGH GAIN CONTROL AUGMENTATION M.S. Thesis
David G. Morton Jun. 1972 102 p refs
(AD-746001; GGC/EE/72-10) Avail: NTIS CSCL 01/3

Research was undertaken to analytically predict strafing accuracy of the F-4C aircraft with an experimental high gain control augmentation system incorporated. A model of the pilot-aircraft is formulated which relates pilot tracking performance to overall strafing accuracy. This model permits realistic

determination of the essential flight control system dynamic performance characteristics. Projectile impact error is expressed in terms of errors in the task variables which are directly under the pilot's control. Mathematical representations of the aircraft, the control system dynamics, the turbulence environment, and the human pilot are used to estimate the tracking error contribution. Author (GRA)

N73-11030# Dunlap and Associates, Inc., Santa Monica, Calif.
PREDICTION OF PILOT PERFORMANCE DURING INITIAL CARRIER LANDING QUALIFICATION
Clyde A. Brictson, William J. Burger, and Thomas Gallagher 1972 9 p refs
(Contract N00014-72-C-0041; NR Proj. 196-115)
(AD-746095) Avail: NTIS CSCL 01/2

Several different levels of carrier landing performance criteria based on initial day and night carrier landing qualification trials were developed for inexperienced Navy F4 pilots. The performance criteria were used to estimate the relative proficiency of pilots during landing trials. Selection tests along with basic, advanced flight and RAG training measures were then used to predict the landing performance of each pilot, with emphasis on night carrier recovery. The results indicate that a composite night performance score can be predicted from training measures at an obtained multiple R = .72 (p less than 0.01). Night boarding rate was also predicted at R = .58 (p less than 0.01). Author (GRA)

N73-11031# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
ROLLING RESISTANCE AND CARCASS LIFE OF TIRES OPERATING AT HIGH DEFLECTIONS
Peters Skele Feb. 1972 49 p
(AF Proj. 5212)
(AD-746304; AFFDL-TR-70-138) Avail: NTIS CSCL 01/3

The purpose of the study was to determine the effects of tire deflection on rolling resistance and tire life. The tests were conducted on a standard 84-inch diameter aircraft tire dynamometer. Some qualitative effects of deflection were determined. The rolling resistance of a pneumatic tire subjected to a load acting through the wheel axis and normal to the contact patch plane is a function of velocity, deflection, and carcass temperature. When the load and carcass temperature are held constant, rolling resistance increases with increasing deflection and increasing velocity. For a constant deflection and carcass temperature, rolling resistance decreases with increasing inflation pressure. Experimental data indicate that increasing carcass temperature while maintaining a constant deflection results in decreasing rolling resistance. Author (GRA)

N73-11032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
An-2 AIRCRAFT
I. V. Radchenko, V. P. Kramchaninov, and V. P. Dubrinskii 14 Apr. 1972 657 p Transl. into ENGLISH of the book "Samolet AN-2" Moscow, Izd-vo Transport, 1969 p 1-440
(FTD Proj. 20906391A)
(AD-746791; FTD-MT-24-36-71) Avail: NTIS CSCL 01/3

The book contains the basic flight characteristics and specifications of the An-2 aircraft and its modifications: An-2V, An-2P and An-2M. Considerable space is allotted to the questions of flight operations of the aircraft and its equipment. The description of the construction of units of the aircraft, its systems and special equipment is given as applies to aircraft of the latest production. Author (GRA)

N73-11033# Battelle Memorial Inst., Columbus, Ohio.
FATIGUE CRACK PROPAGATION IN D6AC STEEL PLATE FOR SEVERAL FLIGHT LOADING PROFILES IN DRY AIR AND JP-4 FUEL ENVIRONMENTS Final Report, Feb. - Oct. 1971
Charles E. Feddersen Wright-Patterson AFB, Ohio AFML 28 Jan. 1972 82 p refs
(Contract F33615-71-C-1054)
(AD-746343; AFML-TR-72-20) Avail: NTIS CSCL 01/3

The objective of this experimental program was to obtain an independent evaluation of the fatigue-crack propagation characteristics of D6AC steel for the F-111 aircraft under specific flight loading spectra. The program also included selected studies of constant amplitude fatigue-crack propagation and crack growth retardation under the influence of single overloads. It was determined that fatigue crack propagation specimens evaluated under spectra with peak loads exceeding one-half of the tensile yield strength of the material sustained significantly longer lifetime than under spectra wherein the peak loads were significantly below this stress level. Although the observations were limited, an effect of maximum cyclic stress on constant amplitude crack growth rates was apparent. In the crack growth retardation studies, it was observed that the overload ratio plays a direct role, and the maximum cyclic stress level an inverse role, in delaying crack growth. Author (GRA)

N73-11034# Navy Fleet Material Support Office, Mechanicsburg, Pa. Operations Analysis Dept.
THE 3M AVIATION USAGE RATE SYSTEM USER'S MANUAL
J. W. Sari and Samuel W. Fisher 3 Aug. 1972 49 p ref
(AD-746482) Avail: NTIS CSCL 15/5

Usage rates for aviation items are a basic input to the computation of the range and depth of spare parts carried in support of deployed aircraft. The 3M Aviation Usage Rate System was developed to provide these rates. Following an extensive evaluation, the Aviation Supply Office recently implemented this system to serve as the primary source of data for updating aviation equipment support requirements. This user's manual describes the operation of this usage rate system and its application in the aviation allowance function. Author (GRA)

N73-11035# Naval Air Development Center, Warminster, Pa. Aero Structures Dept.
SURVEY OF FLIGHT LOAD PARAMETERS OF SERVICE AIRCRAFT Summary Report
David J. Rhoads 31 Dec. 1971 219 p refs
(AD-747285; NADC-ST-7001; Rept-8) Avail: NTIS CSCL 01/3

Maneuver data (normal acceleration, airspeed, and altitude) from six models of Naval aircraft for 5130.54 flight hours are presented in the report in the form of frequency curves, histograms, and correlation tables for selected combinations of the measured parameters. Author (GRA)

N73-11036# Boeing Co., Morton, Pa. Vertol Div.
DEVELOPMENT OF COMPOSITE TECHNOLOGY FOR DYNAMIC COMPONENT APPLICATION Final Report
Robert L. Pinckney and H. L. Fritzsche Jun. 1972 97 p refs
(Contract DAAG46-70-C-0006)
(AD-747337; D210-10480-1; AMMRC-CTR-72-9) Avail: NTIS CSCL 01/3

Composite materials were used in the fabrication of a CH-47 pitch link (a heavily loaded tension-compression member in the dynamic flight control system). A dual-load-path structure was designed. HT graphite was selected for the primary load member, S-901 glass for the secondary member, and high-tensile carbon-steel wire for the hoop windings in the metal end-fittings. Semiautomatic production techniques were evaluated and refined during fabrication of the two specimen pitch links as a means of reducing the cost of the components. Author (GRA)

N73-11037# Walter Kidde and Co., Inc., Belleville, N.J.
US ARMY AIRCRAFT IN-FLIGHT FIRE DETECTION AND AUTOMATIC SUPPRESSION SYSTEMS Final Report
Mathew DeRouville and Roger B. Jones Jul. 1972 107 p refs
(Contract DAAJ02-70-C-0056; DA Proj. 1F1-62205-A-529)
(AD-746630; USAAMRDL-TR-72-27) Avail: NTIS CSCL 13/12

In-flight fire reports at U.S. Army Materiel System Analysis Agency (combat) and U.S. Army Agency for Aviation Safety

(noncombat) for UH-1, AH-1 and CH-47 helicopters were studied to determine the cause and location of helicopter compartment fires. Two Army helicopter operating bases were visited for firsthand information. The in-flight fires were divided into groups, and from the number of incidents in each group, a priority was established to secure the most effective results toward development of automatic suppression systems. A survey was made of fire detectors and methods of extinguishment and suppression, and the characteristics of such systems were evaluated for possible use in the fire suppression systems. System concepts were developed and methods of detection and extinguishment/suppression were selected as most suited for integration into the aircraft system. Design criteria for the various concepts were developed and recommendations made as to systems to be used in the test phase. Simulations of engine, oil cooler, and electronics compartments were fabricated, and selected systems were tested. Author (GRA)

N73-11038# Dynamic Science, Phoenix, Ariz.
THE DESIGN, DEVELOPMENT, AND TESTING OF AN AIRCREW RESTRAINT SYSTEM FOR ARMY AIRCRAFT Final Report
Gregory Kourovklis, John J. Glancy, and Stanley P. Desjardins Jun. 1972 250 p refs
(Contract DAAJ05-70-C-0065; DA Proj. 1F1-62205-A-529)
(AD-746631; USAAMRDL-TR-72-26; Rept-1680-72-5) Avail: NTIS CSCL 13/12

The purposes of this study were to design, test, and optimize an aircrew restraint system for a forward-facing, nonejection seat for Army aircraft based on the criteria contained in Chapter 4 of USAAMRDL Technical Report 71-122, Crash Survival Design Guide, October 1971, and to prepare a proposed draft Military Specification. A literature search was conducted to determine the state-of-the-art in restraint system development and injury potential prediction technology. The dynamics of an occupant restrained in an integrally armored crew seat were analyzed to establish restraint system performance trends as a function of pertinent variables. Author (GRA)

N73-11130# Research Inst. of National Defence, Stockholm (Sweden).
RADIATION DIAGRAM MEASUREMENTS ON ANTENNA FOR UHF COMMUNICATION TO FPL 35F
S. Dahlin Jun. 1971 53 p In SWEDISH; ENGLISH summary
(FOA-3-C-3678-61) Avail: NTIS HC $4.75

Radiation diagram measurements on a model surface to scale 1:10, with the antenna placed in the skin of an aircraft fuselage are examined. Measurements with external stores are given, as well as with two drop tanks and two Rb 27 missiles. Author

N73-11156# Electrophysics Corp., Nutley, N.J.
INFRARED LASER/SONAR BEAM INTERACTION AT SEA AIR INTERFACE
L. M. Vallese May 1972 15 p refs Presented at the Natl. Infrared Inform. Symp. (IRIS) (20th), Gaithersburg, Md., 16 May 1972
(Contract N00014-71-C-0043)
(AD-746106) Avail: NTIS CSCL 17/2

A novel technique for direct communication between an aircraft and a submarine, based on the use of laser beams in air and sonar beams in the sea, interacting at the sea surface, is described. Initial laboratory feasibility studies are described. Author (GRA)

N73-11196# Naval Research Lab., Washington, D.C.
SIMULATION OF AADC (ADVANCED AVIONIC DIGITAL COMPUTER) PAGE REPLACEMENT ALGORITHMS Interim Report
William R. Smith Jul. 1972 14 p refs
(AD-746110; NRL-MR-2464) Avail: NTIS CSCL 09/2

Page replacement algorithms have been simulated to aid in making a choice from among those proposed for the Advanced Avionic Digital Computer (AADC) processing element. An E-28 program model and a statistical page reference generator were used to evaluate performance of these replacement schemes. Author (GRA)

N73-11209# Naval Electronics Lab. Center, San Diego, Calif.
PROCEEDINGS OF THE ARRAY ANTENNA CONFERENCE, VOLUME 1, PART 1
24 Feb. 1972 330 p refs Conf. held at San Diego, Calif., 22-24 Feb. 1972
(AD-744629; NELC-TD-155-Vol-1-Pt-1) Avail: NTIS CSCL 09/5

Contents: Phased arrays, A future; Vertical array of spirals for hemispheric coverage; Cylindrical and conical array investigations; A cylindrical phased-array antenna for air traffic control; Solid-state aircraft IFF transponder array; Solid-state phased arrays for satellite communications; Solid-state aperture despun antenna; Stripline strap-on antenna array; A new simulator technique for phased arrays; Decision-theoretic parallel processing arrays; An array synthesis technique for sidelobe control; Beam steering control system for a cylindrical array; Pattern analysis of wideband circular sector arrays; Images of antennas by spectrum analysis of microwave holograms; Analysis of antennas on aircraft; A 16-element frequency-locked bulk-effect array; Mair solid-state array. GRA

N73-11210# Naval Electronics Lab. Center for Command Control and Communications, San Diego, Calif.
PROCEEDINGS OF THE ARRAY ANTENNA CONFERENCE, VOLUME 1, PART 2
24 Feb. 1972 215 p refs Conf. held at San Diego, Calif., 22-24 Feb. 1972
(AD-744630; NELC-TD-155-Vol-1-Pt-2) Avail: NTIS CSCL 09/5

Contents: Adaptive arrays for aircraft communication systems; Adaptive antenna compatibility with radar signal processing; Adaptive null steering for rf antenna arrays; A technique for generation of phase shifts required for circularly polarized and adaptive array antennas; Design and adaptive control of conformal arrays; Approximation of a conformal array with multiple, simultaneously excited planar arrays; A technique for control of conformal arrays; Synthesis techniques for conical arrays; Conical arrays; Some aspects of tem slot design in stripline; Wideband phase locking and phase shifting using feedback control of oscillators; Computer-aided design of microwave components for a linear phased array. GRA

N73-11229*# Lockheed Missiles and Space Co., Huntsville, Ala.
FEASIBILITY OF WAKE VORTEX MONITORING SYSTEMS FOR AIR TERMINALS Final Report, Jan. 1971 - Jul. 1972
D. J. Wilson, K. R. Shrider, and T. R. Lawrence Aug. 1972 234 p refs
(Contract NAS8-26668)
(NASA-CR-123921; LMSC-HREC-D225936; HREC-6668-1) Avail: NTIS HC $3.75 CSCL 01E

Wake vortex monitoring systems, especially those using laser Doppler sensors, were investigated. The initial phases of the effort involved talking with potential users (air traffic controllers, pilots, etc.) of a wake vortex monitoring system to determine system requirements from the user's viewpoint. These discussions involved the volumes of airspace to be monitored for vortices, and potential methods of using the monitored vortex data once the data are available. A subsequent task led to determining a suitable mathematical model of the vortex phenomena and developing a mathematical model of the laser Doppler sensor for monitoring the vortex flow field. The mathematical models were used in combination to help evaluate the capability of laser Doppler instrumentation in monitoring vortex flow fields both in the near vicinity of the sensor (within 1 kilometer and at long ranges(10 kilometers). Author

N73-11230# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
LONGITUDINAL SPLITTING OF A WIND TUNNEL MOVING GROUND BELT AND ITS EFFECT ON A JET FLAP MODEL
A. Berg Jan. 1972 34 p refs Sponsored by Natl. Res. Council of Canada
(UTIAS-TN-173) Avail: NTIS HC $3.75

An experiment undertaken to examine the effects of variation in the geometry of moving ground boards used in the testing of high lift aircraft models in wind tunnels is presented. A high lift STOL model with a blown flap was designed, constructed, and tested in the NRC 3 x 3 pilot tunnel in Ottawa. It was found that if the moving ground belt was split into two pieces, and the gap was of the order of the fuselage width or smaller, that no effect was observed on the tested aerodynamic properties of CL, CD, NT. However, if the split or dead band was increased to a width much greater than that of the fuselage, significant decreases in CL were observed. It was also found that the belt velocity used in the test required only to be matched to the tunnel speed to within + or - 8% to ensure no error in the measured aerodynamic parameters. Author

N73-11235# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF HIGH-ACTIVITY LEVEL TOWER CAB Final Report, Sep. 1971 - Jul. 1972
J. Roy Bradley, Jr. Oct. 1972 57 p
(FAA Proj. 144-170-07(X))
(FAA-NA-72-63; FAA-RD-72-111) Avail: NTIS HC $5.00

The development of operator's consoles, lighting systems, and equipment to produce an efficient airport tower environment is discussed. The equipment included in the tower mockup is described and the results of performance tests are presented. It was concluded that the tower mockup met all the requirements for an efficient and comfortable operating environment.
Author

N73-11241# Naval Research Lab., Washington, D.C.
PROTECTIVE COVER FOR FLUSH-DECK NOZZLES ON AIRCRAFT CARRIER FLIGHT DECKS Interim Report
H. B. Peterson and R. L. Gipe Jul. 1972 18 p refs
(NRL Proj. C05-19203)
(AD-746841; NRL-MR-2471) Avail: NTIS CSCL 06/17

A flexible cover for use with the Type S flush-deck nozzle installed on aircraft carrier flight decks has been evaluated. The cover was cut from a sheet of silicone rubber and affixed to the nozzle with a screw fitting into the hole normally provided for insertion of the center plug. The purpose of the cover is to provide protection against entry of foreign material with consequent clogging of the orifice. It was found that the cover, which could be readily installed on all existing nozzles, did not interfere with the normal discharge pattern characteristics. Also, the cover is capable of providing a built-in masking when the flight deck is anti-skid coated because a typical epoxy coating did not adhere to the rubber. The rubber material is stable up to 800F, and above this temperature it burns to a harmless powdery ash without melting. No performance data were obtained on the cover's ability to resist mechanical damage from vehicle and aircraft movement. Author (GRA)

N73-11242# Air Force Systems Command, Wright-Patterson AFB, Ohio.
REPAIR OF SYNTHETIC AIRPORT COATINGS
E. M. Dashevskii and A. P. Parfenov 24 Mar. 1972 263 p refs Transl. into ENGLISH of the book "Remont Izkusstvennykh Aerodromnykh Pokrytii" Moscow, Izd-vo Transport, 1969 p 1-190
(AF Proj. 1256)
(AD-746718; FTD-MT-24-1914-71) Avail: NTIS CSCL 01/5

An artificial airport surface complex is a very expensive installation. Thus prolonging the service life or increasing the inter-repair use period of this structure is a very important problem from the economic viewpoint. No less important is ensuring safety during takeoff, landing, and taxiing of aircraft during the whole course of use of the airport by creating conditions promoting *reduction in the operational loads on the aircraft as a whole* and on its individual units. On the basis of the generalization of Soviet experience and the study of the foreign literature, the causes of the appearance of deformations in the basic types of artificial airport surfaces and the most effective methods of repairing them with the use of new structural materials are examined. Author (GRA)

N73-11243# Naval Postgraduate School, Monterey, Calif.
PRODUCTION TEST FACILITIES FOR TURBOJET AND TURBOFAN ENGINES: 1975 - 1995
David L. Bailey and Philip W. Toner May 1972 83 p refs
(AD-745877; NPS-57BA72061A) Avail: NTIS CSCL 14/2

A review is made of test cell design options in order to identify characteristics of jet engine test facilities to be constructed in the 1970's and designed to be operable for a minimum of twenty years. The necessity of providing replacements for many current facilities is documented, and the factors which will ensure future production capability and economic feasibility are detailed. Present turbine engines are reviewed and projections of future engines and aircraft are made. A confidential supplement is available for qualified recipients. Author (GRA)

N73-11244# Nielson (John P.), Durham, N.H.
STRUCTURAL EVALUATION OF CELLULAR PLASTIC AS A BASE COURSE MATERIAL FOR EXPEDIENT PAVEMENTS Technical Report, May - Nov. 1971
John P. Nielsen and Charles B. Schriver Mar. 1972 78 p refs
(Contract F29601-71-C-0083; AF Proj. 683M)
(AD-747048; AFWL-TR-71-134) Avail: NTIS CSCL 01/5

The report is a study concerned with the development and structural analysis of a new pavement concept for military expedient pavements. Advanced tactical mobility concepts require a non permanent, quickly constructed and easily repaired airfield pavement system which can successfully withstand a limited number of aircraft coverages. Such pavements are referred to as expedient pavements. The concept presented considers the use of plastics as a construction material for expedient pavements. These all-plastic pavements consist of a thin *(0.5-inch) wearing course fabricated from a tough and durable* fiberglass reinforced polyester having very high strength properties, and a cellular plastic base course placed directly upon the subgrade. For purposes of the study, rigid polyurethane was used as the base course material simply as a means of providing strength data for the structural analyses. The study demonstrates the feasibility of the concept of an all plastic system for expedient pavements. Author (GRA)

N73-11245# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.
FORWARD AREA REFUELING EQUIPMENT (FARE) Technical Report, Jan. 1969 - Jul. 1971
Wayne E. Studebaker and James E. Christopher Apr. 1972 180 p refs
(DA Proj. 1J6-64717-DL-41)
(AD-746249; USAMERDC-2029) Avail: NTIS CSCL 15/5

The U.S. Army has sponsored the development of the Forward Area Refueling Equipment (FARE) in response to an Army requirement for a simple to operate, lightweight, air transportable set to refuel helicopters in extreme forward areas. The FARE, intended primarily for refueling helicopters in forward area operations, is transportable by Army utility or cargo helicopters either as internal cargo or as a sling load. Emplacement of the equipment can be accomplished by two men without the use of materials handling equipment. Author (GRA)

N73-11252*# Vanderbilt Univ., Nashville, Tenn.
AN ANALYTICAL INVESTIGATION OF THE IMPINGEMENT JETS ON CURVED DEFLECTORS
N. M. Schnurr, J. W. Williamson, and J. W. Tatom [1972] 41 p refs
(Grant NGR-43-003-034)
(NASA-CR-129136) Avail: NTIS HC $4.25 CSCL 20D

Numerical solutions are obtained for the cases of straight circular jets impinging on axisymmetric curved surfaces and plane jets impinging symmetrically on two-dimensional curved surfaces. These geometries are representative of some types of thrust reversers for transport aircraft. The solutions are based on the assumptions of incompressible and potential flow. The velocity field, pressure distribution at the deflector surface and reverser effectiveness are predicted for deflector turning angles of 15 to 75 deg, deflector width to jet diameter ratios of 1.5 to 2.0, and ratios of deflector clearance to jet diameter of 1.0 to 3.0. Reverser effectiveness' is found to be a maximum for a ratio of deflector clearance to jet diameter of about 2.0. The effect of back pressuring due to the presence of the deflector is predicted. Experimental verification of the theoretical predictions is obtained. A compressible solution obtained for a limited number of cases indicates that the incompressible solution is satisfactory for jet exit Mach numbers less than 0.8. Author

N73-11253# Aircraft Research Association, Ltd., Bedford (England).
EXPERIMENTAL DETERMINATION OF INLET CHARACTERISTICS AND INLET AND AIRFRAME INTERFERENCE
E. C. Carter Aug. 1972 24 p refs Repr. from AGARD-LS-53, Jun. 1972 23 p
(ARA-27; AGARD-LS-53-3) Avail: NTIS HC $3.25

The experimental methods of determining internal and external forces on airframe inlets are reviewed. The use of complete aerodynamic force models and partial models is discussed including the use of the full and half model tunnel techniques. Particular attention is given to drag, both basic and spillage drag, and the special techniques and accuracies required. Where necessary distinction is drawn between the use of different techniques for different inlet applications, integral parts of the inlet/airframe combination such as bleeds, diverters and dump doors are considered in the experimental methods. In order to optimize inlet and airframe integration, measuring methods for flow environment and visualization are discussed. The measurement of steady state engine face flow and distortion is discussed including the design of rakes and their interference, pressure recording methods and displays. Methods of surge simulation are described and associated unsteady measurements in the inlet. Measurement of mass flow and calibration techniques are discussed. Author

N73-11268*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SURFACE-FLOW, PRESSURE, AND HEAT-TRANSFER STUDIES ON TWO CONICAL DELTA WINGS AT A MACH NUMBER OF 6
Jerry N. Hefner and Allen H. Whitehead, Jr. Washington Dec. 1972 19 p refs
(NASA-TM-X-2668; L-8548) Avail: NTIS HC $3.00 CSCL 20D

An experimental investigation of the surface flow, pressures, and heat transfer on two conical delta wings having attached leading-edge shocks has been conducted at a Mach number of 6. The angle of attack was varied between 0 deg and 12 deg. The pressure data were compared with predictions obtained by the method-of-lines technique, and the heating data were compared with the heating levels predicted by the Spalding-Chi method. Author

N73-11272# Larock (Bruce E.), Davis, Calif.
TRANSVERSE GRAVITY EFFECTS ON A FULLY CAVITATING HYDROFOIL RUNNING BELOW A FREE SURFACE Final Technical Report, Dec. 1971 - Jul. 1972
Bruce E. Larock Jul. 1972 73 p refs
(Contract N00014-72-C-0109; SR0090101)
(AD-746484; TR-7201) Avail: NTIS CSCL 13/10

Equations are presented which describe the fully cavitating flow of fluid past a flat plate hydrofoil running below a free surface. Transverse gravity field effects are included in the analysis. The equations are developed by the use of complex function theory and Tulin's double-spiral-vortex cavity model. Two FORTRAN 4 computer programs have been developed to evaluate the equations. Features and use of these programs are discussed, and program listings are presented in the appendix. Author (GRA)

N73-11273# Naval Postgraduate School, Monterey, Calif.
SUBSONIC LIFTING SURFACE ANALYSIS WITH STATIC AEROELASTIC EFFECTS M.S. Thesis
Larry Glen Pearson Jun. 1972 74 p refs
(AD-745894) Avail: NTIS CSCL 20/4

A computer program was coded to obtain static aeroelastic effects on simple planforms through the use of subsonic lifting surface theory. The program was divided into two major technical areas, aerodynamic and structural, with matrix notation used to indicate the influence of each in the final aerodynamic loading distribution. Several typical stability derivatives were then obtained to make an accurate stability and control analysis on the desired planform. Author (GRA)

N73-11284# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
ON THREE-DIMENSIONAL STRUCTURE OF TRANSONIC FLOWS
H. K. Cheng and Mohammed M. Hafez Jul. 1972 47 p refs
(Contract N00014-67-A-0269-0021; NR Proj. 061-192)
(AD-747266; USCAE-121) Avail: NTIS CSCL 20/4

The basic structure of three-dimensional transonic flows past lifting configurations having finite leading-edge swept angles are studied. Unlike the axisymmetric structure following the transonic area rule, the inviscid transonic small-disturbance regime admits three principal domains, representing different degree of asymmetry controlled by the lift and side forces. An outline of the basic theory and a transonic equivalence rule that follows are presented; the implication of this research to other transonic studies related to far-field properties and to flow field computations are discussed. The possibility of an extension and application to yawed critical wings is pointed out. Author (GRA)

N73-11398*# Kanner (Leo) Associates, Redwood City, Calif.
DETERMINATION OF TIME CONSTANT OF LOW-INERTIA RESISTANCE THERMOMETERS BY THE ALTERNATING CURRENT METHOD
I. P. Pelepeychenko Washington NASA Sep. 1972 8 p refs Transl. into ENGLISH from Priborostroenie (Moscow), v. 13, no. 5, 1970 p 95-99
(NASA-TT-F-14494) Avail: NTIS HC $3.00 CSCL 14B

A method is analyzed for determining the time constant of a resistance thermometer by double heating with direct and alternating currents. Author

N73-11407# Advisory Group for Aerospace Research and Development, Paris (France).
V/STOL DISPLAYS FOR APPROACH AND LANDING
Jul. 1972 50 p refs
(AGARD-R-594) Avail: NTIS HC $4.50

The design and development of display systems were studied for developing all-weather operational capability in terminal areas for V/STOL aircraft. Aspects of the study discussed include: operational factors and ground environment, vehicle configuration, terminal area flight profiles, pilot factors, tradeoffs, guidance and control, and human engineering. The conclusions of the study are summarized, and the recommendations for future research and development are included. F.O.S.

N73-11416# Naval Air Development Center, Warminster, Pa. Aero-Electronic Technology Dept.
NAVY FLIGHT EXPERIMENT OF SECANT TRANSPONDER CORRELATION RANGING EQUIPMENT Final Report

James L. Hinds, Michael G. Raditz, and Oscar Shames 27 Jul. 1972 70 p refs
(AD-746448; NADC-72112-AE) Avail: NTIS CSCL 14/2

Flight tests of portions of an airborne collision avoidance system designated as SECANT were conducted. The feasibility of a random sequence binary correlator, digital range and range rate tracker was established. Further testing of a complete system is recommended. Author (GRA)

N73-11423# Naval Ordnance Lab., White Oak, Md.
STRIKE CAMERA SURVEY
Charles G. Grover and Frank H. Pierce, III 1 Jun. 1972 51 p refs
(AD-746837; NOLTR-72-59) Avail: NTIS CSCL 14/5

The problem of photographically recording aircraft strikes is considered from the standpoint of the photographic instrumentation required. Emphasis is placed on recording guided weapon strikes during air-to-air encounters. Currently used and available techniques are enumerated and their advantages and disadvantages are discussed. Recommendations are made for continuing lines of investigation aimed at determining by test, the true usefulness of two of the techniques reviewed which are not currently in use. The appendices give background technical data on resolution required for aircraft detection, and optical problems involved in implementing the recommended techniques. Author (GRA)

N73-11429 Engineering Sciences Data Unit, London (England).
GUIDE TO THE DESIGN OF TANKS FOR FORCED CIRCULATION OIL LUBRICATION SYSTEMS
1 Jul. 1968 12 p refs Sponsored by Inst. of Mech. Engr.
(ESDU-68039) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A description is given of a tank designed to provide storage for oil, allow settling of solid and liquid contaminants, and promote de-areation and foam removal in forced circulation oil lubricating systems. Data are also provided for the function of various constituent components used in the tanks. E.H.W.

N73-11446# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE MAGNITUDE OF THE TRANSVERSE FORCE ACTING ON THE IMPELLER OF CENTRIFUGAL PUMPS
N. K. Gladchenko 1972 6 p refs Transl. into ENGLISH from Izv. Vtssh. Ucheb. Zaved., Aviats Tekh. (Kazan), no. 2, 1972 p 92-99
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The influence of radial and dynamic pressure magnitude on bearing rupture in centrifugal pump impellers of aircraft fuel systems is measured. Two systems with different snail geometries were used. E.H.W.

N73-11466*# *Scientific Translation Service, Santa Barbara, Calif.*
ADAPTATION OF THE LIDAR TO AIRCRAFT AND MISSILE RANGEFINDING
Pierre Weber Washington NASA Nov. 1972 38 p refs Transl. into ENGLISH from Rech. Aerosp. (Chatillon), no. 1, Jan. - Feb. 1972 p 23-35
(Contract NASw-2035)
(NASA-TT-F-14716) Avail: NTIS HC $4.00 CSCL 20E

From its inception, the lidar has been considered as a remarkable localization instrument, due to its space and time coherence. The operating conditions of the lidar on satellites and on aircraft of missiles are compared. Means for adapting one case to the other are proposed. Results obtained with ONERA experimental lidars are presented: an accuracy of about 0.8 m and a reproducibility of about 1.3 m (rms) were obtained on a vehicle carrying corner reflectors. Author

N73-11474# GTE Sylvania, Inc., Mountain View, Calif.
AMPLITUDE STABILIZED PULSED LASER Final Report, 29 Jun. 1970 - 29 Jun. 1972
William D. Fountain and Ronald L. Hansen 10 Jul. 1972 35 p refs
(Contract N00014-70-C-0342; ARPA Order 306)
(AD-746512; EOO-23) Avail: NTIS CSCL 20/5

The report summarizes the results during the reporting period of a program whose goal is the development of a flash-pumped, Q-switched, mode-locked, cavity-dumped, amplitude-stabilized laser operating at approximately 1.06 micrometer in the fundamental transverse (TEM(oo)) mode. System design and test results are presented. Author (GRA)

N73-11681# National Bureau of Standards, Washington, D.C.
SIMULATION OF AIR TRAFFIC CONTROL RADAR BEACON CODE ASSIGNMENT PLAN 3d1 Final Report
R. D. Elbourn and P. B. Saunders Sep. 1972 101 p ref
(Contract DOT-FA72WAI-257)
(FAA-RD-72-103) Avail: NTIS HC $7.25

During implementation of the National Airspace System En Route Stage A, some Air Route Traffic Control Centers will have complete radar data processing capability while other centers have only flight plan data processing capability. A digital computer simulation of three versions of a radar beacon code assignment plan designed for this situation is described. The simulation employs one peak day's IFR traffic in the U.S.A. It determines the number of codes required, the numbers of code changes in flight for various reasons, and the variation of the number of code conflicts with the number of codes used. Author

N73-11683# Federal Aviation Administration, Washington, D.C. Economic Analysis Div.
AN EVALUATION OF THE ARTS 3 LEVEL OF AUTOMATION (THIRD LOT PROCUREMENT) Final Report
Seymour M. Horowitz Jul. 1972 158 p refs
Avail: NTIS hc $10.00

An experiment employing air traffic controllers in a realistic, but simulated, terminal environment was conducted to evaluate an automated air traffic control system. A simple terminal geometry was devised as the appropriate setting in which to compare the automated system with the manual system. In isolated experiments, the air controllers were presented with identical traffic samples under statistically controlled conditions. Measurements of the comparative system performance in seven major categories were taken. Statistical analyses of the evaluations are presented. Author

N73-11684# Federal Aviation Administration, Washington, D.C.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: EN ROUTE AUTOMATION Interim Report
Jun. 1972 155 p
(FAA-ED-12-2) Avail: NTIS HC $9.75

The functions of an automated system for processing flight data and surveillance functions are described. The need to improve the system capability to meet forecast demands is discussed. The program development plan to provide the required improvements is presented. The program goals, approach, development activities, expected results, and resource requirements are analyzed. Author

N73-11791# *Army Coating and Chemical Lab., Aberdeen Proving Ground, Md.*
ANALYTICAL METHOD FOR ETHYLENE DIBROMIDE DEPLETION IN AVIATION GASOLINE Final Report
George G. Esposito May 1972 12 p ref
(DA Proj. 1T0-62105-A-329)
(AD-746250; CCL-304) Avail: NTIS CSCL 21/4

The measurement of ethylene dibromide depletion in aviation gasoline is one criterion for evaluating the storage stability of coatings used for the corrosion prevention of tanks and containers

used for the storage and protection of military petroleum based hydrocarbons fuels. The standard procedure for the determination of ethylene dibromide depletion is time-consuming, requires special equipment, and necessitates extraordinary care in handling. The method described affords an accurate, uninvolved procedure for measuring ethylene dibromide depletion; the procedure is free from hazardous operating conditions and is highly reproducible. It is based on the following reactions: $BrCH_2CH_2Br$ over KOH yields $CH_2 = CHBr$ and $BrCH_2CH_2Br$ + KOH yields $CH_2 = CHBr$ + KBr + H_2O, then $AgNO_3$ + KBr yields AgBr precipitate. Author (GRA)

N73-11793*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FLIGHT INVESTIGATION OF AN UNDERWING NACELLE INSTALLATION OF AN AUXILIARY-INLET EJECTOR NOZZLE WITH A CLAMSHELL FLOW DIVERTER FROM MACH 0.6 TO 1.3

Verlon L. Head Washington Nov. 1972 39 p refs
(NASA-TM-X-2655; E-7042) Avail: NTIS HC $3.00 CSCL 21A

A nozzle installation of general interest is a podded engine mounted near the aft lower surface of the wing. The effect of this installation on the performance of an auxiliary-inlet ejector nozzle with a clamshell flow diverter was investigated over a Mach number range of 0.6 to 1.3 by using a modified F-106B aircraft. The clamshell flow diverter was tested in a 17 deg position with double-hinged synchronized floating doors. The ejector nozzle trailing-edge flaps were simulated in the closed position with a rigid structure which provided a boattail angle of 10 deg. Primary nozzle area was varied as exhaust gas temperature was varied between 975 and 1561 K. With the nozzle in a subsonic cruise position, the nozzle gross thrust coefficient was 0.918 at a flight Mach number of 0.9. Author

N73-11794*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OPERATIONAL PROCEDURE FOR COMPUTER PROGRAM FOR DESIGN POINT CHARACTERISTICS OF A GAS GENERATOR OR A TURBOJET LIFT ENGINE FOR V/STOL APPLICATIONS

Richard P. Krebs Washington Nov. 1972 36 p refs
(NASA-TM-X-2656; E-6968) Avail: NTIS HC $3.00 CSCL 21E

The computer program described calculates the design-point characteristics of a gas generator or a turbojet lift engine for V/STOL applications. The program computes the dimensions and mass, as well as the thermodynamic performance of the model engine and its components. The program was written in FORTRAN 4 language. Provision has been made so that the program accepts input values in either SI Units or U.S. Customary Units. Each engine design-point calculation requires less than 0.5 second of 7094 computer time. Author

N73-11797*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHODS FOR REDUCING BLADE PASSING FREQUENCY NOISE GENERATED BY ROTOR-WAKE - STATOR INTERACTION

James H. Dittmar Washington Nov. 1972 32 p refs
(NASA-TM-X-2669; E-7066) Avail: NTIS HC $3.00 CSCL 21E

A theoretical model for the generation of blade-passage noise caused by the interaction of rotor wakes with the downstream stator blades in a fan stage has been compiled. This model has combined a description of the rotor wake based on existing experimental correlations with an existing theory for the response of the stator blades to those wakes. This model of the interaction-caused blade-passage noise has been used to examine some effects of blade geometry and flow conditions on the noise generated. A set of significant parameters has been identified to reduce this interaction-caused blade-passage frequency noise. A redesign of an existing fan with the use of these concepts has produced a theoretical noise reduction of more than 7 decibels. Author

N73-11799*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

EXPERIMENTAL QUIET ENGINE PROGRAM AERODYNAMIC PERFORMANCE OF FAN C

R. G. Giffin, D. E. Parker, and L. W. Dunbar Aug. 1972 153 p refs
(Contract NAS3-12430)
(NASA-CR-120981) Avail: NTIS HC $9.75 CSCL 21E

This report presents the aerodynamic component test results of Fan C, a high-bypass-ratio, low-aerodynamic-loading, 1550 feet per second (472.4 m/sec), single-stage fan, which was designed and tested as part of the NASA Experimental Quiet Engine Program. The fan was designed to deliver a bypass pressure ratio of 1.60 with an adiabatic efficiency of 84.2 percent at a total fan flow of 915 lb/sec (415.0 kg/sec). It was tested with and without inlet distortion. A bypass total-pressure ratio of 1.61 and an adiabatic efficiency of 83.9 percent at a total fan flow of 921 lb/sec (417.8 kg/sec) were actually achieved. An operating margin in excess of 14.6 percent was demonstrated at design speed. Author

N73-11801*# Translation Consultants, Ltd., Arlington, Va.

THE EFFECTIVENESS OF DIFFUSION METALLIZATION IN INCREASING THE LIFE OF GAS TURBINE ENGINE TURBINE BLADES

P. T. Kolomytsev, P. P. Lebedev, and L. A. Kostina Washington NASA Nov. 1972 8 p Transl. into ENGLISH from Zashchitnyye Pokrytiya na Metallakh (USSR), no. 4, 1971 p 257-263
(Contract NASw-2038)
(NASA-TT-F-13914) Avail: NTIS HC $3.00 CSCL 21E

The use of diffusion metallization by chromium and aluminum to increase the longevity of parts made of heat-resistant materials at a comparatively low operating temperature (750 C) is considered. The efficiency of the turbine blades of the VK-1A engine was estimated from the results of full-scale tests of the endurance of uncoated and chromoaluminized blades after various times of operation. It is shown that in-vacuum chromoaluminizing increases the operating life of these turbine blades, the endurance limit being increased from 650 to 1300 hr. Author

N73-11803*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AERODYNAMIC STUDY OF A TURBINE DESIGNED FOR A SMALL LOW-COST TURBOFAN ENGINE

Milton G. Kofskey and William J. Nusbaum 1972 24 p refs To be presented at Gas Turbine Ann. Conf. and Products Show, Washington, D. C., 8-12 Apr. 1973; sponsored by ASME
(NASA-TM-X-68157; E-6850) Avail: NTIS HC $3.25 CSCL 21E

An eight inch mean diameter two-stage turbine was experimentally investigated over a range of speeds from 0 to 110 percent of equivalent design speed and over a range of pressure ratios from 2.2 to 4.2. The principal results indicated that the performance level was substantially higher than that assumed in the design. As part of the program to reduce manufacturing costs, the first stage blading was reduced in thickness for ease in coining. Tests of the modified blades indicated that the aerodynamic performance of a stator or rotor blade with a large amount of reaction was effected very little by a significant change of the pressure surface. Author

N73-11806# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Strahldeflexion.

THE RECIRCULATION FLOW PATTERN OF A VTOL LIFT ENGINE Ph.D. Thesis - Brunswick Univ. [DAS REZIRKULATIONSSTROEMUNGSFELD EINES VTOL-HUBTRIEBWERKS]

Eckart Schwantes Jul. 1972 169 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-50) Avail: NTIS HC $10.50

A method was developed to predict theoretically the increase in temperature due to wind recirculation in the inlet of a VTOL lift engine exhaust discharging downward toward the ground. Calculation of the velocities in the recirculation flow and determination of the temperatures using the laws of spread of buoyant plumes, are presented with regard to potential theory.

Model investigations were carried out to check the results. The three regions of a VTOL propulsion jet (the free jet, the wall jet, and the zone of separation of the wall jet from the ground due to wind effects and buoyancy forces) were investigated using model jets with critical nozzle pressure ratio and temperatures up to 1000 C. Author (ESRO)

N73-11980# General Applied Science Labs., Inc., Westbury, N.Y.

HIGH SPEED IGNITION AND COMBUSTION CHARACTERISTICS OF STORABLE FUELS USING A HOT GAS PILOT IGNITER Interim Report

Stephen N. Schmotolocha and Raymond B. Edelman Apr. 1972 72 p refs

(Contract F44620-71-C-0014; AF Proj. 9711)

(AD-746063; GASL-TR-773; AFOSR-72-1304TR) Avail: NTIS CSCL 21/2

The report presents the results of a study on the ignition and combustion characteristics of high density storable fuels injected into supersonic and subsonic air streams. The fuels include liquid n-hexane, Shelldyne-H, and magnesium/hexane slurry and a boron/magnesium/hexane slurry. The subsonic and supersonic tests were performed in the same constant area combustor using a pebble bed heater and a vitiated heater, respectively. Autoignition and hot gas piloting were studied over a range of airstream total temperatures from ambient (300K) to 1950K. The results include definition of ignition and stable flame limits and pilot effectiveness parameters. Further evidence of staged ignition and combustion of the metallized slurries was obtained. In addition, a comparison between existing subsonic premixed combustion data and the present diffusion flame results is presented. Author (GRA)

N73-11988# Rohr Corp., Chula Vista, Calif.

AIRLINE ECONOMIC IMPACT COMPUTER MODEL. *VOLUME 1: DETAILED DISCUSSION Final Report*

Gregory W. Jordan, Sydney X. Smith, William L. Metzger (Mitchell Res. Assoc., San Diego, Calif.), and Ralph C. Gibson (Mitchell Res. Assoc., San Diego, Calif.) Jun. 1972 306 p refs

(Contract DOT-FA72WA-2699)

(FAA-EQ-72-4-Vol-1) Avail: NTIS HC $17.50

A computer model is described which determines the economic impact of aircraft retrofit on the airline industry. The purpose of the model is to provide the Federal Aviation Administration with an effective procedure to rapidly and reliably determine the economic impact on the U.S airline industry of an aircraft sound suppression retrofit program under a wide variety of reasonable assumptions and alternatives. The model is capable of handling 20 airlines, 15 aircraft types and 20 years. The major computational areas of the model are: airline traffic, revenue, investment base, direct operating expenses, retrofit kit cost, change in direct operating cost due to retrofit, required capital and change in investment base due to retrofit, critical route revenue loss due to retrofit, indirect operating costs, airline rate of return on investment and fare elasticity of traffic demand. Twelve sample cases have been run to demonstrate the model's utility. The cases consist of changes in retrofit kit design, government policy and the types of aircraft covered. Author

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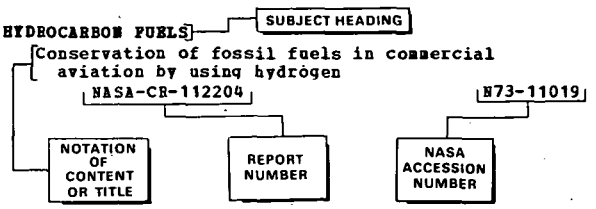

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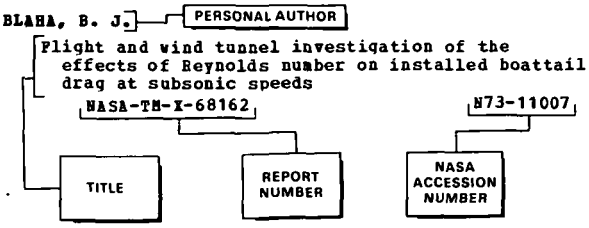

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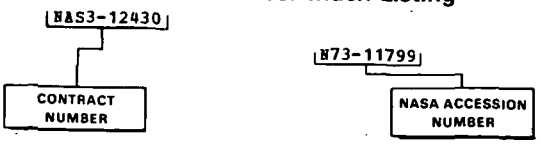

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