

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 37

NOVEMBER 1973

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 37

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 October 1973 in:

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

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. 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 511 reports, journal articles, and other documents originally announced in **October 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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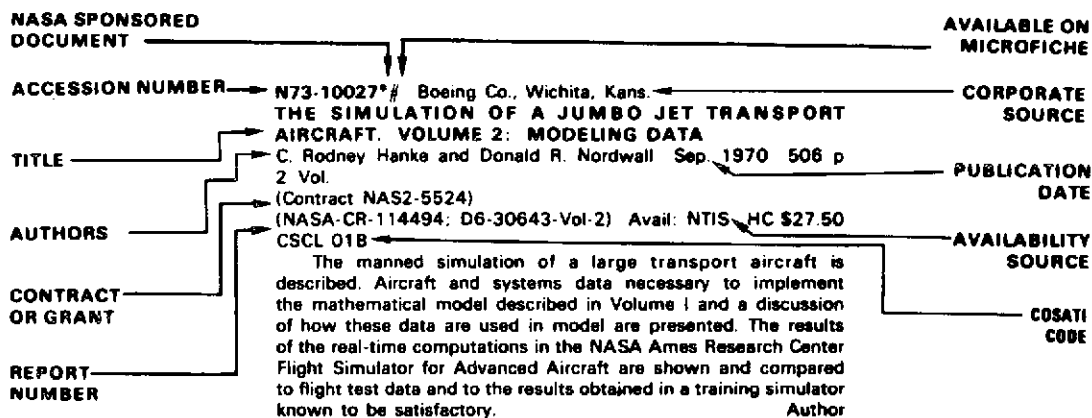
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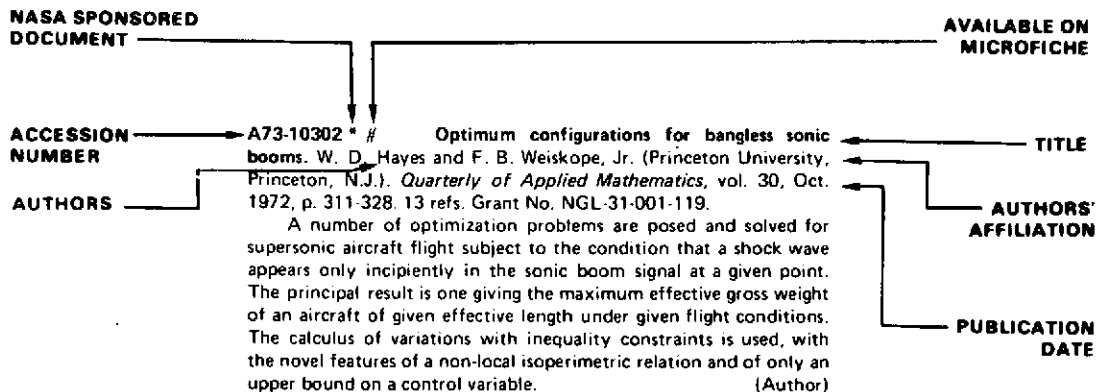
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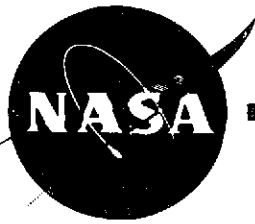
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AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 37) NOVEMBER 1973

IAA ENTRIES

A73-37187 # Synthesis of the optimal characteristics of the engines of multiengine systems (Sintez optimal'nykh kharakteristik dvigatelei mnogoprivodnykh sistem). E. G. Goloskokov and N. F. Kirkach (Khar'kovskii Politekhicheskii Institut, Kharkov, Ukrainian SSR). *Prikladnaia Mekhanika*, vol. 9, July 1973, p. 62-65. In Russian.

Methods used in the analytical design of aircraft control circuits are applied to the synthesis of the optimal characteristics of the energy sources of torsional multiengine systems with n rotors. Optimization is performed in the sense of the quality of the transient starting process, using a certain functional as the quality criterion.

V.P.

A73-37271 Impedance and far field characteristics of a linear antenna near a conducting cylinder. A. H. Cherin (Bell Telephone Laboratories, Inc., Atlanta, Ga.) and J. Goldhirsh (Johns Hopkins University, Silver Spring, Md.). *IEEE Transactions on Electromagnetic Compatibility*, vol. EMC-15, Aug. 1973, p. 110-117. 11 refs.

An analytic-numerical technique to analyze the characteristics of a thin dipole antenna near a perfectly conducting cylinder is developed. The finite length cylinder configurations considered are of practical importance in that they may represent a first-order approximation of the fuselages of vehicles such as aircraft, missiles, and satellites. A hybrid model combining wire and surface modeling techniques was used to represent the general problem. The validity of the model has been partially tested by checking the output from it with previously established experimental, theoretical, and/or numerical results.

F.R.L.

A73-37275 # Improved aircraft capability through variable camber. D. Miller (Boeing Aerospace Co., Research and Engineering Div., Seattle, Wash.). *Naval Research Reviews*, vol. 26, June 1973, p. 11-23.

Increasing camber increases the lift coefficient at which minimum drag will occur. More camber is needed to improve maneuverability, and a highly cambered airfoil will significantly reduce drag at the high lift coefficients required for air combat. Because the thin wing high speed stall and buffet problem is associated with leading edge separation, the leading edge slat has been used to alleviate the problem. Leading edge flaps represent another means of fixing the leading edge stall problems of thin wings. It is shown that variable camber design reduces drag by 1000 drag counts (coefficient of drag equals 0.100) at a lift coefficient

corresponding to the maximum usable lift of the basic wing without variable camber. A flexible panel design has been developed based on background information and testing developed in the course of preparing the 747 flexible skin variable camber Krueger flap for commercial operations.

F.R.L.

A73-37276 Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings and Tutorial Papers. Conference sponsored by the Institute of Noise Control Engineering. Edited by M. J. Crocker (Purdue University, Lafayette, Ind.). Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972. Proceedings, 580 p.; Tutorial Papers, 138 p. Price of Proceedings, \$25.; Tutorial Papers, \$12.50.

Subjects related to industrial noise criteria and control are examined together with topics connected with noise legislation and ordinances, community noise, noise control in buildings, and materials for noise control. Other areas considered include surface transportation noise, machinery noise, aircraft and airport noise, and noise instrumentation and measurement. Jet, compressor, and aircraft noise sources are also discussed, giving attention to fan noise mechanisms and control, the noise source distribution in subsonic jets, and the development of a sonic inlet for jet aircraft.

G.R.

A73-37277 * On the role of the radiation directivity in noise reduction for STOL aircraft. H. D. Gruschka (Tennessee, University, Tullahoma, Tenn.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 326-331. U.S. Department of Transportation Contract No. FA72WA-3053; Grant No. NGR-43-001-075.

The radiation characteristics of distributed randomly fluctuating acoustic sources when shielded by finite surfaces are discussed briefly. A number of model tests using loudspeakers as artificial noise sources with a given broadband power density spectrum are used to demonstrate the effectiveness of reducing the radiated noise intensity in certain directions due to shielding. In the lateral direction of the source array noise reductions of 12 dB are observed with relatively small shields. The same shields reduce the backward radiation by approximately 20 dB. With the results obtained in these acoustic model tests the potentials of jet noise reduction of jet flap propulsion systems applicable in future STOL aircraft are discussed. The jet flap configuration as a complex aerodynamic noise source is described briefly.

(Author)

A73-37278 The ultimate noise barrier - Far field radiated aerodynamic noise. J. S. Gibson (Lockheed-Georgia Co., Marietta, Ga.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 332-337. 17 refs.

The noise produced by the airframe itself as it passes through the air is considered. There are several possible aerodynamic noise sources involved, including boundary layer turbulence, fuselage

wake, and wing vortex shedding. The development of basic aerodynamic noise technology is considered, giving attention also to aural detection related noise measurements on three sailplanes. The effects of sailplane velocity and gross weight are examined. In recent investigations noise reduction effects were found to occur in the case of large areas of attached flow due to vortex sheet generation caused by feather serrations near the leading edge. G.R.

A73-37279 Noise certification of a transport airplane. N. Shapiro and J. W. Vogel (Lockheed-California Co., Burbank, Calif.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 338-343. 7 refs.

The establishment of effective perceived noise level limits to be met at three reference locations is discussed, giving attention to the allowable test conditions. Aspects of the test site are discussed together with questions of equipment and instrumentation. Difficulties encountered during the noise certification program are related to 'pseudo' high-frequency tones, ground reflection tones, an inadequate dynamic range, and transient ambient signals. Improvements are needed in the techniques and procedures for measuring aircraft flyover noise. G.R.

A73-37280 A proposed littoral airport. M. Rettinger and D. W. Green. In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 344-349.

An acoustic analysis of offshore airports is conducted, taking into account such factors as the variation of aircraft noise level with distance and the noise reduction achieved by a two-segment approach pattern. The so-called polder-and-dike system makes use of an impervious perimeter dam or causeway which is built from the sea bottom up. The water is subsequently pumped out of the basin so that the reclaimed land (the polder) can be used as a landing field. According to the fill method of construction, a man-made island is formed by dumping dirt into the ocean. Other possibilities include a caisson-carried airport and an airport held afloat by means of huge air-chambers below the water. G.R.

A73-37281 Predicting the reduction in noise exposure around airports. W. J. Galloway (Bolt Beranek and Newman, Inc., Canoga Park, Calif.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 356-361.

An airport noise model is discussed taking into account a simplified model that would allow planning analyses of alternate fleet configurations to be made without detailed knowledge of operations at each airport. The relative effect of many possible combinations can be evaluated simply by assuming a single runway airport having straight-in and straight-out flight paths. The model techniques described are applied in a planning problem involving all U.S. air carrier airports with more than 10 flights a day. G.R.

A73-37282 Aircraft noise disruption in public schools - A definition of an impasse. S. J. Kravontka (New York City, Board of Education, New York, N.Y.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 362-365. 10 refs.

A73-37283 Noise in an airport community. R. L. Hurlbut (Environmental Standards, Inglewood, Calif.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington,

D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 366-371.

An investigation concerning the possible reduction of aircraft noise was conducted, taking into account the approach angles of aircraft landing at San Diego International Airport and at Los Angeles International Airport. It was found that a reduction in aircraft noise by 56% could be achieved if 5 deg approaches were flown at Los Angeles. Other studies conducted involved the determination of noise exposure in the City of Inglewood, near the Los Angeles Airport. High noise levels were found to be correlated with low land values and with high vacancy rates. Aspects of soundproofing ordinance are also considered. G.R.

A73-37285 Correction procedure for outdoor noise measurements. P. B. Oncley (Boeing Co., Renton, Wash.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 439-444. 9 refs.

Noise measurements are of limited value unless they can be normalized to standard conditions and extrapolated to extend their range of application. The procedure requires the consideration of a large number of factors. Atmospheric absorption is a very important factor which has to be taken into account. A graph showing the absorption in dB per 1000 ft of the atmosphere between 1 kHz and 1 mHz is provided. Reflection effects are also explored, giving attention to the phase of the reflected signal and the pressure difference between total pressure and free field value. G.R.

A73-37287 Jet noise research - Progress and prognosis. T. E. Siddon (British Columbia, University, Vancouver, Canada). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 452-457. 17 refs.

The evolution of engine technology is discussed, giving attention to flyover aircraft noise and the modern high bypass turbofan engine. Annoying high frequency tones generated by complex blade interactions have been reduced by the use of a new fan technology and by the introduction of special acoustical linings. The role of basic research is discussed together with developments in diagnostic tools and aspects of the noise source distribution in a round jet. G.R.

A73-37288 Fan noise mechanisms and control. I. T. G. Sofrin (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 458-466.

Some of the special test rigs used in fan noise programs are described. Fan noise radiates in a complicated directivity pattern from the inlet and discharge ducts. At each angular position in the far field, the noise is conveniently described by the frequency distribution of acoustic energy. The three processes involved in fan noise include generation, duct propagation, and radiation. Facilities for the study of fan noise are discussed together with discrete blade passage noise generation, broadband noise generation, and combination or multiple pure tone noise. In connection with efforts to control fan noise inlet guide vanes have been eliminated and the spacing between rotating and stationary blades has been increased. G.R.

A73-37289 * Fan noise mechanisms and control. II. M. V. Lawson (Loughborough University of Technology, Loughborough, Leics., England). In: Inter-noise 72; International Conference on

Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 467-471. Research supported by the National Gas Turbine Establishment of England and NASA.

The fluctuating velocity input into the fan is measured by two approaches. One approach makes use of stationary hot wires mounted in front of the rotor. The other approach employs rotating hot wires moving with the rotor. It is shown that the noise has three principal source components including discrete frequencies, which are governed by inflow distortion, low frequency broad band noise governed by inflow turbulence, and high frequency broad band noise governed by the blade tips. G.R.

A73-37290 Noise source distribution in subsonic jets. W. T. Chu, J. Laufer, and K. Kao (Southern California, University, Los Angeles, Calif.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 472-476. 21 refs. U.S. Department of Transportation Grant No. OS-00002.

The method used in the investigation is based on the imaging principle of a spherical concave reflector. Fourier transform techniques are used in the analysis. Measurements were conducted in an anechoic chamber of both a 1 in. and a 2 in. diameter jet operating at subsonic Mach numbers up to 1. The initial results are sufficiently convincing to demonstrate that the considered approach is an accurate quantitative method for noise source distribution measurements. G.R.

A73-37291 Noise of jets discharging from a duct containing bluff bodies. E. G. Plett, M. Summerfield (Princeton University, Princeton, N.J.), T. M. Tower, and A. N. Abdelhamid (Carleton University, Ottawa, Canada). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 477-481. 8 refs. Contract No. N00014-67-A-0151-0029.

Experimental study of a noise originating from a ducted flow that exhausts as a jet into an anechoic chamber with and without bluff bodies inside the duct. The bluff bodies act as a source of unsteady flow fluctuations and of turbulence inside the duct which, in turn, result in exit plane unsteadiness. It is found that relatively small-size bluff bodies in flow ducts can produce large increases in noise levels over a wide range of jet velocities. M.V.E.

A73-37292 Effect of spanwise circulation on compressor noise generation. E. Lumsdaine (Tennessee, University, Knoxville, Tenn.) and A. Fathy (South Dakota State University, Brookings, S. Dak.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 482-487. 12 refs. NSF Grant No. GK-5030.

A theoretical method for determining fan rotor noise from the blade design characteristics is presented. The method uses a three-dimensional flow model in a cascade and combines the work of Scholz with the Prandtl lifting line theory to obtain the integral equation for circulation distribution. The effect of the casing enclosing the cascade is introduced using the well-known method of images. Comparisons of the present method with limited experimental results show good agreement. The effects of gap width, hub-tip ratio, number of blades, rpm, camber, taper angle, and twist angle on sound power level are presented. It is shown that for a given design there is a critical twist angle which will produce minimum noise. (Author)

A73-37293 Recent studies of fan noise generation and reduction. E. A. Burdall (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C.,

October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 488-495.

Summary of the work performed and results obtained under research programs whose primary objective was the development of an accurate fan noise prediction system which would make possible the selection of proper acoustical design choices for future engines and provide a deeper understanding of noise generating mechanisms. Specific noise reduction programs are reviewed. M.V.E.

A73-37294 Extraneous modes in sound absorbant ducts. P. G. Vaidya and A. S. Hilaire (Tufts University, Medford, Mass.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 496-500. 12 refs.

Brief account of some of the recent developments in the theory of transmission and attenuation of sound in lined ducts. These developments are shown to be significant for the optimization of sound attenuation and for the analysis of sound transmission instabilities in lined ducts. M.V.E.

A73-37295 Development of a sonic inlet for jet aircraft. E. Lumsdaine (Tennessee, University, Knoxville, Tenn.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 501-506. 16 refs. NSF Grant No. GK-5030.

Discussion of the problems involved in the development of a noise-suppressing choked inlet for jet aircraft, and review of some of the work performed toward their solutions. In particular, a summary of the theoretical work accomplished and of experimental results recently obtained is presented. M.V.E.

A73-37296 Combustion noise prediction techniques for small gas turbine engines. P. Y. Ho and R. N. Tedrick (AirResearch Manufacturing Company of Arizona, Phoenix, Ariz.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 507-512. 5 refs.

Investigation of the engine parameters that control the generation of combustion noise in small gas turbine engines. An empirical evaluation of potential noise factors affecting exhaust noise was conducted. A parameter uniting the combustor inlet temperature, the combustor discharge velocity, and the equivalent discharge diameter of the combustor was found. A similar expression was derived dimensionally and compared with data from both combustor rig and engine tests. In particular, two equations are presented that provide a method for the small gas turbine engine designer to predict the acoustical power level generated by a given design and to determine the effects of changing one or more design parameters. This method has proven useful for several different families of small engines. M.V.E.

A73-37297 Engineering design considerations in the noise control of commercial jet aircraft's vent and drain systems. A. G. Jhaveri (Harris F. Freedman and Associates, Mercer Island, Wash.). In: Inter-noise 72; International Conference on Noise Control Engineering, Washington, D.C., October 4-6, 1972, Proceedings. Poughkeepsie, N.Y., Institute of Noise Control Engineering, 1972, p. 513-518.

Approaches are considered for controlling unacceptable and unsatisfactory noise levels prevalent in the cabin lavatories and toilet rooms of a modern jet aircraft. The objectionable noise is mainly produced by the operation of exhaust air-vent and water drain systems, including the toilet flush mechanisms. An acoustical muffler

was designed for controlling exhaust and intake noise levels. A mock-up of the existing vent/drain system was built for an acoustical evaluation of the muffler in the laboratory. G.R.

A73-37332 Application of self-organizing control to remote piloting of vehicles. R. L. Barron (Adaptronics, Inc., McLean, Va.) and R. A. Gagnon (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio). In: Remotely manned systems: Exploration and operation in space; Proceedings of the First National Conference, Pasadena, Calif., September 13-15, 1972. Pasadena, Calif., California Institute of Technology, 1973, p. 409-422. 21 refs. USAF-supported research.

All electrooptical (E-O) and electromagnetic (E-M) instruments for remotely manned spacecraft and aircraft can measure phenomena indicative of the magnitude of the resultant bearing angle (boresight angle) between a fiducial axis in the instrument assembly and an external point target or signal source. It is shown that the remote piloting of vehicles can be materially aided by the use of simple E-O or E-M sensors in primary or backup control systems which can successfully employ self-organizing control logic to process input information under circumstances that would be highly confusing for the remote pilot, thus providing means to augment his actions or take over from him in automatic modes of control. F.R.L.

A73-37374 # Measurements of surface pressure on an elliptic airfoil oscillating in uniform flow. T. Asanuma, A. Takaku, A. Okajima, and T. Tanikatsu. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin*, vol. 9, Apr. 1973, p. 323-341. 9 refs. In Japanese, with abstract in English.

In order to analyze the dynamic characteristics of an elliptic airfoil oscillating in a uniform flow, the distributions of steady and unsteady pressure over the surface of the airfoil are measured simultaneously by using many newly developed miniature pressure transducers. These transducers were especially designed to be easily and directly applied to any arbitrary spot on the moving surface. Measurements are carried out for various Reynolds numbers, angles of attack, and frequencies of airfoil oscillation. Analysis of these measurements indicates that the characteristics of the pressure distribution depend essentially on whether or not the airfoil is operating in the stalled state. Furthermore, the normal forces calculated from the pressure distributions are found to be in good agreement with those measured directly by means of a strain gauge. (Author)

A73-37385 The Doppler landing system (Le système d'atterrissage Doppler). P. Fombonne (Thomson-CSF, Paris, France). *Navigation (Paris)*, vol. 21, July 1973, p. 298-314. In French.

When the Doppler system was presented to the American SC 117 committee created by the Radio Technical Commission for Aeronautics to propose a system of landing intended to succeed the Instrument Landing System (ILS), in competition with systems of mechanical and electronic beating beams, it was received with much interest. The basic principles and history of the Doppler system are outlined, and the correspondence between the two SC 117 systems is discussed. The spectrum and granularity of the real Doppler system are considered. The Doppler system partakes along with the classical linear networks the particularity of distributing information following conical surfaces having the network for axis; the equivalent lobe is conical. The fact of adding a reflector or horn to the network does not change anything. F.R.L.

A73-37386 Air traffic control and the prevention of collisions (Le contrôle du trafic aérien et la prévention des collisions). C. Castelbou (Compagnie Nationale Air France, Paris, France). *Navigation (Paris)*, vol. 21, July 1973, p. 355-365. In French.

In controlled air spaces, air traffic control is responsible for collision avoidance under instrument weather conditions by maintenance of adequate separation. In visual weather conditions, it is only responsible for maintenance of separations. The obligatory IFR airspace, the controlled airspace where VFR flights are monitored by ATC, mixed civil-military airspaces, and the controlled airspace without particular rules of admission are considered. Attention is given to high density, positive control, mixed, and uncontrolled airspaces. Pilot-controller liaison, aircraft control center liaison, and intersector and interregion control coordination are treated. F.R.L.

A73-37405 Symposium on Optimisation in Aircraft Design, London, England, November 15, 1972, Proceedings. Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1972. 80 p. \$5.75.

The papers deal with optimization problems encountered in the design of civil and military aircraft. The topics covered are the application of numerical methods to optimization calculations; optimization methods based on linear programming; methods of optimizing aircraft structures and wing design; the application of a parameter optimization technique to flight control system design; and a procedure for optimizing an aircraft as a whole. V.P.

A73-37406 # Optimization methods based on linear programming. E. M. L. Beale (Scientific Control Systems, Ltd., London, England). In: Symposium on Optimisation in Aircraft Design, London, England, November 15, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 12 p. 16 refs.

The simplex method for linear programming, the type of problems to which it is applied, and some developments based on this method are discussed. Linear programming is shown to be a powerful tool in operational research, where resource allocation studies may produce large linear programming problems in which each variable occurs in only a few constraints. The solution of such problems with up to 10,000 equations and a large number of variables can be solved by this technique. The application of the technique to technical optimization studies is examined, and the search for global optimum solutions to problems involving qualitative variables and to problems with several local optima is discussed. V.P.

A73-37407 # Optimisation in aircraft structures. I. C. Taig and R. I. Kerr (British Aircraft Corp., Ltd., Military Aircraft Div., Warton, Lancs., England). In: Symposium on Optimisation in Aircraft Design, London, England, November 15, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 21 p. 8 refs.

The application of formal techniques of optimization to the designing of military aircraft is demonstrated by examples. One approach, termed local optimum design, is understood to mean the determination of a set of component dimensions (subject to practical constraints), such that the mass of the component is the minimum necessary to transmit a prescribed set of loads. A specific feature of the technique is that the structural analysis is not modified within the optimization procedure, so that the resulting structure is to some extent inconsistent with the assumed loadings. Two or three cycles of the complete analysis/design procedure usually suffice to reduce this discrepancy to an acceptable level. Another approach, applicable to any structure built up of members whose stiffnesses are proportional to their masses and which is designed to satisfy simultaneously any number of generalized stiffness requirements, is based on a theorem which defines necessary criteria for the structure to be optimum. V.P.

A73-37408 # The optimisation of wing design. P. F. Hughes and R. S. Davies (British Aircraft Corp., Ltd., Weybridge, Surrey, England). In: Symposium on Optimisation in Aircraft Design,

London, England, November 15, 1972, Proceedings.

London, Royal Aeronautical Society, 1972. 18 p.

Work performed to improve efficiency and provide real time savings in the field of wing geometry definition and data transmission is described. The optimization of the design of three-dimensional wing geometries, and their expression of these geometries by the intrinsic parametric method is demonstrated. The computer system described is a set of compatible programs processing data to and from the geometry data library, i.e., magnetic tapes or disks on which section data, planform data, and surface data can be stored. The form of representation was chosen as the most appropriate to the generation of wing sections and surfaces on the basis of intrinsic parametric equations. The individual programs of the system may be considered as data converters between the data library and various aerodynamic procedures. The use of least squares techniques employed in these data converters is discussed. V.P.

A73-37409 # A parameter optimisation technique applied to the design of flight control systems. F. R. Gill and M. R. Watts (Royal Aircraft Establishment, Farnborough, Hants., England). In: Symposium on Optimisation in Aircraft Design, London, England, November 15, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 9 p.

A parameter optimization procedure and its application to design studies of numerous flight control modes and integrated systems are described. In this technique, control parameters are automatically and simultaneously selected to minimize a function chosen to represent all aspects of performance. One or two elements are minimized whilst constraining all others to be less than preselected values. Some problems are examined which have arisen in the application of the technique to the design of complete systems or subsystems for practical evaluation in fighter-attack and transport aircraft. The example used for illustration is part of an elevator control system. It also illustrates the complexity of a relatively simple problem. Elements of the hybrid computer program used in parameter optimizations are described. V.P.

A73-37410 # Optimisation in aircraft design - The whole aircraft. A. W. Bishop (Hawker Siddeley Aviation, Ltd., Hatfield., Herts., England). In: Symposium on Optimisation in Aircraft Design, London, England, November 15, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 13 p. 7 refs.

The problem of choosing the criterion for optimizing the design of an entire aircraft is discussed, and the constraints that can affect the optimization processes are examined. The accuracy of the predictions (at various times) in the design process is assessed. The optimization during feasibility studies and during project design is covered in detail. V.P.

A73-37451 # Recent progress in boundary layer research. H. Schlichting (Braunschweig, Technische Universität, Braunschweig; Aerodynamische Versuchsanstalt, Göttingen, West Germany). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-780.* 24 p. 67 refs. Members, \$1.50; nonmembers, \$2.00.

Review of some of the advances in boundary-layer theory and research applications achieved in Germany in the course of the last five years. Discussed basic research topics include turbulent boundary layers in supersonic flow, in laminar free convection flow, layers on a flat plate with suction and injection, or with pressure gradient and heat transfer, as well as turbulent near-wake flow, heat transfer in supersonic flow, and stability in Poiseuille flow. Reviewed boundary layer research applications in aeronautics concern maximum lift coefficient calculation for airfoils in incompressible flow, drag reduction of airfoils in transonic flow, boundary layers on a Caret wing in hypersonic flow or on a delta wing at a high angle of attack. Boundary layer research applications to turbomachinery are also surveyed. M.V.E.

A73-37452 # B-52 control configured vehicles ride control analysis and flight test. J. R. McKenzie (Boeing Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-782.* 8 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-71-C-1926.

A73-37453 # An in-flight investigation of the influence of flying qualities on precision weapons delivery. G. W. Hall, N. C. Weingarten (Calspan Corp., Buffalo, N.Y.), and J. L. Lockenour (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-783.* 7 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1072.

A73-37454 # Evaluation of F-15 inlet dynamic distortion. A. P. Farr (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-784.* 9 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33657-70-C-0300.

Description of an instrumentation and data acquisition system for evaluating inlet dynamic distortion. The system consists of the following: high- and low-response pressure transducers mounted in an inlet rake; data acquisition systems for both high- and low-response measurements; and an analog computer for economical evaluation of dynamic distortion data. The rake incorporates 48 low-response and 48 high-response total-pressure probes, arranged in an 8-leg, 6-ring configuration. A set of matched filters removes the high-frequency components from the low-response signals, and the low-frequency components from the high-response signals. After filtering, separate data acquisition systems record the low- and the high-response data. Because cost prohibits digital reduction of all recorded data, an analog computer is used to monitor the data and mark the data tape in the regions of peak distortion. (Author)

A73-37455 # Design-build-fly, an effective method to teach undergraduate aerospace vehicle design. A. G. Bennett (Mississippi State University, State College, Miss.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-785.* 8 p. Members, \$1.50; nonmembers, \$2.00.

A73-37456 # Design for teaching aerospace engineering at Texas A & M University. C. A. Rodenberger, S. H. Lowy, J. L. Rand, and D. J. Norton (Texas A & M University, College Station, Tex.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-786.* 5 p. Members, \$1.50; nonmembers, \$2.00.

The supervised performance of specific design teamwork tasks by aerospace engineering students in their senior year is shown to increase student motivation, improve both oral and written communication skills, develop the student's confidence in his ability to define engineering problems and to generate adequate solutions, and prepare the student better for the professional practice of engineering by providing a transition from the University concept of an individual working in isolation to the industrial environment of engineers working as a team. Reviewed task areas include structural, gas-turbine, and aerospace vehicle design. The limitations of the team design approach as a teaching tool are also discussed. M.V.E.

A73-37457 # A new approach to aircraft design education. J. Roskam (Kansas, University, Lawrence, Kan.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-787.* 6 p. 34 refs. Members, \$1.50; nonmembers, \$2.00.

A new approach to aircraft design education is outlined that requires every student in his senior year to design an airplane to a given specification in competition with his peers. Students can

participate in actual airplane oriented hardware development projects and receive both financial and academic credit for so doing. These R & D projects are strongly integrated with graduate programs. M.V.E.

A73-37458 # Compatibility of maneuver load control and relaxed static stability. L. H. Pasley, W. J. Rohling, and W. J. Wattman (Boeing Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-791.* 10 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-71-C-1181.

The design of two classes of military aircraft, a bomber and a fighter, was used to investigate the compatibility of the relaxed-static-stability and maneuver-load-control concepts of advanced flight control technology in the achievement of significant flight performance improvements. The primary question to be answered was: do the two concepts operating simultaneously enhance or degrade each other and are the combined performance gains the sum of the gains of the individual concepts. The results of the investigation show that the two concepts are completely compatible. The performance benefits from each concept incorporated independently were essentially additive when both systems were incorporated simultaneously. (Author)

A73-37459 # A synthesis of transonic, 2-D airfoil technology. K. P. Burdges (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-792.* 14 p. 14 refs. Members, \$1.50; nonmembers, \$2.00.

Design of supercritical transonic wings using subcritical methods is effective but requires an empirical relationship between airfoil subcritical characteristics and transonic performance. Results of a two-dimensional airfoil test program are presented for systematic variations in four regions of subcritical design pressure distribution: leading edge suction peak, recompression region, aft loading region, and lower surface suction peak. The design concepts, experimental data, and correlation of analytical methods are synthesized into a useable statement of 2-D, transonic airfoil design methodology with specific design criteria. The design methodology and specific criteria cover cruise conditions as well as off-design conditions. (Author)

A73-37460 # Computer aided design-drafting (CADD)/Engineering/manufacturing tool. C. H. English (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-793.* 7 p. Members, \$1.50; nonmembers, \$2.00.

A description is given of a powerful computer-operated graphic system which has made designers many times more productive than when they are using conventional drawing board methods. High engineering productivity, however, is only an initial benefit. When fully developed, the system will allow manufacturing personnel to machine parts, utilizing the programmed data created by the designer at the console, without writing additional programmed instructions to drive the milling machines. In addition, tool design and quality assurance personnel have direct access to the original three-dimensional geometric data, thus eliminating misinterpretation of design intentions. With lofted surfaces developed, defined mathematically, and stored in a shared-computer file, a designer is able to indicate the plane in which a lofted contour is desired, and in a matter of seconds, he can have the contour displayed on the CRT. This enables the designer to create a design almost as fast as he can think. Further, his designs are defined mathematically at a degree of accuracy never before known. (Author)

A73-37461 # Effects of noise curfews on airline operations. R. J. Hart (Pan American World Airways, Inc., New York, N.Y.).

American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-798. 11 p. Members, \$1.50; nonmembers, \$2.00.

The role of night curfews in the system of constraints governing airline operations is explored. The effects of currently imposed curfews around the world are described with some specific examples indicating that the ability of the individual air carrier networks to adjust to these constraints is already undergoing some strain. Estimations are made of the probable effects of nationwide and worldwide curfews for both subsonic and supersonic aircraft which show that the efficiency and utility of the air transport system would be seriously reduced. (Author)

A73-37462 # Managerial implications of computerized aircraft design synthesis. W. L. Straub, Jr. (LTV Aerospace Corp., Dallas, Tex.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-799.* 10 p. 16 refs. Members, \$1.50; nonmembers, \$2.00.

A summary of the managerial aspects of starting the aerospace vehicle design synthesis programs is presented in two tables. Feasibility studies are discussed together with computer systems. System developments in the case of a number of American aerospace firms and of NASA are considered. It is found that the use and the development of synthesis or parametric analysis programs have substantially aided interdisciplinary communications. Modular program construction with open ended capability for revision/update is either used or sought by all program developers. The success of a design synthesis model is strongly dependent upon the cooperation and effective working relationship between the synthesis group and the technology groups. (Author)

A73-37463 # DC-10 full-scale fatigue test program. M. Stone (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-803.* 7 p. Members, \$1.50; nonmembers, \$2.00.

This paper presents information on crack initiation, crack growth and residual strength from development and full-scale repeated load tests conducted on the DC-10 airframe structure. The influence of test schedules on drawing release of structural components is reviewed. Development tests used to establish service life, operating stress levels, detail design and fabrication procedures are described in detail. Multisection testing used to accelerate full-scale testing is discussed. Results showing fatigue sensitive areas, identification of design improvements, and incorporation of repairs of modifications into early delivered airplanes are also discussed. (Author)

A73-37464 # Weldbonding/rivetbonding - Application testing of thin gauge aircraft components. J. M. Craddock (LTV Aerospace Corp., Dallas, Tex.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-805.* 9 p. Members, \$1.50; nonmembers, \$2.00.

The use of weldbonding/rivetbonding is studied as a solution to the acoustic fatigue problem in thin gauge aircraft components. Three test panels were fabricated by Vought Systems Division (VSD) using (1) a baseline, conventional A-7 riveted construction, (2) weldbonding by 'weld-through' techniques, and (3) weldbonding by 'capillary' techniques. These panels were tested by the U.S. Air Force Flight Dynamics Laboratory in a joint cooperative effort with VSD. Testing consisted of static strength and acoustic fatigue. The work has shown that the weldbonded components were considerably stiffer and possessed greatly improved fatigue life characteristics over the conventional baseline component. (Author)

A73-37465 # Aircraft installation requirements and considerations for variable pitch fan engines. R. T. Kawai (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics*

and *Aeronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-807*. 8 p. Members, \$1.50; nonmembers, \$2.00.

Studies have been conducted using the variable pitch fan engine for externally blown flap powered lift aircraft. Results show the variable pitch fan promises to be a viable propulsion system for future short-haul aircraft that have to meet noise limits below 100 EPNdB on a 500-foot sideline. The use of fan pitch change to eliminate the need for a separate thrust reverser, and the use of a variable area nozzle for flow control may allow improved capabilities. These potential benefits to aircraft design and operations are reviewed. Reasons for ground and flight test demonstrations are summarized. (Author)

A73-37466 # V/STOL aircraft testing for the sea control ship environment. G. E. Clarke, J. G. Hoeg, and J. M. Rebel (U.S. Navy, Naval Air Test Center, Patuxent River, Md.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-810*. 8 p. Members, \$1.50; nonmembers, \$2.00.

Shipboard testing of the AV-8A Harrier was conducted in an effort to expand and redefine the operational envelope to increase the utility of V/STOL type aircraft in the carrier environment. Specific objectives were to determine the minimum launch speeds for a short takeoff and to evaluate the effects of a quick release holdback on takeoff performance. Minimum airspeeds were found to be essentially those predicted from a performance study performed by the Royal Aircraft Establishment. Use of the quick release holdback resulted in end-of-deck speeds one to two knots greater than free deck takeoffs. However, the gains were negated by earlier automatic thrust reduction by the jet pipe temperature limiter due to the longer time at the maximum thrust rating. (Author)

A73-37467 # Direct side force control for STOL crosswind landings. E. M. Boothe and H. J. Ledder (Calspan Corp., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-811*. 13 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1712.

The Total In-Flight Simulator (TIFS) airplane was used to investigate the application of direct side force control (DSFC) to alleviate the crosswind landing problem. The TIFS airplane was configured to simulate the characteristics of a Class II STOL aircraft for these tests. Fifty-four evaluations were accomplished, including the first demonstration of the use of DSFC to perform wings-level crosswind landings. It was concluded that DSFC significantly improved the pilot's ability to perform a crosswind landing and was particularly beneficial when the basic airplane exhibited degraded flying qualities. (Author)

A73-37468 # Development of an Air Cushion Landing System. D. J. Perez and W. A. Benner (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-812*. 12 p. Members, \$1.50; nonmembers, \$2.00.

The Air Cushion Landing System is based on the ground effect principle which employs a stratum of air instead of wheels as the aircraft ground contacting medium. The concept has experienced an evolutionary process from wind tunnel and dynamic free-fall models to actual flight test vehicles. The flight test vehicles include the 2500 lb Lake LA-4 and the 41,000 lb de Havilland XC-8A. The LA-4 has demonstrated the ability to operate from snow, rough terrain, soft soil strips and even lakes. This paper summarizes the important ACLS developments, including the XC-8A; flight test films will be included. (Author)

A73-37469 * # Noise from turbomachinery. C. E. Feiler and E. W. Conrad (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-815*. 10 p. 28 refs. Members, \$1.50; nonmembers, \$2.00.

This paper reviews turbomachinery noise from turbofan engines as typified by fan noise. The mechanisms and theories of fan noise are reviewed and concepts for its reduction, including acoustic suppression are discussed. Correlations of the overall noise data from several full-scale fans tested at NASA-Lewis Research Center are presented as indicative of the current state-of-the-art. Estimates are presented to show economics versus reduced noise for two quieted experimental engines, one with subsonic and one with supersonic fan tip speed. Finally, some concepts that may have the potential to reduce fan noise are indicated. (Author)

A73-37470 * # The design or operation of aircraft to minimize their sonic boom. A. R. Seebass (Cornell University, Ithaca, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-817*. 9 p. 32 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. NGR-33-010-054.

Means of reducing or eliminating the sonic boom through aerodynamic design or aircraft operation are discussed. These include designing aircraft to minimize or eliminate certain features of the overpressure signature, operating aircraft at slightly supersonic speeds so that the sonic boom does not reach the ground, and seeking reductions through the high altitude-high speed flight conditions of hypersonic transports. A simple computer program has been developed that determines the area development of the equivalent body of revolution required to minimize various sonic boom signature parameters. (Author)

A73-37471 # Consequences of aircraft noise reduction alternatives on communities around airports. R. L. Paullin and H. B. Safer (U.S. Department of Transportation, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-818*. 10 p. 13 refs. Members, \$1.50; nonmembers, \$2.00.

It is expected that the introduction of jet aircraft with new, high bypass ratio engines which are quieter than their predecessors will, over the long run, afford relief from noise to airport neighbors. An airport analysis is discussed together with a population analysis, modified approach procedures, and a cost analysis. Relations between noise reduction effectiveness and cost are explored. It is found that the noise reduction effectiveness of each alternative varies as a function of time. An analysis is conducted of the cost/effectiveness associated with retrofitting the current fleet with either new nacelles or refanned engines and new nacelles or modified operational procedures. G.R.

A73-37472 # The F-12 series aircraft aerodynamic and thermodynamic design in retrospect. B. R. Rich (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-820*. 10 p. 7 refs. Members, \$1.50; nonmembers, \$2.00.

A brief description of the F-12 series aircraft, and the concepts behind the design are presented. An aerodynamic discussion of some of the unique features of the aircraft, such as the blended body or chine, the all-movable verticals, and flight characteristics are shown. A review of the thermodynamic procedures and a comparison of estimated and flight test data are presented. A series of miscellaneous factors related to Mach 3 flight experience, such as the effects of ambient temperature, sonic boom, weather balloons, and in-flight refueling are discussed. (Author)

A73-37473 # F-12 series aircraft propulsion system performance and development. D. H. Campbell (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-821.* 11 p. Members, \$1.50; nonmembers, \$2.00.

The F-12 series of aircraft share a common propulsion system. The major elements of this system are described. Flight performance of the inlet, engine, and ejector are treated, and the importance of flow field simulation and engine nacelle leakage are demonstrated. The inlet design philosophy is discussed along with the importance of inlet control to the whole propulsion system. The inlet unstart is described, followed by a brief development history of the control schedules and their effect on the frequency of unstarts. Close cooperation between the airframe and engine manufacturers allowed an interface beneficial to the propulsion system. (Author)

A73-37474 # The development of the F-12 series aircraft manual and automatic flight control system. J. R. McMaster and F. L. Schenk (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-822.* 13 p. 5 refs. Members, \$1.50; nonmembers, \$2.00.

Description of the manual and automatic flight control system of the F-12 series aircraft. The impact of the aircraft configuration and flight regime on the design philosophy utilized in the design of the control system is reviewed. Implementation of this design philosophy into a relatively simple, highly reliable control system for the first supersonic cruise aircraft is described in detail. The development process from initial analog computer analysis to first flight is reviewed. Flight experience including reliability on the triple-redundant, fail-operational stability augmentation is presented. Differences from conventional flight control practice are noted and justified. The inadequacy of certain conventional pilot presentations is discussed. Finally, the control problems encountered in high-speed, high-altitude flight are identified. (Author)

A73-37475 # Flight testing the F-12 series aircraft. R. L. Miller, Jr. (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-823.* 6 p. Members, \$1.50; nonmembers, \$2.00.

The airplanes were tested largely within the framework of military specifications applicable in the 1965-1966 time period and did extremely well in meeting the published requirements. The wide range of speeds and altitudes made the normal design flight profile the most logical performance testing area, with limited excursions for off-design checks. Stability and control tests included enough without stability augmentation operative to assure adequate definition of basic aerodynamic coefficients. Structural flight tests were at critical design speeds and weights. Safety chase aircraft information at high supersonic Mach numbers provided interesting results. (Author)

A73-37476 National Symposium on Computerized Structural Analysis and Design, George Washington University, Washington, D.C., March 27-29, 1972, Proceedings. *Computers and Structures*, vol. 3, July 1973, 236 p.

The application of computers to the analysis and design of structures is considered in papers dealing with specific numerical methods and algorithms for calculations involving aircraft structures, shells, concrete elements, seismic structures, and thin-walled steel beams. Topics examined include the selection of optimal materials for meeting conflicting design objectives, the application of reliability concepts in structural design, membrane statics of parachute-like shells termed scalloped paraboloids, numerical prediction of the post-buckling response of cold-formed stainless steel beams, and high-frequency acoustic vibration of flight-vehicle structures representative of wing or stabilizer designs.

T.M.

A73-37483 Finite element elastic-plastic-creep analysis of two-dimensional continuum with temperature dependent material properties. N. A. Cyr and R. D. Teter (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). (*National Symposium on Computerized Structural Analysis and Design, Washington, D.C., Mar. 27-29, 1972.*) *Computers and Structures*, vol. 3, July 1973, p. 849-863. 16 refs.

A73-37486 Automated structural design and analysis of advanced composite wing models. L. A. McCullers and J. D. Naberhaus (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). (*National Symposium on Computerized Structural Analysis and Design, Washington, D.C., Mar. 27-29, 1972.*) *Computers and Structures*, vol. 3, July 1973, p. 925-935. Contract No. F33615-70-C-1837.

A finite-element procedure and a direct Rayleigh-Ritz procedure, specialized for the preliminary analysis of wing-type structure, are investigated. The use and accuracy of these procedures have been demonstrated on a low cost, low risk basis in the design and analysis of a composite wind tunnel model and in test-theory correlation for static and dynamic response. Material selection, intermediate design decisions, fabrication, testing for natural modes and frequencies, and testing for influence coefficients for the wind tunnel model are discussed. (Author)

A73-37487 The lift on a wing in a turbulent flow. R. Jackson (Rolls-Royce, Ltd., Bristol, England), J. M. R. Graham (Imperial College of Science and Technology, London, England), and D. J. Maull (Cambridge University, Cambridge, England). *Aeronautical Quarterly*, vol. 24, Aug. 1973, p. 155-166. 16 refs. Research supported by the Science Research Council.

Experiments are described in which the lift on a rectangular element of a two-dimensional wing and on a finite aspect ratio wing has been measured in grid turbulence. By measuring the spectrum of the lift and the spectrum of the turbulence upwash component, an experimental value for the turbulent admittance may be found. This is compared with a calculated value based upon linearized theory. (Author)

A73-37490 Interference between a wing and a surface of velocity discontinuity. N. Inumaru (National Aerospace Laboratory, Tokyo, Japan). *Aeronautical Quarterly*, vol. 24, Aug. 1973, p. 192-206. 12 refs.

A study is made on the aerodynamic interference between a wing and a surface of velocity discontinuity in a nonuniform potential flow field. Actually, the surface of velocity discontinuity is deformed around the wing, which penetrates the surface, but no theoretical predictions of the surface deformation can be found in existing papers. In the present paper, a deformation of the surface is theoretically predicted, leading to the conclusion that a 'sectorial region' will be formed on the wing. Formation of the sectorial region is recognized in new experiments and in many existing experimental results. Both theoretical and experimental analyses are made of the physical roles of the sectorial region. (Author)

A73-37493 A theoretical note on the lift distribution of a non-planar ground effect wing. T. Kida and Y. Miyai (Osaka Prefecture University, Sakai, Osaka, Japan). *Aeronautical Quarterly*, vol. 24, Aug. 1973, p. 227-240. 8 refs. Research sponsored by the Matunaga Memorial Foundation.

The problem of a nonplanar wing of finite span very close to the ground is considered by the method of matched asymptotic expansions. This method is based on the work of Widnall and Barrows, in which a planar wing very close to the ground was examined in detail. A simple analytic solution, to first-order approximation, is obtained for a nonplanar wing which is uncambered. Expressions for the lift coefficient, induced angle and induced drag coefficient, which are valid for small ground clearance

and moderately small aspect ratio, are derived for the case when the configuration of the wing projected onto a transverse plane normal to the free stream is elliptic. The problem of the optimum lift distribution around the wing and the rolling-moment coefficient for the inclined flat wing are discussed. (Author)

A73-37494 Towards microwave landings. J. McIlwraith (National Air Traffic Service, London, England). *Flight International*, vol. 104, July 26, 1973, p. 131-135.

The microwave landing system (MLS) remains to be verified in extensive testing under all conditions. MLS is intended to provide increased accuracy and reliability of the guidance signal in space. To achieve this and to ensure more freedom from environmental and siting effects, most of the proposals submitted to ICAO are for systems operating in C-band (5 GHz) with flare guidance provided in most instances at Ku-band (15 GHz). The operational requirement calls for equipment modularity to enable ground-based systems to be tailored to the type and grade of service required at a particular site. In the air-derived systems which have been proposed, the ground stations will provide volumetric coverage of angle guidance signals to enable the airborne receiver to obtain precision guidance information in azimuth, elevation, and range relative to the touchdown point. Auxiliary information will also be transmitted to the aircraft. F.R.L.

A73-37495 MLS and the industry. H. W. Cowin. *Flight International*, vol. 104, July 26, 1973, p. 135-138.

Four major programs are discussed. The U.S. program is aimed at developing a modular, building-block microwave landing system that would meet the needs of everything from fully automatic landings in CAT 3b weather down to the simpler instrument approach requirements of a light aircraft. ICAO instrument landing system studies, and the NATO industrial advisory group (NIAG) and interim instrument landing systems are considered. F.R.L.

A73-37496 * # Cyclic oxidation evaluation - Approaching application conditions. C. A. Barrett and E. B. Evans (NASA, Lewis Research Center, Cleveland, Ohio). *American Ceramic Society, Annual Meeting and Exposition, 75th, Cincinnati, Ohio, Apr. 29-May 3, 1973, Paper. 22 p.* 6 refs.

Review of 1000 to 1200 C cyclic oxidation testing conducted on potential aircraft gas turbine Ni-, Co-, and Fe-base alloys. Furnace and burner rig testing are discussed, and the results are compared for selected alloys. The alloys fall into two groups, depending on their Cr and Al contents. One group forms mainly Cr₂O₃/chromite spinel scale(s), while the other forms alpha Al₂O₃/aluminate spinel scale(s). Spalling on thermal cycling leading to increased metal consumption is associated with the appearance of a chromite spinel. In the case of high-velocity burner rig tests this chromite forming tendency is reinforced by Cr₂O₃ vaporization depleting Cr in the alloy. In both types of tests, specific weight change is used as an indirect indicator of metal attack, since direct metal loss measurements require destructive analysis. An alternative nondestructive metal loss estimating parameter, based on a tentative mass balance gravimetric approach, shows some potential. (Author)

A73-37498 * # Turbojet emissions - Hydrogen versus JP. J. Grobman, C. Norgren, and D. Anderson (NASA, Lewis Research Center, Cleveland, Ohio). *Working Symposium on Liquid-Hydrogen-Fueled Aircraft, Hampton, Va., May 15, 16, 1973, Paper. 22 p.* 20 refs.

Preliminary data from an experimental combustor show that the NO sub x emission index, g (NO₂)/kg fuel, is about three times greater for hydrogen than for JP at simulated cruise conditions. However, if these results are applied to aircraft designed for a given mission, hydrogen's higher heating value enables the aircraft to have a lower gross weight and a lower fuel flow rate so that the NO sub x emission rate, kg(NO₂)/hr may be reduced about 30% compared to JP. Theoretical kinetics calculations indicate that combustors may be

designed for hydrogen that could further decrease NO sub x emissions by taking advantage of hydrogen's wide flammable limits and high burning velocity. (Author)

A73-37500 Very short range local area weather forecasting using measurements from geosynchronous meteorological satellites. G. J. Sikula and T. H. Vonder Haar (Colorado State University, Fort Collins, Colo.). *Archiv für Meteorologie, Geophysik und Bioklimatologie, Serie A - Meteorologie und Geophysik*, vol. 22, no. 2-3, 1973, p. 227-256. 14 refs. Research supported by Colorado State University; Contract No. F1962B-71-C-0073.

Quantitative radiance measurements from NASA's ATS-3 geosynchronous satellite have been used to develop and test a statistical forecast method to predict air terminal weather over the very short range (0-6 hours) time period. Results from more than 800 hourly weather situations at a wide range of U.S. weather stations show that the parameters of ceiling and total opaque cloud cover can be specified or predicted with skill, exceeding persistence forecasts for time periods greater than two hours. Statistical predictions based on satellite data alone are much better than those based on some 500mb upper air parameters tested. The potential global applications of the satellite data-based forecasts can apparently be improved by the use of certain criteria, such as region of interest, in developing and applying the multiple regression equation. Considering the present status of objective short range weather forecasting, these first results using geosynchronous satellite data demonstrate a new potential for improved forecasts at this scale. (Author)

A73-37545 # New contributions to the iterative method for aerodynamic calculations of wings in subsonic flows (Noi contributii la metoda iterativa pentru calculul aerodinamic al aripii in regim subsonic). N. N. Patraulea (Institutul de Mecanica a Fluidelor si Constructii Aerospatiale, Bucharest, Rumania). *Studii si Cercetari de Mecanica Aplicata*, vol. 32, no. 1, 1973, p. 15-29. In Rumanian.

Application of a method presented earlier by the author (1972) to the aerodynamic calculation of aircraft wings in subsonic flows. In the proposed method the number of divisions of the wing span is reduced by considering oblique vortices the finite sides of which are not parallel to the y-axis but have a variable direction which converges to the direction of the wing taper. It is shown how the structure of the turbulent nucleus can be calculated by attaching the turbulent vortices to the wing. A general procedure for extrapolating the results to an infinite number of divisions is outlined. The use of the proposed method is illustrated by applying it to a variety of wings of different aspect ratios and shapes. A.B.K.

A73-37546 # Certain interesting aspects of conical flows (Citeva aspecte interesante ale miscarilor conice). E. Carafoli and S. Staicu (Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Studii si Cercetari de Mecanica Aplicata*, vol. 32, no. 1, 1973, p. 31-54. 5 refs. In Rumanian.

Study of supersonic flows past delta-shaped obstacles or tapered structures which correspond to conical compressions or expansions. Choosing certain examples of simple or mixed (expansion and compression) flows, the pressure distributions and the transverse profile configurations of the tapered structures are determined. Following this, a study is made of the flow past an antisymmetric delta wing with constant angle of attack, taking into account flow separation at the leading edge, as an application of the concept of negative slope. This latter problem is solved by substituting for the complex flow past the real wing the sum of three conical flows past three different types of equivalent fictitious wings. A.B.K.

A73-37584 Operational principles and testing of a digital radar target extractor (Wirkungsweise und Erprobung eines digitalen Radar-Zielextraktors). L. Späth and B. Zick (Bundesanstalt für Flugsicherung, Frankfurt am Main, West Germany). *Elektronik*, vol. 22, July 1973, p. 237-241. In German.

A device which uses the principle of the moving-window

detector to provide automatic target recognition in air traffic control is described. Its main purpose is to provide a link between the (analog) video signals of the radar and the digital computer used for data processing. A special display program is described, and the data-flow chart of the device is presented. V.P.

A73-37671 # Design method of the axial-flow blade row on modified isolated aerofoil theory with interference coefficient. II - The influence of the aerodynamic parameter on the fan performance at low flow rate. Y. Nakashima and K. Shiramoto (Kumamoto University, Kumamoto, Japan). *JSME, Bulletin*, vol. 16, June 1973, p. 971-980; Discussion, p. 980; Authors' Closure, p. 980. 8 refs.

A73-37675 Radio noise from towns - Measured from an airplane. G. W. Swenson, Jr. (Illinois, University, Urbana, Ill.) and W. W. Cochran (Illinois Natural History Survey, Urbana, Ill.). *Science*, vol. 181, Aug. 10, 1973, p. 543-545.

Measurements of broadband radio noise in the range 73 to 440 megahertz were made over several small Illinois cities during August, September, and December 1972. Results for cities with a population larger than 25,000 are presented as brightness temperatures between 2400 and 9600 degrees Kelvin. Even the smallest villages produce significant noise pollution. There is considerable diurnal variation and some evidence for seasonal variation. (Author)

A73-37676 Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Conference sponsored by the University of Tennessee Space Institute. Tullahoma, Tenn., University of Tennessee, 1973. 859 p. \$15.

The development and current status of air cushion landing systems (ACLS) are described in papers containing ACLS applications, novel schemes, design features, and performance data for specific ACLS-equipped aircraft. Some topics considered include an evaluation study of ACLS for military tactical airlift aircraft, requirements for off-airport operation of ACLS-equipped aircraft, cost benefits of ACLS to civil aviation, design and performance of the CC-115 aircraft equipped with ACLS, dynamic model tests of various ACLS versions, use of ACLS technology for improved recovery of remotely piloted air vehicles, and effects of various landing conditions on ACLS performance.

T.M.

A73-37677 Introduction to air cushion landing systems. W. E. Lamar (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 1-27.

Discussion of air cushion landing systems as a means of solving the problems of aircraft mobility on unprepared surfaces. Retraction, rotation, vertical energy absorption, steering and braking, and reduced power and weight are considered as important characteristics which should be adequately controlled by such landing systems. The Air Cushion Landing System (ACLS) concept of the Bell Aircraft Company is given particular attention as a significant step in coping with these requirements. Some specific applications of ACLS are considered to indicate its potential for the military. V.Z.

A73-37678 ACLS on tactical airlift aircraft. J. W. Alexander (USAF, Tactical Air Warfare Center, Eglin AFB, Fla.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 36-71. 47 refs.

This study was conducted to explore the possible uses of air cushion landing techniques for tactical airlift aircraft. The paper is directed toward identifying present operational needs, analyzing the present employment concepts, and evaluating the operational capabilities that would be obtained by using an air cushion landing

system. The results of the study are encouraging. There is a need for an aircraft capable of landing on unprepared surfaces of low California Bearing Ratio (CBR) rating. The air cushion landing system is more efficient than the conventional landing gear for airfields of low CBR surface. The use of air cushion landing system-equipped aircraft will reduce the requirements for parachute delivery. A significant cost saving is indicated by the changes in employment concepts that would result by using an air cushion landing system. (Author)

A73-37679 Requirements for off-airport operations in the Canadian North. M. Brenckmann (Ministry of Transport, Transportation Development Agency, Montreal, Canada). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 72-95.

Discussion of potential applications of aircraft with the Air Cushion Landing System (ACLS) for air transport of goods and passengers involving off-airport operations on unprepared sites with minimum ground facilities in the Canadian North. The topics include climatic constraints, current experiences in the barren lands and the arctic islands, aircraft uses on sea ice, and ACLS advantages in the arctic islands. Priorities and limitations of northern aircraft operations are specified. The prospects for ACLS equipped aircraft employment in the Canadian North are considered to be generally favorable. V.Z.

A73-37680 The Navy SETOLS program and its potential applications to Navy aircraft. J. C. Vaughan (U.S. Naval Air Systems Command, Washington, D.C.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 96-109.

A survey of the Navy Surface Effect Takeoff and Landing System program (SETOLS), covering work already done and remaining. Several operational SETOLS mission concepts are considered, including carried-based aircraft in close air support missions, assault aircraft in landing missions, high performance SETOLS-equipped aircraft for delivery and pickup of warfare swimmer teams to and from inland assignments, and SETOLS aircraft in combat search and rescue missions. V.Z.

A73-37681 Drone launch and recovery requirements. W. W. Welch (USAF, Recovery Systems Group, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 110-115.

High-performance launch and recovery systems, either adaptable to present families of drones or to be integrated into the design of future drone generations, are discussed in terms of their desirable capabilities and features. The latter include reliability, maintainability, all-weather capability, cost effectiveness, flexibility, survivability, and covertness. Target, reconnaissance, defense-suppression, air-to-air combat, and high-altitude long-endurance drones call for variously distributed feature emphases in their respective launch and recovery system design. Some of the systems studied for possible use are: air cushion landing systems, VTOL, fixed and mobile ground launchers, steerable gliding parachute systems (parasail, parafoil, and parawing), normal cargo parachutes, and various energy attenuation devices. M.V.E.

A73-37682 An ACLS for the medium STOL transport. L. Gardner (Boeing Co., Research and Engineering Div., Seattle, Wash.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 117-138.

The LA-4 and the CC-115 have been modified with air cushion landing system (ACLS) to gain experience with this type of landing gear. However, the question as to the advantages of a cargo airplane designed exclusively for an ACLS was still unanswered. The study discussed here first describes such an airplane and then compares that airplane with a counterpart airplane having a conventional gear. The study shows a 10,800 pound (7.5%) reduction in gross weight, some cost reductions, and potential operational (mission) advantages. Partially offsetting these advantages are problems of ground steering, braking, ACLS generated water spray, and debris. (Author)

A73-37683 **ACLS trade study for application to STOL tactical aircraft.** R. C. Gustavson (North American Rockwell Corp., Los Angeles, Calif.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 139-165. 5 refs.

A design study was made to compare the installation of an air cushion landing system (ACLS) being developed by the Air Force Flight Dynamics Laboratory (AFFDL) with conventional landing gear on a contractor-designed military STOL transport (MST). Two ACLS installations were designed together with three conventional gear arrangements. All designs were analyzed for weight and aerodynamic effects in terms of increments from the basepoint configuration. Using these data, airplane gross weight effects to maintain a constant performance airplane were directly read off the previously generated growth trade curves. Landing performance as a function of a number of passes over various soils were estimated from the footprint pressures of all concepts. Thus field operational capability can be directly compared for alternate landing design concepts for airplanes having a constant mission performance. F.R.L.

A73-37684 **Air cushion landing system applications and operational considerations.** C. E. Burr (Bell Aerospace Co., Buffalo, N.Y.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 166-198. 8 refs.

Applications of the air cushion landing system (ACLS) are reviewed and its operational advantages described. The medium STOL transport mission serves as an example for an evaluation of the major considerations which will be encountered when an ACLS is introduced into a military operational environment. Many of these considerations are also pertinent to a counterpart civil mission, the short haul STOL aircraft operation. Operational considerations examined are concerned with runway construction, transport efficiency, the airport-aircraft interface, safety, reliability-maintainability-vulnerability and the environment. An ACLS aircraft is compared with a wheel gear aircraft. A number of important advantages accrue to the aircraft equipped with the ACLS. The various ramifications encountered in realizing these advantages are analyzed. (Author)

A73-37685 **On the cost benefits of air cushion landing gear to civil aviation.** P. A. Sullivan and R. VanderStraeten (Toronto, University, Toronto, Canada). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 199-239. 29 refs. Research supported by the National Research Council of Canada.

The potential economic benefits resulting from the use of air cushion landing gear in commercial aviation are examined in this study. It is suggested that significant safety improvements and reductions in insurance rates may be possible, and that performance in adverse runway conditions may be superior to that for conventional landing gear. Economic benefits through the use of reduced real estate costs and simpler runway construction techniques and the like are also, in certain circumstances, possible. It is noted that to obtain full effect, certain details of aircraft design will have to be changed. (Author)

A73-37686 **ACLS equipped vehicles in inter-city transportation.** D. R. Miller and N. J. Sinclair (Daniel, Mann, Johnson, and Mendenhall, Los Angeles, Calif.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 240-248.

A possible solution to the problems of transportation congestion is the use of air cushion landing system (ACLS) equipped STOL aircraft, such as the CC115 Buffalo. The nature of the problems is analyzed, and the transportation modes currently being utilized are reviewed. The potentials of ACLS-equipped aircraft as a substitute or supplemental mode for intercity travel are examined in the light of environmental and financial constraints to be encountered. Recommendations for demonstration projects are developed as a test for the feasibility and efficacy of ACLS-equipped vehicles in intercity service. F.R.L.

A73-37687 **ACLS/CC-115 development program.** W. C. Buzzard (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 250-259.

Description of the joint effort undertaken by the U.S. and Canada for developing the design and fabrication of an air cushion landing system (ACLS). The effort will culminate in a test and evaluation program which is to demonstrate the capability of an ACLS on an assault transport. Various subsystems, such as those used for braking and parking an ACLS, are being developed. Guidelines will be established in the areas of special maintenance, ground support equipment, and crew training. M.V.E.

A73-37688 **CC-115 design development.** T. D. Earl (Bell Aerospace Co., Buffalo, N.Y.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 260-336. 15 refs.

The program technical objectives are described and the 'all external' configuration chosen is presented. An outline air cushion analysis considers sizing showing variation of overwater hump drag and cushion power with cushion length, consideration of pitch trim, and selection of trunk pressure. Cushion characteristics are displayed. Air cushion powering is considered, comparing the power level selected with that used on the LA-4. Fan pressure and duct loss are discussed. Conversion design criteria are discussed with reference to ground loads criteria, especially new conditions due to water, snow, soft and rough ground and due to aircraft behavior in crosswind. The air cushion system design is discussed in detail including trunk, brake and parking systems and wing floats. Elastic material construction is described. The ACLS airplane stability and control, weight and performance, and configuration alternatives are also discussed. (Author)

A73-37689 **The aircraft modification phase of the joint U.S./Canadian ACLS program.** V. R. Billings (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 337-358.

The de Havilland Buffalo was first selected in 1970 as the most suitable vehicle for an air cushion landing system (ACLS) advanced development program. The preliminary design of the ACLS modification was settled early in 1971 and work on the detail design was started in the fall of that year. Flight tests with simulated engine/fan units were completed early in 1972 and demonstrated that no adverse effects on handling, stability and control need be anticipated. The modification task affected many parts of the aircraft. The mid-portion of the fuselage required not only additional stiffening to cater for the trunk attachment and trunk pressure loads, together

with engine/fan mount pick-up points, but also required numerous additional structural penetrations for pneumatic services, fuel supply, hydraulics, additional wiring and other services. (Author)

A73-37690 Report on an ST6 powered air supply package for air cushion landing systems. G. Hardy (United Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 359-389.

The ASP-10 air supply package was designed and developed for use in supplying the lift air needed to operate air cushioned landing systems. It was developed specifically for use on a CC-115 Buffalo demonstrator aircraft. The package is made in handed configuration and breaks down into three units for side mounting on the CC-115 fuselage. These are the engine/fan assembly, the engine nacelle and air inlet, and the fan exit duct. The two ASP-10's have control systems suitable for use with a control console which works in conjunction with an electronic control box on each ASP-10. Various other systems are briefly described, and attention is given to the test facility, rig test, and development and flight clearance tests. Performance checks all met or exceeded the original predictions with the sole exception of fan airflow. F.R.L.

A73-37691 CC-115/ACLS flight test program. G. R. Wyen (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and C. L. Stauffer (Bell Aerospace Co., Buffalo, N.Y.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 390-416.

A comprehensive ground and flight test program is being performed to evaluate the air cushion landing system (ACLS) concept and to verify the satisfactory operation of an ACLS equipped test aircraft. In the most general terms, there are two major objectives: to gather detailed information on ACLS capabilities and handling qualities and to ascertain the effect of the ACLS on performance and stability/control characteristics of the CC-115. A logical sequence of tests has been developed in which the operating envelope on various surfaces, in-flight and in transitions will be incrementally evaluated. Quantitative and qualitative data are taken to substantiate analyses and model tests and to provide correlation with predicted performance values. This paper outlines the flight test program for the above goals. (Author)

A73-37692 Initial ACLS development testing on a Lake LA-4 aircraft. D. Howe and J. F. Daley (Bell Aerospace Co., Buffalo, N.Y.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 418-440.

Description of the air cushion landing system (ACLS) development tests performed in the course of a program designed to reduce to practice an aircraft with a ground-effect type landing gear. Following a series of initial static and mobile ground tests and preliminary flight tests, a series of flights were performed from (and to) snow, grass, asphalt, and concrete surfaces. The test results show that ACLS does not adversely affect flight performance, is superior to conventional landing gear for unimproved surfaces, has acceptable handling characteristics, and is capable of positive and repeatable control. M.V.E.

A73-37693 ACLS CC-115 model simulation, test analysis and correlation. A. Coles (Bell Aerospace Co., Buffalo, N.Y.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 441-478.

Models were tested in support of air cushion landing system (ACLS) design activity to validate analytical methods and assumptions used in calculating ACLS performance, loads, and aircraft

aerodynamics. Wind tunnel tests were performed using a 1/10-scale model with a powered ACLS to evaluate incremental aerodynamic effects of external ACLS components and the inflated ACLS trunk. Dynamically similar ACLS models (1/10 and 1/4 scale) were tested in simulated landing drop tests and in taxiing tests to evaluate the effects of terrain obstacles and the ACLS brake system. To assist in both basic design calculations and correlation of model test data, a digital computer mathematical model of the ACLS was formulated. Model test data validated the mathematical model and refined certain empirical constants in the mathematical equations. F.R.L.

A73-37694 * Preliminary results from dynamic model tests of an air cushion landing system. T. J. W. Leland, W. C. Thompson, and D. S. Vohinger (NASA, Langley Research Center, Hampton, Va.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 479-509.

Experimental study of the behavior of an air cushion landing system on 1:10 and 1:4-scale dynamic models of the CC-115 aircraft over a range of initial impact, on a smooth hard surface of fiberglass-coated plywood, on calm water, and on rough water with waves 5 ft high and 100 ft crest-to-crest wide. The performance was satisfactory with the 1:10 scale model on hard surfaces and calm water and was less certain, requiring more tests, on rough water, while substantial pitching oscillations were observed in tests on the 1:4 scale model. V.Z.

A73-37695 Surface effect take-off and landing system for high performance aircraft. W. B. Maguire and A. E. Johnson (U.S. Naval Material Command, Ship Research and Development Center, Bethesda, Md.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 510-538. ARPA-sponsored research.

This paper presents some results obtained during experimental investigations to evaluate the effects of a surface effect take-off and landing system (SETOLS) on a high performance aircraft. The results of 0.10 scale wind tunnel experiments indicate a reduction of the static longitudinal stability and a significant degradation of the static lateral stability, particularly at high angles of attack for the A-4E aircraft configuration. Results of the static drop tests of a 0.3-scale dynamic trunk for the F-8 are discussed along with the theoretical and experimental program being conducted to investigate the phenomenon of trunk flutter. (Author)

A73-37696 Feasibility study of skirt configurations and materials for an ACLS aircraft. H. Boyd, L. A. Peelman, and F. M. Milhoan (Goodyear Tire and Rubber Co., Akron, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 539-557.

Advantages and disadvantages of elastomer-coated fabrics in applications in pressure-rigidized air cushion landing systems (ACLS) are discussed, covering plain weave, basket weave, rip stop pattern, twill weave, satin weave, and cord fabrics. The properties of elastomers, including natural rubber, nitrile, neoprene, butyl and nitrile-PVC, are also compared. It is concluded that a universal brake pad material cannot be developed for ACLS aircraft and that brake pad materials must be designed to satisfy the operational requirements of each particular ACLS. V.Z.

A73-37697 The Jindivik Drone Program to demonstrate air cushion launch and recovery. J. C. Vaughan, III (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 559-590.

Discussion of the Jindivik Drone Program as an advance in air cushion launch and recovery technology. The advantages promised by this exploratory program are listed as rapid braking, high speed landing, integral pressure vessel trunk, inexpensive trunk material, efficient nozzle design, and the use of main engine bleed air for the source of air supply. Detailed studies of these design characteristics are scheduled for completion in 1973 with the participation of the Australian Government Aircraft Factories. Final preparations for recovery system flight tests as well as a more complete study of various takeoff and launch configurations are visualized in 1974, and flight testing is expected in 1975. V.Z.

A73-37698 **ACLS technology for recovery of unmanned aircraft.** G. R. Lutz (San Diego Aircraft Engineering, Inc., San Diego, Calif.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 591-622. 6 refs.

The increased use of larger and more sophisticated remotely piloted vehicles (RPV's) presents the need for a more efficient method of recovery than those now employed. Accordingly, this paper describes two air cushion landing system (ACLS) concepts which may be applied to the 3,000-pound Jindivik Mk 3A unmanned aircraft. One concept reflects a high-performance configuration which will result in minimal degradation of the present Jindivik aircraft capabilities. An alternate, simplified concept was configured with the intent of serving as an inexpensive ACLS prototype test bed. (Author)

A73-37699 **Application of ACLS to RPV's.** J. Ryken (Bell Aerospace Co., Buffalo, N.Y.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 623-661. USAF-supported research.

A design study of an Air Cushion Landing System (ACLS) suggests the feasibility of such a system for recovery of unmanned military aircraft at low cost. The best concept of ACLS is discussed in terms of low initial systems cost, operating costs and support systems cost, with high performance levels and improved quick-response capabilities. A modified Teledyne Ryan Model 147G drone was used in flight tests for the investigation of equipment, operating procedures and capabilities of unmanned aircraft. It is pointed out that ACLS has several advantages over the present Mid Air Retrieval System (MARS). Suggestions are given as to further development and substantiation of ACLS, including full-scale drop tests, slideout tests, wind tunnel tests, and tread material tests for the confirmation of predicted ACLS characteristics. V.Z.

A73-37700 **A multicell air cushion system for landing gear application.** F. W. Wilson (U.S. Naval Material Command, Ship Research and Development Center, Bethesda, Md.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 662-684. Results are presented on static tests of a multicell air cushion landing system concept designed to separate the primary aircraft take-off and landing system variables of normal taxi loads and landing impact loads. Test data on basic cushion performance and power indicate reasonable comparison with exponential theory. Preliminary total power estimates including impact absorption system power show an advantage over existing air cushion landing system concepts. (Author)

A73-37701 **The potential influence of the ACLS on the development of logistical cargo aircraft.** C. H. Hurkamp. In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 685-696.

A73-37702 **The application of ACLS to Navy fighters.** L. Gardner and P. Milns (Boeing Co., Seattle, Wash.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 697-719.

Results of preliminary design studies for a test installation of an air cushion landing system (ACLS) on a Navy fighter. Of two aircraft considered as logical choices for an ACLS (the LTV F-8 and the McDonnell-Douglas A-4), the A-4 was selected as the best aircraft because of the location of the landing gear trunnion which becomes the logical attach point for the ACLS pods. Moreover, the engine inlets on the A-4 are above the wing, where ingestion of water spray and debris is less likely. A twin-pod ACLS configuration is chosen which provides a good test vehicle for carrier deck evaluation due to lack of interference with arrestor hook or catapult attachment. The effect of adding an ACLS on aircraft weight and performance is considered, and some potential difficulties of carrier operation are noted. Finally, some conjectures are made as to the likely configuration for a production version. A.B.K.

A73-37703 **Static performance of plenum and peripheral jet air cushions.** K. H. Digges (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 721-742.

Experiments with a section of air cushion trunk which approximates a configuration used on the LA-4 aircraft indicate that the flow and jet height predictions do not agree with the classical momentum theories which are satisfactory for ACV configurations. A modified theory is presented which gives good agreement with experimental results. (Author)

A73-37704 **Theory and experiments for air cushion landing system - A ground jet concept.** S. Han (Ohio State University, Columbus, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 743-765.

A73-37705 **A digital computer flight simulation of an ACLS vehicle.** G. Kurylowich (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 766-795. 11 refs.

A digital computer flight simulation of the DHC - DeHavilland Buffalo equipped with the ACLS was performed for landing, take-off, and ground run. Of interest was the identification of problems that a pilot may face in controlling the configuration. It was found that differential thrust was a powerful way to control yaw during ground run if engine failure occurred and the vehicle was subjected to a side gust. (Author)

A73-37706 **Simulation of the ACLS during landing roll.** F. E. Unfried (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December 12-14, 1972.

Tullahoma, Tenn., University of Tennessee, 1973, p. 796-813.

The application of the air cushion effect as an alternative to the conventional landing gear system creates unique low speed handling quality problems for the pilot. A ground based six degree-of-freedom piloted simulation program provides a powerful tool to study these problems. (Author)

A73-37707 **An approach to ACLS ground loads.** P. Milns (Boeing Co., Seattle, Wash.). In: Air cushion landing systems; Proceedings of the First Conference, Miami Beach, Fla., December

12-14, 1972. Tullahoma, Tenn., University of Tennessee, 1973, p. 814-834. 8 refs.

A method is developed for predicting landing and taxiing loads for an airplane equipped with an air cushion landing system. Trunk and cushion foot-print shapes are predicted for any trunk inclination and deflection by removing the portion of the trunk hovering shape that would be below the ground plane. Using energy considerations to predict touchdown deflections the required peak trunk pressure can be predicted. By specifying trunk forces and moments as arbitrary functions of airplane orientation relative to the ground plane, the taxiing performance and loads can be predicted once the effect of trunk end lift-off on cushion pressure has been established. (Author)

A73-37716 **Radiation pattern of a low-frequency beacon antenna located on a semi-elliptic terrain irregularity.** D. A. Hill and J. R. Wait (NOAA, Institute for Telecommunication Sciences, Boulder, Colo.). *Archiv für Elektronik und Übertragungstechnik*, vol. 27, July-Aug. 1973, p. 293-296. 7 refs. FAA-supported research.

A73-37726 **Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1973. 115 p. \$7.50.

The problem of minimizing the workload of pilots in commercial airline operations is examined in papers dealing with factors affecting crew activities, techniques of measuring and evaluating task effort, appropriate design of cockpit equipment, and improvement of flight operation procedures. The effects of airport design and location, aircraft characteristics, the ATC system, meteorological conditions, the requirements of the corporate structure, the cockpit physical environment, communication with the ATC system, interface with the on-board systems, and functional requirements are examined together with various methods and devices for monitoring pilot activity, the interpretation and implementation of the results of workload analyses, and the use of mockups and simulators for suitable design of flight decks.

T.M.

A73-37727 # **The external operational environment.** R. Bennett (Guild of Air Traffic Control Officers, London, England). In: Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 7 p.

The external operational environment of transport aircraft is conditioned by the navigational facilities provided, the ATC equipment and methods employed, and the quantity of aircraft in the various existing categories of airspace. The technical services required for support of modern ATC functions, the flight operations system, and special conditions in flight near terminal areas are discussed in terms of their contributions to the pilot's workload. The future operational environment is considered in the light of present trends affecting the development of the conditioning factors.

T.M.

A73-37728 # **The internal environment and flight deck layout.** W. R. Pierson, C. R. Mercer, and L. L. Susser (Lockheed-California Co., Burbank; Southern California, University, Los Angeles, Calif.). In: Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 8 p.

The internal operational environment of commercial aircraft flights is defined in terms of factors conditioning the man-machine interface between the pilot and the aircraft control system. Possible sources of error stemming from this interface are briefly outlined, and emphasis is placed on flight deck design aimed at minimizing such errors. Basic principles considered include standardization and simplification of controls and displays, definition of reach and vision

parameters, a functional approach to shape forming, and a systems approach to cockpit design. T.M.

A73-37729 # **Internal environment and flight deck layout.** S. L. Wallick, Jr. (Boeing Co., Seattle, Wash.). In: Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 8 p.

Discussion of factors affecting cockpit design in jet transport airplanes for commercial airline operations. Pilot vision requirements within limitations imposed by fuselage size and aerodynamic considerations, the layout of control and display panels with provisions for modification according to customer preferences, and disposition of avionics systems in a manner reducing crew tasks and procedures are topics examined from the viewpoint of providing an environment that allows the flight crew to perform their duties in an efficient manner, consistent with safety. The philosophy followed in providing a two-man crew cockpit for the 737 aircraft is outlined.

T.M.

A73-37730 # **STOL: The pilot - His problems and requirements.** C. R. Tennstedt (Eastern Air Lines, Inc., New York, N.Y.). In: Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 8 p.

Description of the needs of pilots functioning in an updated, well managed, STOL air transportation system of the short-haul variety. It is stressed that STOL and VTOL aircraft must have terminal facilities which are segregated from the conventional aircraft, and special runway configurations and operational procedures are discussed for use at STOL ports. Desirable performance characteristics of the aircraft are discussed, along with ATC requirements, route selection, navigational equipment, and communications aspects.

T.M.

A73-37731 # **Establishing priorities during flight deck operation.** H. A. Hopkins (British Air Line Pilots' Association, Hayes, Middx., England). In: Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 15 p.

In the high-pressure phases of normal aircraft operation as well as in emergency situations, the pilot should have a clear view of the priorities of available courses of action. This requires the elaboration of a mental model which constitutes a simple and integrated representation of the aircraft and its environment. It is stressed that this model must be retained in spite of procedures that make ever-increasing use of automatic control and processed data, but it must also be sustained by the documentation, displays, and planning techniques employed. In addition flight-deck management, and training policies should be structured to aid the pilot in developing such a model.

T.M.

A73-37733 # **Techniques for the evaluation of cockpit layouts and activities.** J. M. Shaw (Royal Aircraft Establishment, Farnborough, Hants., England). In: Symposium on Flight Deck Environment and Pilot Workload, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 17 p. 10 refs.

Description of procedures and devices for studying the usage of flight deck equipment by crewmembers in commercial transport aircraft. Attention is given to (1) paper records of pilot activities typed on a portable recorder by an objective observer, (2) photographic film and video tape recording of the aircrew at work, and (3) observation of the movements of the pilot's eyes by photographic, electro-oculographic, and photo-diode techniques. Sample records obtained by the techniques discussed are illustrated.

T.M.

A73-37735 # The need for mock-ups and simulators. J. M. Wilson (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England), H. Zeffert, and A. D. Wilkey (British Aircraft Corp., Ltd., Filton, Bristol, England). In: *Symposium on Flight Deck Environment and Pilot Workload*, London, England, March 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973, 9 p.

It is argued that although in-service studies of pilot workload have some value, most workload analysis must be carried out on mockups and simulators in the interests of timeliness and economy. The mockups and simulators that have been built for the Concorde program and for initial V/STOL research are described in terms of design details and applications relative to workload analysis. Attention is given to the use of simulators and mockups in minimizing pilot workload for future complex aircraft. T.M.

A73-37736 Symposium on International Aircraft Accidents Investigation, London, England, January 15, 1973, Proceedings. Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1973, 58 p. \$5.10.

Annex 13 of the Chicago Convention set out the standards and recommended practices for aircraft accident inquiry. Various questions and problems related to Annex 13 and its provisions are discussed, giving attention to practical problems of applications, the results of the Third Session of the ICAO Accident Investigation Division, and aspects of sabotage and malicious acts against aircraft. Other subjects considered include practical problems involved in the work of the aviation pathologist in connection with the implementation of the concepts outlined in Annex 13.

G.R.

A73-37737 # Annex 13 and the problems it poses - Practical problems of application. W. H. Tench (Department of Trade and Industry, London, England). In: *Symposium on International Aircraft Accidents Investigation*, London, England, January 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973, 8 p.

The Standards and Recommended Practices in Annex 13 have their origins in Article 26 of the Convention on International Civil Aviation. This Convention provides that the state in which the aircraft is registered should be given the opportunity to appoint observers to be present at the inquiry conducted by the state in which an aircraft accident occurs. Annex 13 amplifies the rights and duties of the observers. The terms of participation are contained in a Recommendation. Difficulties experienced when Inspectors of Accidents from the UK participated in inquiries are discussed. G.R.

A73-37738 # A current look at Annex 13. C. O. Miller and W. L. Halnon (National Transportation Safety Board, Bureau of Aviation Safety, Washington, D.C.). In: *Symposium on International Aircraft Accidents Investigation*, London, England, January 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973, 15 p.

The results of the Third Session of the ICAO Accident Investigation Division in January and February of 1965 are considered. The meeting recognized the importance of providing for participation of the State of Manufacture's accredited representative in the investigation of accidents, on both international and domestic routes. Types of accident notification are discussed together with aspects of the summaries of accident reports submitted to the ICAO, questions of incident reporting, on-board data recorders, questions regarding accredited representation, the accident/injury statistical base, the inquiry process, and the law-safety interface. G.R.

A73-37740 # Annex 13, sabotage and malicious acts against aircraft - Practical problems. V. J. S. C. Clancey. In: *Symposium on International Aircraft Accidents Investigation*, London, England, January 15, 1973, Proceedings. London, Royal Aeronautical Society, 1973, 11 p.

Malicious acts against aircraft often involve the introduction of an explosive device into passengers luggage, into the luggage or freight bays or into any of the many cavities capable of accommodat-

ing a small parcel. The types of explosion to be considered include a deflagration and a detonation. The characteristics of a detonation are discussed together with questions regarding the evidence which might be found in the case of aircraft lost due to effects produced by an explosion. Problems considered are related to the needs of the investigations which have to be conducted in the case of the loss of an aircraft. G.R.

A73-37741 International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2. Conference sponsored by AIAA, FAA, and IWRA. Edited by J. Grey (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). New York, American Institute of Aeronautics and Astronautics, Inc., 1973, 81 p. Members, \$10.00; nonmembers, \$12.

A review of a 1972 feasibility study of an offshore airport for Sydney, Australia and floating structures for marine construction are among the topics covered in papers concerned with offshore airport technology. Attention is given to environmental considerations for offshore airports, urban and regional planning aspects of offshore airport technology, and the machinery to be developed for an offshore airport constructed by reclamation.

M.V.E.

A73-37742 # Environmental considerations for offshore airports. W. G. Hoydysh (New York University, Bronx, N.Y.). In: *International Conference on Offshore Airport Technology*, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 11-20, 21 refs.

Discussion of the environmental problems of air, water, and noise pollution generated by the presence of airports within metropolitan areas, as well as by the increasing demand for air transportation and the subsequent pressure on airports to expand. It is shown that the offshore airport concept may prove to be one of the most imaginative and environmentally constructive alternatives to land-sited airport construction. The prerequisites to a successful use of this alternative are examined. M.V.E.

A73-37743 # Urban and regional planning aspects of offshore airport technology. D. G. Lam, Jr. (New York City Planning Commission, New York, N.Y.). In: *International Conference on Offshore Airport Technology*, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 21-23.

Consideration of offshore airports in the context of the long-range demand for air travel, and assessment of the effects of an offshore airport complex upon the metropolitan regions of a host community in terms of benefits and costs. The crucial importance for cities to develop comprehensive airport planning policies is stressed. M.V.E.

A73-37744 # An offshore airport in Sydney region - Review of a 1972 feasibility study. H. F. Pryor, N. R. Valentine (Commonwealth Department of Works, Sydney, Australia), and I. W. Wootton (Department of Civil Aviation, Melbourne, Australia). In: *International Conference on Offshore Airport Technology*, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2.

New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 24-28, 8 refs.

Review of a preliminary feasibility study of a 0.5-mile offshore airport in the region of the Sydney metropolitan area, performed in 1972. Physical conditions in these waters are far more severe than those anticipated at any proposed offshore sites in the U.S., Canada, or England. The results of this study are inconclusive, and it is pointed out that many technical problems have to be resolved before offshore airport planning, design, and construction become clearly feasible for other than comparatively sheltered marine conditions.

M.V.E.

A73-37745 # Financing the new generation of airports. W. Jakobsberg (Centers for Study, Inc., Rockville, Md.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 29-34.

The coming generation of metropolitan airports are larger, more complicated and much more expensive to build than the preceding generation of airports. The three factors that must be taken into consideration in selecting a financing mechanism are (1) ownership policy, (2) funding level, and (3) design complexity. The financing of the proposed New York Offshore Airport is an example of how high cost and an unorthodox location for the airport introduce the need for unconventional financing methods. The most promising of these has as its keystone the creation of a fund to which all interested airport developers could contribute and which would be used to guarantee bonds issued by those developers for the construction of their airports. The integrity of the fund would in turn be guaranteed by the Federal Government thus doubly protecting bond holders against default. (Author)

A73-37746 # Machinery to be developed for an offshore airport constructed by reclamation. In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 35-42.

Assessment of the requirements of an artificial offshore-airport island in terms of reclamation construction work and equipment. The assessment is based on the cost and technology experience gained in the construction of a reclaimed artificial island, called Port Island, almost completed in Osaka Bay and designed to provide nine large container terminals and many berths for cargo vessels. Blasting, excavating, conveying, stacking, transporting, dumping, filling, and spreading work and machinery requirements are discussed, along with problems in need of further study. M.V.E.

A73-37747 # Floating offshore airport in Osaka Bay, Japan - Digest of preliminary engineering study. In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 2. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 43-49.

A73-37748 # Floating superport. R. Heinen (Dyckerhoff and Widmann, Inc., New York, N.Y.). AIAA, FAA, and IWRA, International Conference on Offshore Airport Technology, 1st, Bethesda, Md., Apr. 29-May 2, 1973, Paper. 26 p.

Description of a U-shaped floating superport designed for construction in the Gulf of Volos in Greece as an off-shore airport kept in position by 14 engines with a total capacity of 42,000 hp. The superport provides loading and unloading facilities for super-tankers, minitankers and a pipeline terminal. Design features, strength characteristics and structural specifications of the superport are included. V.Z.

A73-37749 # Mobile Ocean Basing System. D. A. Davis and J. J. Hromadik (Naval Civil Engineering Laboratory, Port Hueneme, Calif.). AIAA, FAA, and IWRA, International Conference on Offshore Airport Technology, 1st, Bethesda, Md., Apr. 29-May 2, 1973, Paper. 9 p.

This paper deals with an investigation into the feasibility and practicability of concrete as the construction material for large ocean platforms which are envisioned as satisfying basing requirements of the Navy in the mid 80's. The floating platforms would consist of structural components mass-produced ashore, constructed into modules, launched, towed to the site, and assembled into platforms. Three platform sizes were investigated: 300 by 300, 400 by 1200, and 1000 by 4000, with dimensions given in feet. Various configura-

tions of three basic types were considered: (1) elevated decks on columnar, vertical supports for providing buoyancy, (2) elevated decks with semi-submersible type horizontal hulls and (3) elevated decks with barge-type hulls for floatation. Concrete production quantities and costs are estimated for all platforms investigated. (Author)

A73-37750 # New York offshore airport feasibility study. L. Lerner and M. A. Graham (Saphier, Lerner, Schindler, Environetics, Inc., New York, N.Y.). AIAA, FAA, and IWRA, International Conference on Offshore Airport Technology, 1st, Bethesda, Md., Apr. 29-May 2, 1973, Paper. 32 p. U.S. Department of Transportation Contract No. FA71WA-2626 (FAA-RD-73-45)

The purpose of this study was to determine the technical and economic feasibility of an offshore airport for the New York Metropolitan region. The study included analyses of a series of major tasks and subtasks which affect airport planning including air traffic projections, air traffic control, meteorology, airport design and layout, oceanographic and geologic factors, facilities engineering and construction (with particular emphasis on the special factors due to the site on water), ground access systems, and environmental factors such as marine ecology, noise and air pollution, solid waste disposal and radioactivity. A multimodal concept was considered including a deep-draft harbor at the selected location. (Author)

A73-37766 # Hydraulic ducts of control systems in aviation: The effects of external factors. Shop testing, and reliability (Gidropriivody aviatsionnykh sistem upravleniia: Vliianie vneshnikh faktorov. Stendovye ispytaniia i nadezhnost'). V. G. Neiman. Moscow, Izdatel'stvo Mashinostroenie, 1973. 200 p. 47 refs. In Russian.

Description of in-service and shop testing methods and facilities for hydraulic ducts and pipelines used in hydromechanical and electrohydraulic servo mechanisms of aircraft. The operational conditions of aircraft control systems are elucidated by defining mechanical loads, climatological effects, and typical service regimes which must be duplicated in reliability testing of fluid power transmission systems. Recommendations are given for the selection of shop testing equipment and load simulation facilities ensuring accurate duplication of envisioned service conditions. Attention is also given to accelerated production testing of pipelines aimed at the discovery of weak links in the systems and at artificial reproduction of wear, aging, and fatigue factors expected in normal operation. T.M.

A73-37767 # Manufacture of radio equipment for aircraft (Proizvodstvo samoletnykh radioustroistv). I. M. Zarkh and A. G. Rabinovich. Moscow, Izdatel'stvo Mashinostroenie, 1972. 336 p. 36 refs. In Russian.

The manufacture of radio equipment meeting the stringent requirements of on-board aircraft applications is described in terms of the fabrication of individual circuit elements, harness wiring techniques, assembly procedures, mounting and equipment configuration practices, maintenance provisions, and testing methods. Individual topics considered include equipment bays, frames, and casings; ferromagnetic cores for coils and transformers; mechanical drives; shock absorbing suspensions; coil winding, sealing, and shielding methods; waveguide and antenna feeder duct design; harness and cable preparation; printed circuit boards; documentation; alignment and maintenance; and vibration testing. T.M.

A73-37768 # Aircraft wheel and braking system designs (Proektirovaniie aviatsionnykh koles i tormoznykh sistem). I. I. Zverev and S. S. Kokonin. Moscow, Izdatel'stvo Mashinostroenie, 1973. 224 p. 39 refs. In Russian.

Aircraft landing gear and undercarriage designs are discussed, covering braking systems, wheel assemblies, pneumatic systems, mounting frames, and the associated control systems and automation. Wheel stress, load and strength analyses, wheel materials,

wheel size and weight determination and selection, braking system requirements, cooling systems, pressure control systems, and shock absorbers are considered in a review of the state of the art. The topics also include the conversion of kinetic energy during braking, and tire test, landing gear test and braking system test techniques and installations. V.Z.

A73-37769 # Fuels and lubricants for flight vehicles (Topliva i smazochnye materialy dlia letatel'nykh apparatov). M. E. Reznikov. Moscow, Voenizdat, 1973. 232 p. 142 refs. In Russian.

Extensive practical information is given on the fabrication, handling, and properties of various fuels, lubricants, coolants, de-icing liquids, and hydraulic fluids used with rockets and aircraft. Theoretical aspects providing an understanding of functional specifications, advantages, and drawbacks of particular materials are supplemented by practical data on handling requirements in usage, transport, and storage. Specifications of aviation fuels, oils, lubricants, and other fluids are given in accordance with established standards, while the characteristics of liquid and solid rocket propellants and of fuels for various experimental thruster systems are largely based on foreign literature. T.M.

A73-37777 One possible approach to the probability assessment of the vibration strength of turboengine components. B. F. Shorr, E. A. Lokshtanov, and Iu. M. Khalatov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR). (*Problemy Prochnosti*, vol. 4, Nov. 1972, p. 11-14.) *Strength of Materials*, vol. 4, no. 11, Aug. 1973, p. 1299-1303. 7 refs. Translation.

A method of assessing the vibration strength of turbine components on the basis of a safety factor calculated from the statistically maximal values of the variable acting and breaking stresses is proposed. The statistically maximum stresses are determined with allowance for certain random factors which influence the nature of the stress distribution near a dissipation center. The advantage of using statistically maximum stresses instead of maximal measured stresses is demonstrated. V.P.

A73-37778 Calculating the fundamental oscillations in turboengine blades with different types of excitation. Iu. S. Vorob'ev and N. G. Medvedev (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). (*Problemy Prochnosti*, vol. 4, Nov. 1972, p. 15-19.) *Strength of Materials*, vol. 4, no. 11, Aug. 1973, p. 1304-1308. 6 refs. Translation.

The problem of the forced vibrations of rotor blades is solved by a variational method on the basis of an improved vibration theory for twisted rods which takes into account the influence of aerodynamic damping and inelastic internal resistance. The vibration modes and the distribution of internal forces, moments, and stresses along the blades are determined for loads varying arbitrarily in time over the blade length. V.P.

A73-37801 # Trends in avionics simplification for light utility aircraft. G. F. Quinby (NARCO Scientific Industries, NARCO Avionics Div., Fort Washington, Pa.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 7 p.*

The U.S. has developed an effective private civil air fleet for transportation and other special purposes partly because of the contribution to flight safety and utility made by developments in avionics. The advent of the jetliner caused a fundamental change in operating requirements and this in turn greatly increased the demand for ATC services. Avionics function changes, design trends in low cost VHF NAV/COM, and digital technology in ancillary avionics are discussed. Areas of needed improvement in functional avionics performance are reviewed. F.R.L.

A73-37802 # Monitoring of navigational aids. R. J. Shank (Wilcox Electric, Inc., Kansas City, Mo.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 9 p.*

The reasons for monitoring the navigational aid system are considered, giving attention to aspects of safety, requirements for legal records, maintenance problems, questions of feedback for technical and managerial progress, and the status of all system elements regarding their availability for use. Other subjects investigated include approaches used for monitoring, trends in monitoring requirements, the characteristics of the VOR equipment, the SAFI system, the DME equipment, details regarding the instrument landing system, and some monitoring systems which might be used in the future. G.R.

A73-37803 # The Federal Aviation Administration program to improve terminal area traffic control. W. F. Flener (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 4 p.*

A73-37804 # Automation of airline passenger processing. W. E. Jenkins (Control Data Corp., Atlanta, Ga.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 11 p.*

The airline industry is approaching the objective of a fully automated passenger processing system. Aspects of the beginning of automation are considered, giving attention to first electronic devices, inventory control by computer, schedule display with the aid of the cathode ray tube, and approaches for printing tickets by utilizing a computer. Fundamental goals for a new system are related to passenger acceptance, fare quotation, self-service ticketing, and the display of flight information. Magnetically encoded tickets are discussed together with magnetically encoded credit cards and aspects of a total systems concept. G.R.

A73-37805 # Recent improvements in ILS Category I, II, and III cost, integrity, and siting. R. M. Lockerd and V. W. Fisher (Texas Instruments, Inc., Dallas, Tex.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 15 p.*

Summary of United States Government and industry efforts to improve critical performance factors in the integrity, cost, and siting immunity of ICAO Instrument Landing Systems. The programs and systems discussed include both Category II and Category III implementation at U.S. sites, together with smaller programs aimed at piecemeal improvement of ILS through the upgrading of major system components. The presentation accepts without discussion the basic operational need for higher category systems and discusses cost and effectiveness only in terms of achieving the desired objectives of Category II and Category III operations. The major subelements of the cost, integrity, and site sensitivity factors are presented, and historical ILS problem areas are described. The basic 'block diagram' elements and features of ILS equipment are identified, with emphasis on those areas which have received recent improvement efforts. (Author)

A73-37806 # Advanced concepts in terminal area control systems - Aircraft tracking and collision alert. H. McEvoy (FAA, Falls Church, Va.) and H. C. Rawicz (Lockheed Electronics Co., Inc., Plainfield, N.J.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 15 p. 8 refs.*

In connection with the expected increase in air traffic ap-

proaches are being developed which will reduce the time the controller has to spend on functions which can be handled by a computer. The track-while-scan algorithm is considered, giving attention to Kalman filter development, aspects of Kalman filter simplification, measurement quantization, and filter models. Adaptive requirements are related to questions of acquisition, small biases in aircraft parameter estimates, maneuver detection, track/radar return correlations, the coast procedure, coast recovery, and track termination. A collision alert algorithm is also discussed together with aircraft parameter accuracy, filtering time, collision alert prediction time, and questions of computation time and storage. G.R.

A73-37807 # Area navigation systems for air transport aircraft. T. J. Newman (AMBAC Industries, Inc., Garden City, N.Y.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 23 p.*

Distinctive features of area navigation are considered together with questions regarding the benefits of area navigation. Typical air navigation systems presently in use are examined, taking into account variations in system configuration, area navigation computers, route data storage techniques, control and display units, pictorial displays for area navigation, airline activities to standardize area navigation system characteristics, and present area navigation operations of U.S. airlines. Area navigation activities of the FAA are also investigated, giving attention to the FAA ten-year plan for area navigation and the present status of area navigation in the U.S. G.R.

A73-37808 # Secondary surveillance radar - Current usage and improvements. J. S. Perry (Cutler-Hammer, Inc., Farmingdale, N.Y.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 9 p.*

Interference blanking or 'defruiting' was one of the most effective technical improvements for video display presentation of secondary surveillance radar (SSR). The second most effective technical improvement in the early days was the addition of interrogation path side-lobe suppression. Aspects of environment control are discussed together with the proximity warning indicator and the discrete address beacon system. RF link improvements are also investigated, giving attention to siting, electronic scan antennas, diversity transponders, a monopulse receiver processor, and ground reply code processing techniques. G.R.

A73-37809 # A digital simulation facility for air traffic control experimentation. J. W. Rabb (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 10 p.*

The advantages of digital simulation over the older analog system include the standard considerations of accuracy and repeatability of experiments. In addition, a digital simulator is a general-purpose and flexible tool that is easy to use and can easily be changed to meet changing needs. The simulator provides a great number of aircraft, reduced operating cost per target hour, and less overall floor space requirements. Precise control of error parameters is an important feature in modeling subsystems which makes it possible to perform sensitivity studies. The model can be run in either fast or real time. Another advantage of the digital system is that it affords an automatic means of obtaining a complete controller workload record. F.R.L.

A73-37810 # United States en route air traffic control systems. J. W. Rabb (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po*

Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 13 p.

The en route air traffic control system now coming into use in the U.S. can be classified as a collaborative system, one in which the human is still a major element but many of the tools are automatic. The heart of the en route system is a large stored program digital computer. Data acquisition is radar oriented. Primary surveillance radar and secondary surveillance radar information is converted at each radar site into digital messages and transmitted to the digital computer located in the air route traffic control center. The computer processes this information and drives a plan view display for each air traffic controller. This display gives the air traffic controller the XY position in graphic form and the altitude, identity, and other information in alphanumeric form for each aircraft under his control. Flight plan update information is automatically computed and displayed to appropriate controllers. F.R.L.

A73-37811 # The air traffic controller and control capacity. R. S. Ratner (Stanford Research Institute, Menlo Park, Calif.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 14 p.* FAA-supported research.

Description of the controller's role in the U.S. ATC system at present, indicating development associated with progress toward automation. Estimates of the potential capacity increases expected are presented, along with the probable impact on the controller's evolving role. The controller's role is defined within the context of current system operational concepts and traffic environment. His dual role of (1) short-term, on-line planning, and (2) reaction to unplanned traffic situations is emphasized. The abilities of human controllers to adapt to unplanned system failure contingencies are related to ATC operations. The role of airspace structure and traffic organization as a means of minimizing those controller activities associated with reaction to the unplanned is discussed, along with the operational impact of recent system improvements. {Author}

A73-37812 # Noise and pollution - The Federal Aviation Administration's views. R. P. Skully (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 6 p.*

Recent programs conducted by the Federal Aviation Administration concerning the control and reduction of aircraft pollutants are discussed. Information concerning noise reduction through new technology, acoustical treatment of power plants, and operational procedures is covered with appropriate charts. It is stressed that while progress has been made, particularly in the reduction of aircraft noise, the U.S. Government is committed and dedicated to even further improvement of the environmental impact of aviation. {Author}

A73-37813 # Civilian vertical-lift systems and aircraft. W. Z. Stapiewski (Boeing Vertol Co., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 29 p.* 56 refs.

The current status of VTOL activities is considered, giving attention to operations and development programs. It is pointed out that with the exception of a few flight research aircraft all presently operational civilian VTOL aircraft in the U.S. are limited to conventional helicopters. The industry appears to be concentrating its initiative on the design and development of smaller and medium-size commercial helicopters, and to a lesser degree on other VTOL types of a similar gross weight class such as the tilt-rotor and tilt-wing. Technical problems and trends of VTOL aircraft are also discussed, taking into account safety of flight, aspects of passenger acceptance, environmental problems, and economics. New technology trends related to rotary-wing aircraft are also examined. G.R.

A73-37814 # Guidance, control, and instrumentation program on the McDonnell Douglas DC-10. C. L. Stout (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 14 p.*

The design, development, testing, certification, and initiation of the present generation of jet transport systems into revenue service occurred through scheduled phases. Aspects of these phases as they pertain to the flight guidance and control, automatic thrust management, and area navigation systems of the DC-10 aircraft are discussed. Advances in systems capability and complexity in the wide body jet aircraft greatly increased the problems of flight test. Laboratory testing and simulation were used extensively to reduce flight test time requirements, and an advanced data acquisition and processing system was utilized to support the flight test program.

F.R.L.

A73-37815 # United States Microwave Landing System development program. A. B. Winick (FAA, Systems Research and Development Service, Washington, D.C.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 15 p. 5 refs.*

Aspects regarding the need for an improved landing system are discussed, giving attention to the susceptibility to interference, the single approach path, the antenna size, and economic considerations. The objectives of the Radio Technical Commission for Aeronautics are considered, taking into account operational requirements, questions of technique assessment, the system concept, and the signal structure. Aspects examined in connection with a description of a national program for the development of the microwave landing system include multipath performance characteristics and ground antenna design approaches. Questions of the relationship of the new developments with the ICAO are also examined.

G.R.

A73-37816 # Suction noise investigation in turbine fans with different design parameters (Issledovanie shuma vsasyvaniia ventilatornykh stupenel s razlichnymi raschetnymi parametrami). L. E. Ol'shtein and R. A. Shipov. *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 28 p. In Russian.*

Suction noise levels were measured in four fan designs and their modifications on an experimental assembly with a suction chamber, a relaxation chamber, a microphone, and an acoustic analyzer. A continuous 1:10-octave noise analysis was conducted at frequencies from 0.63 through 20 kHz to determine the spectral composition of noise. The sound power level of the tonal component of suction noise increased by 2 dB in takeoff operation and by 3 dB in landing operation when the revolution rate in fan designs was increased by 10%.

V.Z.

A73-37817 # Area navigation problems for passenger aircraft (Voprosy zonal'noi navigatsii passazhirskikh samoletov). E. P. Novodvorskii. *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 11 p. In Russian.*

The development of an efficient area navigation system for civilian aircraft requires reliable methods of spacing aircraft along all three coordinates, providing flight paths that are not restricted to air corridors following ground radio beacon stations. Attention is given to problems which must be overcome in the development and implementation of such an area navigation system permitting optimal utilization of existing air space. The problems considered include the modernization of on-board navigation equipment, reevaluation of the role of autonomous and radio methods in navigation, reorganization of air traffic control procedures, and improvement of means for interaction between aircraft and the ground.

T.M.

A73-37818 # Reduction of aircraft noise in the vicinity of airports (Snizhenie shuma samoletov v okrestnostyakh aeroportov). B. N. Mel'nikov. *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 30 p. 18 refs. In Russian.*

The main sources of noise from modern transport aircraft are examined along with currently employed means of minimizing the influence of aircraft noise on communities neighboring air terminal areas. The complexity of the task is elucidated by stressing the importance of unified development and implementation of measures designed to reduce the noise both at the source and along its path of propagation. These measures are identified as specially designed low-noise engines, traffic control and flight maneuver procedures stressing noise abatement, and architectural as well as urban planning guidelines in the growth of near-by communities. Operational examples of noise abatement procedures employed by current Soviet transport aircraft are described, and their effectiveness is evaluated.

T.M.

A73-37819 # On-board navigation and landing systems for local airlines in the USSR (Bortovoe oborudovanie navigatsii i posadki samoletov mestnykh vozdukhnykh liniy (MVL/SSSR)). O. V. Uspenskii. *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 20 p. In Russian.*

The general characteristics of Soviet short- and medium-haul airlines, air parks, and on-board instrumentation are examined. The trend to standardize the instruments and the advantages of this standardization are noted. Flight safety measures are discussed, and the technological solutions employed in automatic control are outlined.

V.P.

A73-37820 # Operational considerations in the design of airports. L. Achitoff (Port Authority of New York and New Jersey, Aviation Technical Services Div., New York, N.Y.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 9 p. 6 refs.*

Discussion of some desirable design considerations for safe operation of aircraft and airfield so as to permit new, high-capacity equipment to be introduced efficiently. Certain new developments in taxiing guidance and taxiway lighting are reviewed. Two taxiing techniques and their effects upon fillet design are evaluated, and their relative costs and merits are examined. Runway safety as affected by pavement surface conditions and design, lateral dimensions, and shoulder paving are explored, and an automatic ground traffic control system design is described. The importance of noise and its effect upon airport development is emphasized. (Author)

A73-37821 # The cost challenge of cargo ground equipment. J. T. Farrah (Seaboard World Airlines, Inc., New York, N.Y.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 7 p.*

Discussion of the costs related to the labor and facilities devoted to the handling of freight. The inbound and outbound flow of freight in a typical cargo terminal is reviewed in terms of the basic moves and handlings involved, and the steps necessary to reduce the costs of these basic movements are considered, with special attention to optimum equipment selection and utilization.

M.V.E.

A73-37822 # Survey of clear air turbulence detection methods. P. W. Kadlec (Continental Air Lines, Inc., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aero-*

nautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 7 p. 11 refs.

Summary of airborne and ground-based clear air turbulence detection systems, describing briefly the research programs under active development in the United States at the present time. Several studies utilizing different techniques are shown to have recently made significant progress toward the goal of producing an operationally acceptable system. M.V.E.

A73-37823 # Wake vortex detection and avoidance systems. M. Gorstein (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 12 p. 27 refs.*

An aircraft which inadvertently encounters the wake of a large aircraft can be subjected to rolling moments exceeding its roll control capability. A dangerous loss of altitude can result and aircraft recovery may not be possible at low altitudes. Solutions to the vortex problem are related to the design of a Wake Vortex Avoidance System. Questions of vortex behavior are considered together with the hazards involved in aircraft vortex encounters. Two acoustic sensors are described. The sensors operate according to conventional radar principles and are referred to by the acronym ACDAR for Acoustic Detection and Ranging. A bistatic ACDAR system is described together with a monostatic system. G.R.

A73-37824 # Automatic flight control and navigation systems on the L-1011 - Capabilities and experiences. J. A. Gorham (Gorham Associates, Thousand Oaks, Calif.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 18 p.*

The L-1011 avionic flight control system consists of four integrated subsystems related to both manual and automatic flight control. These consist of systems of yaw stability augmentation, speed control, a flight control electronic system, and an autopilot/flight director system. Automatic flight controls and displays, monitor warning displays, hardware design, direct lift control, and safety analysis for certification are treated. The aircraft has received a Category IIIA certificate. The employment of area navigation systems makes possible aircraft operations on any desired course within the area coverage of the station referenced navigation signals. System design and development are discussed in detail. F.R.L.

A73-37825 # An airline engineer's look at achievement of meaningful noise reduction. J. D. Graef (American Airlines, Inc., New York, N.Y.). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 15 p. 31 refs.*

Much time and energy have been devoted to reducing the noise disturbance arising from the operation of jet aircraft. Early jet suppressors were ineffective, and rulemaking attempts to reduce noise failed because legislators lacked authority. The evolution of aircraft noise measurement and evaluation standards, and examples of government noise control efforts and regulatory requirements affecting airframe and engine design are discussed, as well as operating restrictions such as curfews and preferential runway systems. Examples of noise reduction features in new aircraft and engine designs are described, and attention is given to examples of operational procedures designed to achieve reduced community noise. Research and development on possible retrofit hardware and modified engine cycles to reduce noise is described, and various recommendations are made. F.R.L.

A73-37826 # Simplification of navigation and flight control systems without compromising integrity. N. B. Hemesath (Collins Radio Co., Cedar Rapids, Iowa). *American Institute of Aeronautics and Astronautics and Gosudarstvennyi Komitet po Nauke i Tekhnike, USSR/US Aeronautical Technology Symposium, Moscow, USSR, July 23-27, 1973, Paper. 7 p.*

Navigation and flight control are viewed as closely related functions of a single flight guidance and control system. It is shown how careful integration of flight control and navigation into a single system design can yield improved performance, reduced complexity, and more efficient hardware utilization. The requirements for such a system are discussed, a system structure is defined and described, and the operational benefits of the integrated system are identified. The structure of the integrated system consists of a cruise computer and a fail-operative autoland computer. F.R.L.

A73-37863 Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc. (SAE SP-378), 1973. 68 p. Members, \$10.00; nonmembers, \$12.50.

Aircraft hydraulic tubing is examined in papers dealing with the fabrication, degradation, quality criteria, and inspection of both the currently used corrosion resistant steel (CRES) tubing and the newly introduced 3Al-2.5V titanium tubing. The performance of CRES tubing in its present aircraft applications is reviewed along with (1) methods by which this tubing is selected, dimensioned, and tested, (2) the quality criteria and inspection procedures employed by manufacturers, and (3) test data for tubing having internal defects or service damage. Titanium tubing is covered in papers describing (1) quality control and manufacture of annealed titanium hydraulic lines for the F-15 aircraft, (2) specification proposals for cold worked and stress relieved titanium tubing, and (3) tube hollow and surface finishing recommendations. T.M.

A73-37864 An airline appraisal of tubing system problems. G. F. Moore (Trans World Airlines, Inc., Kansas City, Mo.). In: *Criteria for current and advanced aircraft hydraulic tubing.*

New York, Society of Automotive Engineers, Inc., 1973, p. 14.

Maintaining the integrity of a hydraulic fluid distribution system in the commercial jet transport airplanes during routine operational service offers a major challenge to the airlines. The new 747, DC-10, and L1011 wide-body jet aircraft designs include significant trends that are intended to improve the operational performance and reliability of these systems. Factors such as environmental conditions, accessibility, personnel familiarization, tooling, and parts availability are recommended for thorough consideration by the designer to achieve an optimum degree of maintainability in the aircraft fluid distribution system. (Author)

A73-37865 The application of Armco 21-6-9 steel tubing to the DC-10 hydraulic system. N. F. Robinson (Douglas Aircraft Co., Long Beach, Calif.). In: *Criteria for current and advanced aircraft hydraulic tubing.* New York, Society of Automotive Engineers, Inc., 1973, p. 5-9.

The hydraulic piping system of the DC-10 airplane represents a break with the Military Standard tubes and fittings used for the previous quarter century. This paper summarizes the reasons for the selection of Armco 21-6-9 stainless steel tubing over several other candidate materials. Factors of weight, cost, availability and reliability were important, as well as compatibility with the various joining processes contemplated. Perhaps even more important were ease of fabrication of tube segments and assemblies, installation, and field repair. The McDonnell Douglas material specification is summarized, with emphasis on tube inspection requirements. (Author)

A73-37866 Permissible defects in hydraulic tubing. H. van der Velden (Boeing Commercial Airplane Co., Renton, Wash.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 10-20. 8 refs.

Test methods and data are summarized to assist in establishing limits for defects in aircraft hydraulic tubing. The defects evaluated are (1) cracks as detectable by ultrasonic inspection after tube fabrication, and (2) service damage such as chafing and denting observed on aircraft. Permissible defect limits are listed for 6061T6 aluminum return lines, 3000 psi hydraulic tubing of 21Cr-6Ni-9Mn as well as 304 1/8 hard CRES, and 3Al-2.5V cold worked titanium. The performance requirements to which the defect samples were tested are outlined. (Author)

A73-37867 Defects in high quality aircraft tubing and inspection methods. W. H. Braun (Whittaker Corp., Los Angeles, Calif.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 21-23.

The principal metals and alloys used for aircraft and aerospace tubing applications are 21-6-9, Type 304 stainless to MIL-T-6845, and commercially pure and alloyed (3Al-2.5V) titanium. Specifications covering this tubing require high quality with very tight defect levels. Very careful workmanship in processing and rigid inspection practices must be followed in order to meet the requirements. Inspection practices include every kind of destructive and non-destructive tests applicable to tubing. Each test has certain capabilities and limitations. A combination of tests is required to give best assurance for critical applications. (Author)

A73-37868 Quality requirements for Ti-3Al-2.5V annealed and cold worked hydraulic tubing. C. J. Shaver (Grumman Aerospace Corp., Bethpage, N.Y.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 24-30.

This paper presents the author's view of the items Grumman Aerospace considers the controlling factors in obtaining a high quality aircraft hydraulic fluid transmission system utilizing titanium alloy Ti-3Al-2.5V tubing. The discussion is divided into three separate areas of consideration. Tube length production is discussed in light of those processes or procedures which affect quality and the test methods required to detect flaws. Tube shop tooling requirements are presented which are essential to the maintenance of the strength and quality levels imparted by the tube producer. Included is a theoretical description of the effects of ovality on impulse fatigue life. The third area considered describes the requirements for assembly and installation of the fluid transmission system into the using vehicle. The attachment fittings used in the Grumman F-14A aircraft and the reasons for their choice are described. (Author)

A73-37869 Production of extruded tube hollows for titanium 3Al-2.5V hydraulic tubing. E. F. Baroch, B. A. McClanahan, and R. E. Curtis (Teledyne Wah Chang Albany Corp., Albany, N.Y.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 31-38.

A73-37870 The development and control of crystallographic texture in 3Al-2.5V titanium alloy tubing. T. W. Rees (Superior Tube Co., Norristown, Pa.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 39-45. 9 refs.

A73-37871 The effects of crystallographic texture on the mechanical and fracture properties of Ti-3Al-2.5V hydraulic tubing. W. F. Spurr (Boeing Commercial Airplane Co., Renton, Wash.) and W. E. Quist (Boeing Aerospace Co., Seattle, Wash.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 46-54. 13 refs.

A73-37872 Surface conditioning of titanium alloy tubing. W. W. Stephens. In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 55-58.

Surface conditioning plays a significant part in the production of titanium 3Al-2.5V tubing for use in aircraft hydraulic tubing. It can be performed both mechanically and chemically, for both inside and outside surfaces. The purpose of this surface conditioning is to produce a uniform surface with no remaining defects in size or geometry that will adversely affect the tubing performance. Several tests are then run to ensure conformance to requirements. (Author)

A73-37873 Application of the hydrostatic extrusion process toward production of 3Al-2.5V titanium alloy hydraulic tubing. A. C. Keathley (Princeton Metal Systems Corp., Princeton, N.J.). In: Criteria for current and advanced aircraft hydraulic tubing. New York, Society of Automotive Engineers, Inc., 1973, p. 59-64.

A73-37874 # The B.O.A.C. navigation procedures trainer. J. C. Burt (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). *Journal of Navigation*, vol. 26, July 1973, p. 262-266.

Description of training procedures and equipment for long-range navigators to provide them with the ability of maintaining an airplot and of fixing positions by astro in case of a doppler failure. Details are given on the displays and keying used in this teaching technique which can readily be reprogrammed for other training assignments. V.Z.

A73-37875 # Error synthesis. R. N. Lord (Cranfield Institute of Technology, Cranfield, Beds., England). *Journal of Navigation*, vol. 26, July 1973, p. 329-340. 8 refs.

The drawbacks of observational methods of navigational error analysis are discussed. An error synthesis technique by which the effect of any change in the magnitude and distribution of a component error on the resultant overall error can be evaluated is proposed as an attractive alternative. A description is given of the final step in the development of a universal computer program for synthesizing navigational errors with the evaluation of their effects on any proposed traffic control system. The computer program yields the results in graphical form and prints out data blocks for more detailed numerical analysis. The program is expected to provide cost-effective guidance when dealing with error reduction in sophisticated systems whose overall performance depends on the interaction of multiple component errors. V.Z.

A73-37876 # Strapped down inertial navigation systems. R. P. G. Collinson (Marconi-Elliott Avionics Systems, Ltd., Rochester, England). *Journal of Navigation*, vol. 26, July 1973, p. 341-351.

The basic ingredients of these navigation systems are discussed, covering vehicle orientation measurement techniques, the Euler angle computer, gyro systems and latitude and longitude computation procedures. The advantages of these systems are summarized as reliability, simpler temperature control, lower power consumption,

simplified build and commission phase, reduced investment, lower grade servicing skills, largely solid state electronics, lower development costs, size and weight reduction through the elimination of gimbaling system, flight control with body-referenced data, and economical redundancy for failure absorption. Strapped down systems are characterized as a major step in inertial navigation technology, eliminating the complexity of gimbaling systems and providing the major advantages of greater reliability, lower costs, lower power consumption, and excellent failure absorption characteristics.

V.Z.

A73-37878 A parametric weights study of a composite material prop/rotor blade. J. S. Wisniewski (Boeing Center, Philadelphia, Pa.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 950.* 15 p.

Results of a parametric materials and weights study done by the author on a 26.4-ft-diam hingeless composite rotor blade. The blade was studied using a variety of composite materials including S-glass, boron, graphite, and PRD-49 (an organic fiber developed by the DuPont Company). It was used in conjunction with the lift/propulsion system of a study tilt wing aircraft having a design gross weight of 83,000 lb. The construction, materials, and weights of the study blade are reviewed, including the impact of rotor weight on vehicle size and weight; blade geometry, cross section, construction, material description and structural properties, and the blade design criteria; a detailed weights analysis of the blade components, comparing the weights of the various composite materials used in the study for the respective blades; and a parametric study showing the variation in blade weights with blade radius, chord, and disk loading. An approach for predicting the weight of composite rotor blades in the early stages of preliminary design is presented and discussed.

(Author)

A73-37879 The feasibility of the large freight airship. D. Howe (Cranfield Institute of Technology, Cranfield, Beds., England). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 951.* 34 p. 10 refs.

The reasons for the current interest in airships are analyzed, and certain proposals are critically examined. Some indication of the performance requirements for a large freight airship is given, and the optimum speed for maximum work capacity is established. A discussion of the likely design features of the craft is concluded by the selection of a particular example for numerical comparison. This is a 1000-ton gross displacement airship which in one version employs a novel method for overall control of displacement.

(Author)

A73-37880 The growth factor concept. B. Saelman (Lockheed-California Co., Burbank, Calif.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 952.* 11 p.

Under the assumption of constant performance, a simple equation relating airplane gross weight to the sum of the component weights is obtained. Then, an expression for the growth factor is derived by implicit differentiation of gross weight relative to fixed weight, a term of the basic gross weight equation. Variations in gross weight relative to changes in other design parameters are not presented; however, the weight equation can readily be modified to obtain these relationships. Growth factors for rotary-wing vehicles are distinguished from growth factors relative to fixed-wing aircraft. The rotor weight fraction is shown to be constant under the assumptions. Alternatively, maintaining geometry fixed, a fundamental approach is presented for obtaining growth factors corresponding to changes in weight empty.

(Author)

A73-37884 The weight/performance interface - An argument for weight control. R. Jensen (Lockheed-California Co., Burbank, Calif.). *Society of Allied Weight Engineers, Annual*

Conference, 32nd, London, England, June 25-27, 1973, Paper 967. 22 p. 9 refs.

The purpose of this discussion is to show how aircraft weight growth affects aircraft performance and cost. Several contemporary aircraft are presented (anonymously) to show how design objectives are maintained during the prototype and production design phases of development. Performance parameters such as payload/range, takeoff field length, and landing distance are sustained through a combination of increased design gross weights, improved aerodynamic configuration, and higher-thrust engines. Unfortunately, all three of these methods tend to increase aircraft price and direct operating costs. This emphasizes the importance of an effective weight control program to achieve both performance and cost goals and to ensure success in this competitive aircraft business.

(Author)

A73-37885 Cost-weight interface in aircraft design. R. E. Kenyon (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.) and R. N. Mueller (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 969.* 24 p. USAF-sponsored research.

This paper presents the results of a study sponsored by the U.S. Air Force Flight Dynamics Laboratory aimed at developing preliminary design level techniques to estimate the cost of flight vehicle basic structure, identifying sensitivity to the structural concepts and materials used. The study is intended to provide improved and more systematic cost estimating techniques in support of cost as a design parameter for military aircraft. Two estimating techniques have resulted. One is concerned with supporting trade studies and predicts the relative cost of airframe structures that use different types of materials and constructions. The second estimates aircraft subsystem costs and adds these to the results of the first technique, providing total airframe system cost in terms of manhours and materials, while retaining sensitivity to types of material and construction.

(Author)

A73-37887 Fuselage structure weight prediction. D. M. Simpson (Hawker Siddeley Aviation, Ltd., Brough, Yorks., England). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 981.* 41 p.

A method of estimating fuselage structure weight without allowance for the weight of systems and furnishings is developed. The weight of the shell structure is obtained by using the Mises-Hencky theory of yielding as a basis. The use of this criterion avoids certain difficulties encountered with analyses based upon instability but departs from the design process. Allowance is made for the effects of cutouts, longerons, the presence of a keel and minimum gauge design. The structure is considered to be subjected to bending, shear, torque and internal pressurization loading. Equations are developed which estimate the area of the structural material in the shell at a series of stations on the fuselage. Integration then leads to the weight being obtained. The method is restricted to structures which are of the skin-stringer-shallow frame type of construction. The weight of component items separate from the shell are considered using weight data to give empirical relationships.

(Author)

A73-37888 A computer-aided design procedure to approximate aircraft area curve shapes. W. E. Caddell and M. P. Karll (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 982.* 13 p.

A computerized math modeling routine providing approximation of Mach 1.0 aircraft area distribution has been developed to supplement and expedite the preliminary design process. This routine provides information that was heretofore considered to be impractical to produce with the frequency needed in design synthesis. This process is one of integrating dimensional characteristics of selectable components, comparing the results to a desired shape, and

determining minimum practical body dimensions using configuration-dependent constraints. This process is of particular value to the mass properties engineer because of the interrelation between area curve shape and aircraft balance. (Author)

A73-37889 **The STAN /R/ 'S' Integral Weight and Balance System for the C-130 aircraft.** B. J. Hawkins (Fairchild Industries, Inc., Commack, N.Y.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 985.* 13 p.

Description of a test program for the Integral Weight Balance System (STAN) conducted in late summer and fall of 1972 on four different C-130 aircraft at McGuire Air Force Base. The program was designed as part of further development work aimed at providing an accurate and reliable IWBS for the C-130 aircraft. Design features of STAN are discussed. V.Z.

A73-37890 **Early operational experience with the L-1011 On-Board Weight and Balance System.** J. A. Divine (Electro Development Corp., Lynnwood, Wash.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 986.* 17 p.

Flight experience data of TWA indicate that the L-1011 On-Board Weight and Balance System performed in service within set design limits as it did in the flight test program conducted by Lockheed. The system is free from zero or gain shifts, is easily maintainable and is expected to contribute to improved aircraft operations. Initial startup problems of the system have now been largely resolved. V.Z.

A73-37891 **The DC-10 Twin and its loadability.** M. J. Coulter (Douglas Aircraft Co., Long Beach, Calif.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 987.* 27 p.

The presentation briefly describes design characteristics and special features of the DC-10 Twin being offered by the Douglas Aircraft Company to the airlines of the world. Detailed descriptions of the balance characteristics are included with special emphasis on the derivation of the loading limits. A copy of the instructions and sample forms for a loading system prepared for this aircraft are also included. (Author)

A73-37892 **Boron composites - Development and application status.** W. D. Dittmer and P. R. Hoffman (Avco Corp., Systems Div., Wilmington, Mass.). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 992.* 25 p.

Boron composites are in production use on the F-14 and F-15 and appear in every new aircraft design. Like metals, there are a variety of forms (boron epoxy, boron polyimide, boron aluminum) available to best suit each application. Properties have improved, and U.S. prices are now near the \$100/lb level with further decreases assured. New product forms and design concepts offer simple, practical cost-effective means of using these high-performance materials in a variety of aircraft and turbine engine structures. (Author)

A73-37894 **Design and development of lightweight wheel braking equipment.** I. L. Stimson and F. S. Dowell (Dunlop, Ltd., Foleshill, Coventry, England). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 995.* 13 p.

Examination of potential materials has led to recent development of new types of brake heat packs. These include beryllium and carbon/carbon composites which have provided major weight benefits, but also have disadvantages including high cost. Comparisons are

made between the various types of heat pack. Brake structures have also been improved as a result of a critical and parametric study of the design and available materials. Aluminum alloy remains the first-choice material for wheels. A brief indication is given of possible future design trends in wheel and brake equipment. F.R.L.

A73-37895 **'The hub of the wheel' - A project designer's view of weight.** A. A. Blythe (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). *Society of Allied Weight Engineers, Annual Conference, 32nd, London, England, June 25-27, 1973, Paper 996.* 19 p. 5 refs.

Some of the complex relationships among parameters affecting aircraft design are discussed using weight as the common denominator. It is shown how design and performance parameters tend to be constrained by economic and environmental factors and by the prerequisites of airworthiness. Technological progress, in turn, is shown to ease these constraints. M.V.E.

A73-37998 **Survey of the civil responsibility for damages caused by aircraft noise in American and French law (Aperçu de la responsabilité civile pour les dommages causés par le bruit des aéronefs en droit américain et en droit français).** E. Alvarez-Correa. *Revue Française de Droit Aérien*, vol. 27, Apr.-June 1973, p. 129-165. 319 refs. In French.

A73-38004 * **Resistance diffusion bonding boron/aluminum composite to titanium.** M. S. Hersh (Pressure Systems, Inc., Los Angeles, Calif.). (*American Welding Society, Annual Meeting, 54th, Chicago, Ill., Apr. 2-6, 1973.*) *Welding Journal, Research Supplement*, vol. 52, Aug. 1973, p. 370-s to 376-s. Contract No. NAS1-10766.

A73-38006 **Characteristic overpressure of a supersonic transport of given length in a homogeneous atmosphere.** L. B. Jones (Bradford, University, Bradford, Yorks., England). *Aeronautical Journal*, vol. 77, June 1973, p. 290-295. 7 refs.

A73-38007 **Prediction of the lift and moment on a slender cylinder-segment wing-body combination.** K. R. Crowell and C. T. Crowe (Washington State University, Pullman, Wash.). *Aeronautical Journal*, vol. 77, June 1973, p. 295-298. 8 refs.

A73-38008 **Effect of yaw on supersonic and hypersonic flow over delta wings.** W. H. Hui (Southampton, University, Southampton, England). *Aeronautical Journal*, vol. 77, June 1973, p. 299-301. 7 refs.

A theory developed by the author (1971) of supersonic and hypersonic flows with attached shock wave over the compression surface of an unyawed delta wing is extended to include the effects of yaw. The theory has the advantage of being unified for both supersonic and hypersonic flows, and it gives almost identical results compared with exact numerical solutions. The flows over the expansion surface and the compression surface are independent, and only the compression surface flow is considered. F.R.L.

A73-38010 **Possibilities and problems of achieving community noise acceptance of VTOL.** W. Z. Stepniowski (Boeing Co., Vertol Div., Morton, Pa.) and F. H. Schmitz (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *Aeronautical Journal*, vol. 77, June 1973, p. 311-326. 27 refs.

A73-38028 **Joint Automatic Control Conference, 14th, Ohio State University, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers.** Conference sponsored by the American Auto-

matic Control Council. New York, Institute of Electrical and Electronics Engineers, Inc., 1973. 982 p. \$40.

New trends in control theory and its applications are described in papers dealing with adaptive systems, digital filters for flight control, decoupling problems, environmental and biological systems, stability of power systems, optimization, estimation, aircraft parameter identification, linear multivariable systems, urban and economic systems, industrial process dynamics and control, aerospace systems, fluidic control systems, automatic control of biological processes in waste water treatment, application of modern control theory to autonomous satellite navigation systems, computational algorithms, learning systems, precision pointing and tracking, man-machine systems, and transportation systems. A special effort was made to present a technical program of interest to both the application and theoretical engineers.

T.M.

A73-38033 Decoupling longitudinal motions of an aircraft. E. M. Cliff and F. H. Lutz, Jr. (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 86-91. 14 refs.

The geometric theory of decoupling a linear, time invariant dynamical system is applied to the longitudinal motions of a general aircraft. It is shown that if one decouples flight path angle and speed using state feedback only (restricted decoupling) then in the generic case a pair of the eigenvalues of the augmented system is fixed. To alleviate this constraint, the feedback law must be generalized to include additional dynamics (extended decoupling). An application is made to a STOL vehicle with an externally blown flap for which the fixed eigenvalues are unacceptable. An extended decoupling solution is given and some of the choices and difficulties are discussed.

(Author)

A73-38038 On the use of singular perturbation methods in the solution of variational problems. A. J. Calise (Dynamics Research Corp., Wilmington, Mass.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 184-192. 12 refs. Contract No. F08635-72-C-0191.

The solution of variational problems by singular perturbation techniques is examined using a geometric method. The solutions for two control problems are derived and discussed; (1) aircraft three-dimensional, minimum time turns and (2) maximum altitude thrusting of vertically ascending rockets (the Goddard problem). These solutions not only attest to the benefits of order reduction by time scale separation, but they also illustrate how these methods can serve as practical devices for treating the singularities arising in problems where the control appears linearly and/or in state-constrained control problems. Furthermore, the solutions found for the problems treated in this paper are in the form of feedback control laws.

(Author)

A73-38043 Identification of YT-2B stability and control derivatives via the maximum likelihood method. D. E. Stepper (Systems Control, Inc., Palo Alto, Calif.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 257. 5 refs.

A73-38044 A comparative evaluation of the application of several aircraft parameter identification methods to flight data - with emphasis on the development of rational evaluation criteria. J. C. Duke and A. J. Schuetz (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of

Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 258, 259.

A73-38048 Airborne IRP alignment using acceleration and angular rate matching. R. L. Schultz and C. L. Keyes (Honeywell, Inc., Systems and Research Div., Minneapolis, Minn.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 427-436. 9 refs.

The combined acceleration angular rate matching Kalman filter described is specifically designed to overcome the limitations of earlier approaches for in-flight alignment of two inertial reference packages. The mathematical equations describing the problem are considered together with problems regarding the choice of covariance matrices, aspects of filter performance, and questions of error analysis. It is found that the angular rate matching approach greatly reduces the alignment time and the maneuver requirement on the pilot prior to missile launch.

G.R.

A73-38049 Simulated flight tests of a digitally autopiloted STOL-craft on a curved approach with scanning microwave guidance. F. D. Farrington (Ohio Northern University, Ada, Ohio) and R. E. Goodson (Purdue University, Lafayette, Ind.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 437-448. 16 refs.

A73-38050 Optimal aircraft collision avoidance. A. W. Merz (Systems Control, Inc., Palo Alto, Calif.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 449-454. 8 refs.

The coplanar two-aircraft encounter is modeled by assuming the speeds are constant and that the horizontal turn rates are the controls. The equations of relative motion are then of third order, and optimization theory is used to determine the turn rates such as to maximize the miss distance. Numerical results are presented for the case of two identical aircraft.

(Author)

A73-38051 The sensitivity of optimal flight paths to variations in aircraft and atmospheric parameters. M. A. Nichols (USAF, Washington, D.C.) and J. K. Hedrick (Arizona State University, Tempe, Ariz.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 455-463. 8 refs.

The study reported is concerned with a use of the energy state approximation in the analysis of the sensitivity of nominal optimal flight paths with regard to various parameter and atmospheric variations. Another objective of the study is concerned with the desirability of adjusting the nominal optimal paths in accord with these variations. It is found that both flight time and fuel consumption are sensitive to variations in aerodynamic parameters and atmospheric conditions. If the optimal paths are adjusted to compensate for the aerodynamic parameter and atmosphere variations, the adjusted paths are substantially different from the nominal flight paths.

G.R.

A73-38063 A new approach to the 'inverse problem of optimal control theory' by use of a generalized performance index /GPI/. T. Miski (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers.

New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 686-691. 9 refs.

A73-38064 A projection operator algorithm for optimal control problems with unspecified initial state values. S. G. Rajtora (U.S. Naval Weapons Center, China Lake, Calif.) and B. L. Pierson (Iowa State University of Science and Technology, Ames, Iowa). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 711-721. 13 refs. Research supported by the Iowa State University of Science and Technology.

An automatic gradient projection algorithm is developed to treat optimal control problems with unspecified initial values for some state variables and with an unspecified interval of the independent variable. Repeated use of the projection operator allows a one-dimensional minimization among controls which satisfy the terminal state constraints to be employed as the step size selection procedure. The projection operator is developed for a control space which is the Cartesian product of control parameters, those governing the initial values of the state variables and the independent variable interval length, and the control functions of the dynamical system so that the proposed algorithm iterates on all control parameters and control functions simultaneously. Two numerical examples, including a minimum time-to-climb V/STOL problem, are given to demonstrate the feasibility of the proposed algorithm. (Author)

A73-38072 An improved method of predicting longitudinal handling qualities. J. D. Arnold (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 800-803. 8 refs.

A fixed base simulation of flight tests flown in the USAF/CAL variable stability T-33 was performed. The task was pitch tracking in the presence of turbulence. The rms aircraft state data from the simulation was correlated with the Cooper-Harper pilot ratings. This lead to the development of a pilot rating expression based on rms state errors and pilot workload. This rating expression was used to develop a digital computer program which accurately predicts rms state errors, pilot model parameters, and Cooper-Harper pilot rating using only aircraft stability derivatives, airspeed, and altitude as inputs. (Author)

A73-38073 The prediction of pilot acceptance for a large aircraft. J. R. Stone and G. J. Gerken (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 807-809.

A recently developed digital computer program capable of predicting pilot/vehicle performance, pilot model parameters, and pilot acceptance (in terms of Cooper-Harper ratings) is used to study the longitudinal flying qualities of a large aircraft in landing approach. The predictions of pilot rating are compared with those recorded during a three-degree-of-freedom motion simulation. And, a limited comparison of pilot model parameters and performance is made to the simulation data. The results are promising and demonstrate the utility of modern optimization techniques (used to predict man-machine performance) and identification methods (used to validate the predictions). (Author)

A73-38081 Short term gyro drift measurements. D. W. Gilstad (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, Colo.). In: Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 887, 888.

Noise data from a family of 8 gyros are presented with an explanation of how the data were obtained. The instruments tested were six Kearfott Alpha II and two Sperry SYG-1000 gyros. Spectral analysis of filtered, time domain data is used to provide power spectral density and integrated power spectral density plots of both rate and angle output. All data were taken with the gyros in the torque to balance mode, and the closed torquer loop response was adjusted in each case to be essentially flat to 15-25 Hz. Each gyro was tested with IA, OA, and SA vertical and, in addition, wheel-off data are included for each position in which wheel-on data were obtained. The methods of data analysis and presentation are intended to facilitate comparisons among the gyros and aid in the separation of noise due to the gyro and its support electronics from that due to base motion. (Author)

A73-38106 Correlation and prediction of jet noise. K. K. Ahuja (Syracuse University, Syracuse, N.Y.). *Journal of Sound and Vibration*, vol. 29, July 22, 1973, p. 155-168. 11 refs.

Measurements of subsonic jet noise made on a model jet rig in the anechoic chamber of the National Gas Turbine Establishment are presented. Jet noise spectra for three nozzles of diameters 2.84, 2.4 and 1.52 inches have been obtained. Attempts have then been made to collapse all the data points obtained on to one curve. This is done first of all by normalizing the 1/3 octave and overall sound pressure levels for the theoretical parameters obtained from Lighthill's theory. Empirical schemes are then presented to collapse the data for all the angles and the frequencies. The prediction schemes presented predict noise accurately for cold and clean jets. (Author)

A73-38117 # The effect of ice formation on the stability and maneuverability characteristics of aircraft (Einfluss der Vereisung auf die Stabilitäts- und Steuerbarkeitscharakteristiken von Flugzeugen). O. Trunov and R. Teimurazov (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR). (*Grazhdanskaia Aviatsiia*, vol. 11, 1972, p. 18, 19.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 133-137. In German. (Translation).

Questions regarding the formation of ice on the horizontal tail surfaces of an aircraft are examined, giving attention to conditions in the case of various aircraft types during the approach. It is pointed out that the effect of ice formation at the vertical fin on the flight characteristics has not yet been sufficiently investigated. During the year 1971 specialized flight studies involving the aircraft type An-12 were conducted for minimum velocities under conditions of ice formation on the wing. Operational parameter data are recommended for the approach, taking into account the case in which there is no ice on the horizontal fin and the case in which ice formation on the horizontal fin is suspected. G.R.

A73-38118 # Flight efficiency (Effektivität des Fluges). S. Skripnichenko. (*Grazhdanskaia Aviatsiia*, vol. 11, 1972, p. 21, 22.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 138-142. In German. (Translation).

An approach for finding an economically favorable cruising flight regime involves the determination of the cruising flight time and the fuel consumption for a number of aircraft speeds. Questions of economical cruising flight speed and aspects of total costs for a flight are discussed together with effects of fuel costs, fuel consumption, flight altitude, economical flight range, fuel reserve, commercial load, and the relations between the various parameters. G.R.

A73-38119 # Basic law of engineering activity (Grundgesetz der Ingenieurtätigkeit). I. Razumovskii (Ministerstvo Grazhdanskoi Aviatsii, Moscow, USSR). (*Grazhdanskaia Aviatsiia*, vol. 1, 1973, p. 8, 9.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 143-147. In German. (Translation).

A number of aspects of new regulations regarding the technical operation of aircraft in the civil aviation of the USSR are explored. The issuance of the new regulations is connected with the employment of aircraft having gas turbines and the resulting changes in maintenance organization during the last ten years. General problems considered include questions of training and education of the technical personnel. The performance of periodical technical maintenance operations is discussed together with the technical schooling of the personnel for the flight operations, approaches for guaranteeing the regularity of the flight operations, and regulations concerned with the safety of the personnel during the various activities. G.R.

A73-38120 # The development of propulsion systems in the case of airliners (Entwicklung der Antriebsanlagen bei Verkehrsflugzeugen). E. Schesky (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 157-166. In German.

Improvements in energy transformation efficiency and in the mass-power ratio are considered, taking into account early steam engines designed in 1869 and the internal combustion engine first used in an aircraft which was heavier than air. The thermodynamic processes which can be used for the propulsion of airliners include the Otto, the Diesel, and the Joule process. Developments regarding various propulsion systems are discussed, giving attention to advantages of turbine jet propulsion compared to propeller propulsion at high flight speeds. Specific parameter values for jet propulsion systems are discussed together with present development trends. G.R.

A73-38121 # Calculation of the plan for the transportation performance with the aid of electronic data processing (Berechnung des Planes der Transportleistungen mit Hilfe der elektronischen Datenverarbeitung). E. Klaembt. *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 167-170. In German.

A73-38122 # The Dolphin airship with an undulating propulsion system - Surface and width of the fuselage (Delphinluftschiff mit Wellantrieb - Oberfläche und Breite des Luftschiffkörpers). W. Schmidt. *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 171-174. In German.

The usefulness of the suggestions reported by Queck and Schmidt (1970) concerning the design of the Dolphin airship is investigated. A profile which is well adapted to the form of the 'Zeppelin' airships is considered. Two Dolphin airships of medium width are compared with a 'Zeppelin' airship. The practicality of the suggestion to make the Dolphin airship wider is explored by an analysis of a number of Dolphin airships of various dimensional proportions. G.R.

A73-38123 # Flight-mechanics analysis of various flight conditions of conventional aircraft. VIII/1 - Mechanical foundations: Kinematic equations of motion of a rigid body (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. VIII/1 - Mechanische Grundlagen: Kinematische Bewegungsgleichungen eines starren Körpers). F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 3, 1973, p. 175-184. In German.

The introduction of an earth-related coordinate system is discussed, giving attention to the determination of rotational motions. The coordinates of the flight path and the velocity components are considered in a derivation of the kinematic equations of motion for the flight path. The kinematic equations of motion for the angles describing the aircraft attitude are also obtained. G.R.

A73-38125 # Operative visibility limits over the airports of Milan Linate and Malpensa in the 1960-1969 decade (Limiti operativi della visibilità sugli aeroporti di Milano Linate e Malpensa nel decennio 1960-1969). S. Fanchiotti and L. Nani (Aeronautica Militare, Servizio Meteorologico, Rome, Italy). *Rivista di Meteorologia Aeronautica*, vol. 33, Jan.-Mar. 1973, p. 23-36. 5 refs. In Italian.

A73-38155 Determination of dynamic loads on elastic structures caused by external excitations (Bestimmung dynamischer Lasten an elastischen Strukturen auf Ground äusserer Erregungen). D. Collmann and H. Zimmermann (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 21, July 1973, p. 225-234. 5 refs. In German.

The solution possibilities in the time and frequency domain for determining the dynamic responses of elastic structures due to deterministic or stochastic excitations are described. These structures are either freely movable in space or fixed. In this paper the dynamic and elastomechanical behavior of the systems is assumed to be described by linear relations. The programme system indicates how, in general, the determination of the dynamic responses of elastic structures can be carried through on the digital computer. If, for instance, the programme system is used to determine the response of aircraft structures, the effects of rudders and controllers can be taken into account. (Author)

A73-38167 # VAK 191B - Construction. *Aircraft Engineering*, vol. 45, July 1973, p. 6-11, 14-19(10ff.).

In the VFW-Fokker VAK 191B construction, a shell design was used for the entire fuselage. Due to the numerous cutouts, the normal forces resulting from fuselage flexure are largely carried by four main chordwise webs. The wing is subdivided into wing center section and outboard wing, and the center section is riveted to the fuselage center section. The quadricycle configuration landing gear consists of a single wheel steerable nose leg, a twin wheel main leg, and two fully castoring single wheel outrigger legs at the wing tips. The aerodynamic design is a logical outcome of some basic design requirements. In the interest of cruise efficiency, it was decided to size the RB.193 main propulsion engine to the aircraft cruise thrust requirements. The extra thrust required for VTOL operation is provided by two lightweight RB.162 lift engines, giving a composite lift and lift cruise configuration. Power plant controls, advanced powered flying controls, the main hydraulic components, and the electrical generating system are described. F.R.L.

A73-38179 The processing of photographic data (Le traitement des données photographiques). H. Cruchant (CNES, Paris, France). *La Recherche Spatiale*, vol. 12, July-Aug. 1973, p. 17-19. In French.

The photographic work demanded within the frame of terrestrial resources operations is quite different from that practiced in image processing laboratories. The data processing commences before the chemical processing in the laboratory, and as early as the preparation of the aerial work. There are physical, chemical, and technical constants inherent in the installations which must be absolutely respected. The experimenter must be able to compare, with the maximum of freedom, two results on the same zone, separated in time. F.R.L.

A73-38265 Testing noise-reducing approach techniques with the HFB 320 research aircraft of the DFVLR (Erprobung lärmindernder Anflugverfahren mit dem DFVLR-Forschungsflugzeug HFB 320). P. Hamel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugmechanik, Braunschweig, West Germany) and H. W. Dahlen (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Antriebssysteme, Braunschweig, West Germany). *DFVLR-*

Nachrichten, July 1973, p. 413-416. In German.

Tests performed with a light-weight twin-jet aircraft modified to an aircraft with variable flight characteristics by introducing analog electric fly-by-wire landing flaps and trust controls are discussed. New successful noise-reducing approach techniques based on the use of direct lift control and steep descent paths are described. V.P.

A73-38266 Contributions of the DFVLR to environmental research and environment protection. II - Noise control, water environment protection, nature and landscape, environmental protection techniques (Beiträge der DFVLR zur Umweltforschung und zum Umweltschutz. II - Lärmbekämpfung, Gewässerschutz, Natur und Landschaft, umweltfreundliche Technik). D. Paftrath (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, West Germany). *DFVLR-Nachrichten*, July 1973, p. 417-421. In German.

Recent studies of the generation and propagation of jet aircraft noise and sonic boom are reviewed, and noise-measurement and noise-reduction methods are discussed. The considerations include technological noise-reduction techniques, the selection of favorable flight paths, and proper airport planning and design. The application of remote sensing from aircraft and satellites to the study of the conditions on the earth's surface is examined, and the contribution of these techniques to the protection of lakes and rivers from pollution is outlined. Developments in MHD propulsion, ion engines, and other nonpolluting propulsion systems are discussed. V.P.

A73-38280 # Studies on the time-to-go indexing control scheme for an automatic aircraft landing system. A. Tanaka (Japan Aviation Electronics Industry, Ltd., Tokyo, Japan) and H. Maeda (Kyoto University, Kyoto, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 16, no. 31, 1973, p. 1-18. 7 refs.

An automatic control system for the final phases of landing of an aircraft is derived by formulating the problem in the time domain as a linear tracking problem, applying simple deterministic optimal control theory to a linearized model of the aircraft longitudinal motion. Since the touchdown distance dispersion is more essential than the terminal time error, the control law obtained in the time domain synthesis is modified to control the range so that the touchdown points may be within the prescribed limits. The resulting landing trajectories investigated by digital simulations indicate that the performances are satisfactory under several initial and environmental conditions with regard to touchdown condition requirements. (Author)

A73-38281 # On the aerodynamic damping moment in pitch of a rigid helicopter rotor in hovering. I - Experimental phase. K. Takasawa (National Aerospace Laboratory, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 16, no. 31, 1973, p. 19-36. 13 refs.

A73-38303 # Rumanian contributions regarding the application of the Coanda effect (Contributii Romanesti privind aplicarea efectului Coanda). I. N. Iacovachi and C. Alecsandrescu (Institutul pentru Creatie Stiintifica si Technica, Rumania). *Transporturi Auto, Navale si Aeriene*, vol. 3 (20), Apr. 1973, p. 203-206. In Rumanian.

Description of two classes of Coanda effect devices, stressing the contributions of Coanda himself and those of Teodorescu-Tintea to the development of underlying concepts and the design of prototypes. The two classes of devices discussed are external Coanda ejectors, which cause a deviation of the primary fluid on a circular Coanda shutter surface the underside of which is outside the device, and Coanda-Teodorescu depressive networks, which have the property of attenuating noise generated by a gas stream. External Coanda ejectors have applications in vehicle propulsion systems, in Coanda lenticular aerodynes, and in ground-effect vehicles, while the

depressive networks have applications as turbojet traction reversers, gasdynamic noise attenuators, turbines with depressive blades, and aerodyne lift and propulsion devices. A.B.K.

A73-38321 Engine emissions: Pollutant formation and measurement. Edited by G. S. Springer and D. J. Patterson (Michigan, University, Ann Arbor, Mich.). New York, Plenum Press, 1973. 376 p. \$28.50.

Attention is focused primarily on sources and mechanisms of emission formation within the combustion process, and on measurement techniques. Engine exhaust emissions, the chemistry of spark-ignition combustion and emission formation, the mechanism of hydrocarbon formation in combustion processes, and the kinetics of pollutant formation in spark-ignition engines are discussed. Particulate emission from spark-ignition engines, Diesel engine combustion and emissions, the diffusion and fallout of pollutants emitted by aircraft engines, instrumentation and techniques for measuring emissions, and direct-sampling studies of combustion processes are examined. F.R.L.

A73-38322 Mechanism of hydrocarbon formation in combustion processes. R. A. Matula (Drexel University, Philadelphia, Pa.) In: Engine emissions: Pollutant formation and measurement. New York, Plenum Press, 1973, p. 77-151. 127 refs.

Some of the important factors associated with the formation and emission of hydrocarbons from transportation systems are discussed. Directly related phenomena such as photochemical reactivity of exhaust gases, odor, and potential health hazards associated with polynuclear (PNA) emissions are also considered. Recent experimental and analytical results dealing with ignition delays in low molecular weight hydrocarbon-oxidizer systems are reviewed. Attention is given to the production and emission of unburned hydrocarbons from engines. The effects of wall quenching of the flame on the production of unburned hydrocarbons, the sources of unburned hydrocarbons in spark ignition, compression ignition, automotive and aircraft gas turbines, and the effects of engine variables on hydrocarbon emissions from spark-ignition engines are discussed. Some of the effects associated with hydrocarbon emissions on man and his environment, including photochemical smog, odor, and polynuclear aromatics are examined. F.R.L.

A73-38323 Diffusion and fallout of pollutants emitted by aircraft engines. S. L. Soo (Illinois, University, Urbana, Ill.). In: Engine emissions: Pollutant formation and measurement. New York, Plenum Press, 1973, p. 267-289. 22 refs.

Sources of pollution are identified, and basic relations and procedures for analyzing data from measurements and for predicting the level of pollution from a specified set of operating conditions, are described. Cumulative data substantiate the need for pollution control but do not help future prediction and individual evaluation. The harmful effects of pollutants depend on their spreading in a given environment. Pollutants react chemically with other constituents of the atmosphere, among themselves, and with surfaces of particulates and the ground. The plume axis from a stack and plume paths from aircraft are discussed. Wing tip vortices from aircraft influence the initial dispersion of pollutants near their source. The visibility of a jet plume and its optical characteristics are of interest because of the desirability of treating a smoke plume quantitatively and the possibility and desirability of monitoring the contribution of an individual aircraft by lidar measurement, or by other optical means. F.R.L.

A73-38361 Stuttgarter Profile Catalog I (Stuttgarter Profilkatalog I). D. Althaus. Research supported by the Deutsche Forschungsgemeinschaft. Stuttgart, Universität Stuttgart, 1972. 393

p. 13 refs. \$37.60. In German.

The laminar wind tunnel is discussed, giving attention to equipment for conducting the measurements, the determination of drag and lift for airfoil profiles, balances for force measurements, and aspects of data processing. The theoretical velocity distributions of various types of profiles are considered together with profile coordinates, and profile contours. Measured profile polars are presented along with data obtained in measurements with NACA profiles and in other studies. G.R.

A73-38367 # S-3A development tests. B. D. O'Laughlin, E. L. Graham, and J. Christiansen (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-778.* 14 p. Members, \$1.50; nonmembers, \$2.00.

The aircraft and its systems are described and critical performance characteristics defined. The progress of the total integration test program is shown with particular emphasis on special problems encountered and their solutions. The important B-47 flying test bed program, which allowed flight testing of the TF-34 engine one year before the S-3A first flight, and the P-3 flying test bed which enabled the avionics systems to be flight tested one year before the first S-3A avionics system flight, are described. The S-3A flight test program is reviewed, with particular emphasis on tests relating to flutter, which used a unique fuselage-mounted vane to excite all aircraft flutter modes, stalls, structural envelope expansion, carrier suitability and total weapon system integration. (Author)

A73-38368 # Airplane noise and regulations. J. O. Powers (FAA, Office of Environmental Quality, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-795.* 10 p. 19 refs. Members, \$1.50; nonmembers, \$2.00.

The need for environmental compatibility is considered, taking into account the legal aspects of the aircraft noise problem, difficulties concerning the development of new airports, the short haul air transport concept, and the introduction of the supersonic transport into the CTOL system. Problems of legislation and regulation are also discussed together with the retrofit case and the regulatory program of the FAA for noise control. G.R.

A73-38369 # Maximum air transportation service with minimum community noise. A. L. McPike (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-796.* 9 p.

Comparisons of the noise levels of several different transport aircraft are discussed, and a concept is proposed for helping achieve maximum air transportation at a minimum of community-inconveniencing noise. The proposed concept is developed around the noise levels of Part 36 of the Federal Aviation Regulations. Eight current aircraft, covering a wide variety of range and passenger capacity capabilities, are examined. Wide-bodied aircraft powered by the new high-bypass-ratio turbofan engines produce much less noise exposure when providing a given amount of transportation service than the smaller narrow-bodied aircraft powered by low-bypass-ratio turbofan engines. It is pointed out that the wide-bodied aircraft are superior because they incorporate more advanced noise-suppression features rather than because of their size. Smaller aircraft incorporating the same level of technology should receive a comparable rating by the proposed specific noise level system. M.V.E.

A73-38370 # Designing for air superiority. P. Cysz, R. D. Digton, and W. P. Murden (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-800.* 11 p. 6 refs. Members, \$1.50; nonmembers, \$2.00.

A methodology which translates functional air superiority requirements into a preferred design/performance level is discussed. The elements of this methodology include the synthesis of a tentative requirements matrix, the design of a baseline configuration, and the application of multitechnology aircraft sizing programs to the preliminary optimization of designs corresponding to points in the requirements matrix. Another element is concerned with the simulation of air combat against the threat force structure to identify the highest-payoff region in the requirements space. Multitechnology programs are used to explore cost/performance sensitivities in the high-payoff region for the refinement of the requirements. G.R.

A73-38371 # Structural composites on future fighter aircraft. T. O. Glenn and L. C. Koch (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-806.* 12 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1307.

An assessment is made of current and projected composite materials/structures technologies and trade studies for fighter aircraft through which least-weight design concepts might be identified. In the technology assessment phase of the study, it was determined that composite material allowables will increase during the next five years. These increases, coupled with design concepts which utilize composites to their best advantage, will result in substantial decreases in future fighter aircraft size and weight. Further, due to increased usage and automated fabrication methods, the cost of composite raw material and finished structure will decrease substantially. In the design concept tradeoff phase of the study, attractive concepts were developed with composite materials for the wing torque box, fuselage, and inlet duct. Substantial weight savings were shown with these concepts. (Author)

A73-38372 # Aircraft economics and its effect on propulsion system design. G. P. Sallee (American Airlines, Inc., New York, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-808.* 6 p. Members, \$1.50; nonmembers, \$2.00.

The currently used ATA equations for determining the direct operating cost of aircraft do not provide an adequate indication of the economic impact of propulsion system design and technology on aircraft economics. A review of current commercial aircraft economic trends gives strong indication that these accepted procedures are producing misleading information as to the relative value of improvements in specific fuel consumption and specific weight while ignoring the potential benefits of other important design and performance areas. Progress in the development of an improved method for assessment of engine economics is discussed along with the most significant propulsion system design areas identified. (Author)

A73-38373 * # Energy supply and its effect on aircraft of the future. II - Liquid-hydrogen-fueled aircraft: Prospects and design issues. F. S. Kirkham and C. Driver (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-809.* 11 p. 10 refs. Members, \$1.50; nonmembers, \$2.00.

The performance of hydrogen-fueled commercial aircraft is examined in the subsonic, supersonic, and hypersonic speed regime and compared with JP-fueled systems. Hydrogen aircraft are shown to provide substantial improvements in range and payload fraction as well as to minimize or eliminate many environmental problems. The major elements of a development program required to make hydrogen-fueled aircraft a commercial reality are also outlined and the rationale for and characteristics of both a subsonic demonstrator and a high speed research airplane are described. (Author)

A73-38374 # A status report on jet noise suppression as seen by an aircraft manufacturer. W. C. Swan and C. D. Simcox (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 5th, St. Louis, Mo., Aug. 6-8, 1973, Paper 73-816*. 13 p. 11 refs. Members, \$1.50; nonmembers, \$2.00.

The activities of an aircraft company in the reduction of jet efflux noise for three major commercial aircraft types are summarized. Concerning the SST noise problem, activities on the use of chutes, spades, and tubes in combination with C-D and plug nozzles are outlined. Comparisons of noise suppression and thrust loss are made, and it is shown how these data support the compatibility of an SST with the community. The conventional subsonic jet noise problem is reviewed in light of current and proposed noise regulations. Recent test experience is discussed, and an estimate is made of the apparent jet noise floor which can be economically accepted. The jet noise problems for future STOL or short haul aircraft, and the apparent lack of agreement on noise data in the low velocity 500-800 ft/sec range, are discussed. The amplification of jet noise due to flap impingement in an externally blown flap configuration is noted. Finally, it is noted that each of these jet noise problems tends to dominate the ability to expand commercial aviation in short, intermediate, and long haul operation. Suggested areas of further research are identified. (Author)

A73-38385 * Recursive ideal observer detection of known M-ary signals in multiplicative and additive Gaussian noise. J. H. Painter (NASA, Langley Research Center, Hampton, Va.) and S. C. Gupta (Southern Methodist University, Dallas, Tex.). *IEEE Transactions on Communications*, vol. COM-21, Aug. 1973, p. 948-953. 30 refs. Grant No. NGR-44-007-049.

This paper presents the derivation of the recursive algorithms necessary for real-time digital detection of M-ary known signals that are subject to independent multiplicative and additive Gaussian noises. The motivating application is minimum probability of error detection of digital data-link messages aboard civil aircraft in the earth reflection multipath environment. For each known signal, the detector contains one Kalman filter and one probability computer. The filters estimate the multipath disturbance. The estimates and the received signal drive the probability computers. Outputs of all the computers are compared in amplitude to give the signal decision. The practicality and usefulness of the detector are extensively discussed. (Author)

A73-38416 * # Application of digital computer APU modeling techniques to control system design. D. A. Bailey and W. L. Burriss (AirResearch Manufacturing Co., Los Angeles, Calif.). In: *Intersociety Energy Conversion Engineering Conference, 8th, Philadelphia, Pa., August 13-16, 1973, Proceedings*. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 614-622. Contracts No. NAS3-14408; No. NAS3-15708.

Study of the required controls for a H2-O2 auxiliary power unit (APU) technology program for the Space Shuttle. A steady-state system digital computer program was prepared and used to optimize initial system design. Analytical models of each system component were included. The program was used to solve a nineteen-dimensional problem, and then time-dependent differential equations were added to the computer program to simulate transient APU system and control. Some system parameters were considered quasi-steady-state, and others were treated as differential variables. The dynamic control analysis proceeded from initial ideal control modeling (which considered one control function and assumed the others to be ideal), stepwise through the system (adding control functions), until all of the control functions and their interactions were considered. In this way, the adequacy of the final control design over the required wide range of APU operating conditions was established. (Author)

A73-38439 Reliability in the Federal Aviation Administration. S. S. Hunn (FAA, Systems Research and Development Service, Washington, D.C.). In: *Reliability physics '1973; Proceedings of the Eleventh Annual Symposium, Las Vegas, Nev., April 3-5, 1973*. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 1-5.

Description of the second phase of an en route automation program for the U.S. air transportation system. The NAS en route system, which is essentially made up of radars, is described. This system automatically provides updated flight information to controllers concerned with a particular aircraft via a computer readout device located at each control position. Concurrently, the radar data are put in the computer, where tracking is done, and the radar information is correlated with the flight plan data so that identification of the aircraft can be automatically displayed on a cathode ray tube. A parallel development for terminal air traffic control automation - the ARTS III system - is also described. The ARTS III system displays electronic-generated beacon targets with associated data tags displaying aircraft identity, altitude in 100-ft increments, ground speed, and other relevant control information in alphanumeric characters. A.B.K.

A73-38461 Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973. 72 p. \$3.00.

Activities aimed at the automation and improvement of air traffic control (ATC) are described in papers dealing with radar and communications facilities, computer hardware and software developments, flight data entry and display systems, military developments in aircraft and operations, human factors in ATC, and airport planning and operations. Automation of terminal and en route operations is discussed in terms of metering and spacing programs, automated radar terminal systems, and special computer architectures. Additional topics include collision avoidance systems, oceanic air traffic control, and optimization of the role of human controllers. T.M.

A73-38462 # Metering and spacing. L. W. Allen. In: *Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings*. Washington, D.C., Air Traffic Control Association, 1973, p. 4, 5.

Description of the functions of a metering and spacing program to be used with the computerized ARTS III air traffic control system. The program takes advantage of the available computer capacity and uses the aircraft track information generated by ARTS III to provide recommended commands to the controllers for aircraft arriving in the terminal area. As the aircraft proceeds through the terminal air space, the program generates on the ARTS display the necessary commands for heading, speed, and altitude. The controller evaluates the command, and if satisfied, relays it to the aircraft. T.M.

A73-38463 # ARTS II automated air traffic control systems. E. Bernstein (Lockheed Electronics Co., Inc., Plainfield, N.J.). In: *Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings*. Washington, D.C., Air Traffic Control Association, 1973, p. 5-8.

Through the use of the Lockheed MAC 16 minicomputer, the ARTS II system makes it economically feasible to provide automated air traffic control capability to all smaller radar-equipped air terminals. Major differences from the ARTS III system include lower cost and the use of a 16-in. CRT rather than a 22-in. CRT for each controller position. The system accepts data from both primary and secondary radars for display in standard analog form. It can decode and analyze 256 transponder replies on each radar antenna scan;

correlate up to 140 transponder codes to aircraft identities for each scan while performing all other system functions; and update up to 24 full data blocks or their time equivalent on each of six displays. A functional description of system operation is given. T.M.

A73-38464 # En route automation - An overview. L. G. Culhane (Mitre Corp., Bedford, Mass.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 9-14.

The NAS En Route Model 3 system currently being implemented provides both flight data processing and radar data processing functions. The system configuration and the status of the implementation program are described in terms of radar and communications facilities, the central computer complex, the software provisions, data entry and display functions, and interfacing with ATC personnel. Near- and long-term development efforts aimed at en route automation are discussed relative to activities involving conflict alert, local flow control, reliability enhancement, software development, and the implementation of a discrete address beacon system. T.M.

A73-38465 # Parallel processors and air traffic control automation. G. Y. Wang (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 17-22.

Discussion of computer architecture requirements which are crucial to the enhancement of traffic handling capabilities in automated air traffic control (ATC) systems. The use of parallel processing for ATC augmentation is considered, structural features are outlined for the parallel ensemble processor, the associative processor, and the pipeline processor. Two approaches used to evaluate special computer architectures for ATC applications are summarized. T.M.

A73-38466 # New ATC functions using DABS. N. A. Blake (FAA, Washington, D.C.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 23-27.

The Discrete Address Beacon System (DABS) which (when implemented) will serve the dual purpose of providing aircraft position data and of exchanging digital messages between the ground-based ATC computer and the aircraft is discussed. These messages concern such controller functions as metering, sequencing, and spacing aircraft, and the prediction and resolution of conflicts involving IFR and VFR traffic. A separation minima warning system developed for use until DABS has been introduced is described. The SYNCHRO DABS concept, currently under study and evaluation, which represents an extension of the basic DABS to provide a compatible air-to-air PWI-CAS mode of operation to properly equipped users, is examined. V.P.

A73-38467 # Systems for collision avoidance - An overview. J. H. Reed (National Transportation Safety Board, Washington, D.C.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 30-32.

The results of an evaluation of midair collision accident data and near collision data over the past few years are reported. The general conclusion is that most (78%) midair collisions could have been avoided by the see-and-avoid concept, if the aircrews had conformed with the existing flight rules, followed sound cockpit procedures, and if conspicuity devices had been used aboard the aircraft. Areas in which rapid action is indicated are noted, and recommendations to avoid midair collisions are proposed. V.P.

A73-38468 # Ground based CAS versus airborne CAS. R. E. Erickson (Honeywell, Inc., Minneapolis, Minn.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 33-36.

The need for an independent air-derived collision avoidance system is summarized along with the progress made in the development of these systems. There is a growing need for air-derived collision prevention systems in airspace that is not under positive control. The YG1054 proximity warning indicator, an advanced proximity warning indicator, and the YG1081 collision warning system (CWS) are described. The AVOID (Avionic Observation of Intruder Danger) system is a modification of the YG1081 system. The capability and economies afforded by the relatively simple transponder concept will place effective midair collision prevention devices within the reach of all users of all airspace. F.R.L.

A73-38469 # SECANT - A solution to the problem of midair collisions. L. J. Singleton (RCA, Electromagnetic and Aviation Systems Div., Van Nuys, Calif.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 36-40.

Description of the principal characteristics of a system for the separation and control of aircraft using nonsynchronous techniques (SECANT). This cooperative, transponding collision-avoidance system, designed to be compatible within the entire aviation community, is capable of accommodating the dense air traffic anticipated for the 1980s and beyond. It makes available to the pilot evasion or escape maneuvers in any direction - vertical, horizontal, or a combination. SECANT helps the pilot to avoid midair collisions by transmitting probes and receiving replies with a microsecond pulse of up to 1000 pulses/sec on 24 different frequencies. Various discriminants are used to eliminate undesired signals, and the false alarm rate is near zero. (Author)

A73-38470 # Ground based collision avoidance. W. C. Meilander (Goodyear Aerospace Corp., Akron, Ohio). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 41, 42.

Available techniques for aircraft collision avoidance with the aid of ground-based Collision Avoidance Systems (GCAS) are described, with particular attention to those demonstrated by Goodyear Aerospace in the Knoxville experiments and at the TRANSPPO exposition. Tracking, conflict detection and resolution, and displays are covered. It is indicated that the performance of such techniques was entirely satisfactory for air traffic control uses and that the development of improved tracking algorithms is underway for further improvement of conflict predictions and resolution performance. V.Z.

A73-38471 # Oceanic ATC automation at Oakland. D. E. Brink (FAA, Washington, D.C.). In: Air Traffic Control Association, Annual Meeting and Technical Program, 17th, Chicago, Ill., October 9-11, 1972, Proceedings. Washington, D.C., Air Traffic Control Association, 1973, p. 47-49.

Description of a test system of automatic position reporting via data link for transoceanic flights. The test system (called IDIOM) is made up of three components - a minicomputer of 32K capacity, two 21-in. cathode ray tubes displays giving a situation display and a pictorial revue of traffic, respectively, and a function keypad used to maintain the CRTs. In the proposed system an aircraft equipped with data link relays positional information through a fixed directional VHF antenna and computer to the IDIOM computer, which acts on the message and updates the displays accordingly. A.B.K.

A73-38479 # Practical calculations of transitional boundary layers. H. McDonald and R. W. Fish (United Aircraft Corp., East

Hartford, Conn.), *International Journal of Heat and Mass Transfer*, vol. 16, Sept. 1973, p. 1729-1744. 38 refs.

A general finite-difference procedure for computing the behavior of compressible two-dimensional boundary layers is presented together with a turbulence model which allows quantitative predictions of the location and extent of the transition region between laminar and turbulent flow as it is influenced by such disturbances as surface roughness and free-stream turbulence. Reverse transition, i.e., relaminarization, caused by large favorable streamwise accelerations, is also quantitatively predicted by this procedure. The solution procedure depends upon the calculation of the streamwise development of a turbulent mixing length whose magnitude is governed by the turbulence kinetic energy equation. A large number of comparisons between predictions and measurements have been made and in general very good agreement is obtained. (Author)

A73-38491 # Determination of the proneness of aviation oils to carbon deposition (Opredelenie sklonnosti aviatsionnykh masel k nagarobrazovaniyu). N. I. Kaverina, K. S. Chernova, and O. A. Lebedev. *Khimiya i Tekhnologiya Topliv i Masel*, vol. 18, no. 7, 1973, p. 41, 42. In Russian.

Description of an apparatus for carbon deposit measurements when aviation oil is sprayed onto the surface of an aluminum plate heated from 100 to 400 C, depending on requirements during a 6-hr test. The oil is kept at 80 to 250 C in the stainless steel container of the apparatus with a sprayer. The deposited carbon is determined as the difference between the weights of the aluminum plate before and after the test. V.Z.

A73-38497 Composite applications - Today's aircraft. J. Van Hamerveld and L. D. Fogg (Lockheed-California Co., Burbank, Calif.). *Society of Manufacturing Engineers, Paper EM 73-717*, 1973. 20 p. 6 refs. Members, \$1.50; nonmembers, \$2.00.

Results of a research project initiated to develop a graphite laminate beam type configuration of a floor support post which is typical of many primary structural members used on commercial aircraft. Floor post design selections are discussed, as well as methods of structural analysis, and results of flight test programs to verify the initial design concept are presented. The proposed optimization of the designs to achieve low production costs for the autoclave molding and pultrusion processes is also described. It is shown that common multiflanged structural shapes of advanced composites are both feasible and highly effective structurally. Analysis of the fabrication methods to produce structural shapes indicates that the pultrusion process substantially reduces the cost over the autoclave molding process. A.B.K.

A73-38499 Boron-stiffened longerons on the B-1. J. W. Mahoney (North American Rockwell Corp., El Segundo, Calif.). *Society of Manufacturing Engineers, Paper EM 73-719*, 1973. 12 p. Members, \$1.50; nonmembers, \$2.00.

There are five principal longerons in the B-1 aft fuselage. Current design employs a composite construction for these longerons, consisting of a metallic portion, sized to take the structural tensile and compressive loads, and a boron/epoxy laminate, sized to provide required stiffness. While the vehicle can fly without the boron/epoxy stiffeners and has adequate power augmentation to accomplish mission objectives in this state, soft ride characteristics are significantly improved with the composite design. A total of 1,185 pounds is saved by using boron/epoxy for stiffening, in place of single-component steel longerons. (Author)

A73-38503 Incremental forging of parts with cross-ribs. J. A. Schey (Illinois University, Chicago, Ill.) and P. H. Abramowitz. *Society of Manufacturing Engineers, Paper MF 73-164*, 1973. 20 p. 6 refs. Members, \$1.50; nonmembers, \$2.00. Contracts No. N00019-69-C-0158; No. N00019-70-C-0077.

The feasibility of forming complex shapes typical of many airframe components (incorporating thin webs and narrow, tall ribs and stiffening cross-ribs) was explored in room temperature experiments on plasticine, lead and aluminum workpieces. Sequenced indentation with only one pair of anvils was shown to be unsatisfactory since material was simply pushed back and forth. Simultaneous deformation with two (one horizontal, one vertical) pairs of anvils gave shapes of good definition, thin gage and free of material flow defects, but only if bites, reductions and indexing length were closely controlled. A subpress incorporating the required anvil synchronization and a manipulator for moving the specimen were developed and gave satisfactory service under experimental conditions. (Author)

A73-38565 # Experimental measurement of heat transfer to a cylinder immersed in a large aviation-fuel fire. L. H. Russell and J. A. Canfield (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference, Atlanta, Ga., Aug. 5-8, 1973, ASME Paper 73-HT-2*. 8 p. 14 refs. Members, \$1.00; nonmembers, \$3.00.

Presented are the results of an experimental effort to quantify some of the heat transfer parameters pertaining to the luminous flame that results from the uncontrolled combustion of an 8- by 16-ft pool of JP-5 aviation fuel. The temperature and effective total radiant heat flux, both as temporal mean quantities, were measured as functions of position within the quasi-steady burning flame as it existed in a quiescent atmosphere. A grid of infrared radiometers and radiation-shielded thermocouples served as the primary sensing equipment. A determination was made of the perimeter-mean convection coefficient applicable to a horizontally oriented, smooth, 8.530-in-dia circular cylinder immersed at a particular location within the JP-5 flame. (Author)

A73-38570 # Film effectiveness and heat transfer coefficient downstream of a metered injection slot. F. Burggraf and R. W. Huffmeier (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference, Atlanta, Ga., Aug. 5-8, 1973, ASME Paper 73-HT-31*. 12 p. 28 refs. Members, \$1.00; nonmembers, \$3.00.

A73-38581 # The AEROSAT Programme. J. P. Contzen and J. A. Vandenkerckhove. *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-120*. 14 p.

The aim of the Aerosat program is solely to respond to the needs of the civil aviation authorities. States and international organizations in a position to do so are to be encouraged to carry out an international program to provide a satellite system for experimentation and system evaluation. The development of specifications of airborne equipments to operate in such system is also to be encouraged. Details of Aerosat program contents are discussed together with the institutional arrangements. G.R.

A73-38647 # Dynamic gust, landing, and taxi loads determination in the design of the L-1011. W. A. Stauffer and F. M. Hoblit (Lockheed-California Co., Burbank, Calif.). *Journal of Aircraft*, vol. 10, Aug. 1973, p. 459-467. 8 refs.

The approaches used to obtain dynamic gust, landing, and taxi loads in the design of the Lockheed L-1011 TriStar transport are described. The dynamic gust loads were determined in accordance with power-spectral concepts, utilizing a combination of mission analysis and design envelope criteria. Landing loads were based on conventional time history analyses. Taxi loads were obtained statistically from time history analyses in which taxi on surveyed runway profiles was simulated. A major part of both the gust and taxi load determinations consisted of generating matching conditions that enveloped the statistically defined loads. (Author)

A73-38648 * # Propulsion system design for the ATT. G. L. Brines (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). (*American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-760.*) *Journal of Aircraft*, vol. 10, Aug. 1973, p. 487-490. Contract No. NAS3-15550.

The NASA funded Advanced Transport Technology (ATT) systems studies are directed at identifying the optimum propulsion system characteristics required for a low noise, low emissions level engine designed for an advanced commercial transport that employs the supercritical wing technology. This transport could be in service in the late 70s or early 80s and would be designed for transcontinental and international ranges with cruise speeds up to Mach 0.98. This paper reviews the significant results of the propulsion system study, the implications in the propulsion design concept, and the acoustically treated nacelle. (Author)

A73-38649 * # Flight director design for a STOL aircraft. W. R. Seitz (Bendix Research Laboratories, Southfield, Mich.) and R. E. Goodson (Purdue University, West Lafayette, Ind.). *Journal of Aircraft*, vol. 10, Aug. 1973, p. 491-494. 16 refs. Grant No. NGT-15-005-061.

The study described here was intended to explore some ways of giving the pilot the information necessary to perform as well as an autopilot. A fixed-base flight simulator was built to study pilot/director/aircraft performance. Instrument rated pilots used the different director-displays in an approach down to touchdown, including a flare and decrab maneuver. Two well established areas of control theory are combined in the design of the cockpit display. Optimal control theory and the theory of manual control are used to find the feedback gains required to drive the display symbols. Conclusions based on the simulator are presented. The results show that the director display developed in the work provides more than adequate information for simulated landing in highly turbulent conditions. (Author)

A73-38650 # Thrust reverser noise estimation. M. R. Fink (United Aircraft Research Laboratories, East Hartford, Conn.). *Journal of Aircraft*, vol. 10, Aug. 1973, p. 507, 508.

Thrust reverser noise estimates are needed for STOL aircraft because sideline noise from reversers at approach power settings after touchdown might exceed the takeoff sideline noise limit. There are no rigorous analytical methods for predicting such noise. Over-all sound power level (OAPWL) was found to vary with jet velocity to the sixth power as expected for dipole noise. Maximum over-all sound pressure levels (OASPL) for a nozzle without a thrust reverser was less than the minimum value measured with a reverser. F.R.L.

A73-38651 # Calculation of three-layer minimum-weight panels as a problem of mathematical programming (Raschet trekh-sloynnykh panelei minimal'nogo vesa kak zadacha matematicheskogo programmirovaniia). Ia. Iu. Godes and Iu. M. Pochtman. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela*, May-June 1973, p. 134-140. 8 refs. In Russian.

The proper selection of parameters which will ensure minimum weight and at the same time will satisfy the strength and stability conditions is examined. The problem is solved in general formulation as a linear-programming problem, using a random-search technique (coordinate learning algorithm). V.P.

A73-38652 # Angular momentum and the aircraft-store separation problem. P. Daniels and T. A. Clare (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.). *Journal of Aircraft*, vol. 10, Aug. 1973, p. 511, 512.

Aircraft-store separation is a serious consideration for both weapon and aircraft designers. The weapon designer wants to avoid the large release disturbance since it affects the weapon's accuracy. The aircraft designer wants to avoid the large release disturbance

since it is dangerous to the pilot and can result in damage to the aircraft. One method for increasing the angular momentum of an external store is to spin an internally mounted flywheel. This method would work equally well for all types of racks. It is noted that a store with an internally spinning flywheel, if dropped in the free fall mode, would not spin appreciably because the store and the flywheel fall at the same rate. Consequently, the torque due to friction coupling could not act efficiently. F.R.L.

A73-38725 UHF airborne antenna diversity combiner evaluation. A. L. Johnson (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 9-7 to 9-12.

The antenna combiner considered has four UHF input ports. A filter and preamplifier on each port established the signal-to-noise ratio for the system. The correlation techniques employed in the antenna combiner removed the phase variations from separate antennas and provided a consistently better received signal level than available from any single antenna element. It is pointed out that such a technique should permit the use of several simple antenna elements on an aircraft to obtain consistently good antenna gain. G.R.

A73-38746 * Adaptive multibeam concepts for traffic management satellite systems. J. J. Bisaga, H. A. Blank, and S. A. Klein (Computer Sciences Corp., Falls Church, Va.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 21-19 to 21-27. Contract No. NAS5-21590.

The analysis of the performance of the various implementations of the simultaneous system in the Atlantic and Pacific Oceans has demonstrated that the use of adaptive system concepts in satellite traffic management systems can greatly improve the performance capabilities of these systems as compared to the corresponding performance capabilities of conventional nonadaptive satellite communications systems. It is considered that the techniques developed and analyzed represent a significant technological advance, and that the performance improvement achieved will generally outweigh the increased cost and implementation factors. F.R.L.

A73-38755 Multipath channel characterization for Aerosat. A. Schneider (Mitre Corp., McLean, Va.; Maryland, University, College Park, Md.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 31-30 to 31-35. 11 refs.

This paper describes the salient features of a model capable of describing the principal characteristics of sea-scattered multipath for aircraft/satellite links. The model differs from previous ones by accounting for vector scattered fields and antennas of arbitrary polarization and directive gain. An optional feature permits the incorporation of the composite sea surface model so successfully employed for radar backscatter. Spherical earth geometry is employed. Developed for a typical example are the Delay and Doppler Spread Functions and the Temporal and Two-Frequency Correlation Functions. (Author)

A73-38756 Airborne digital data link terminal for commercial airlines' use. W. W. Sang (McDonnell Douglas Electronics Co., St. Charles, Mo.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 34-2 to 34-4.

Physical and functional description of the airborne avionics of a digital data link system designed for use by commercial airlines. The airborne equipment consists essentially of two units: a control unit and a digital communications unit. Special attention is given to

reviewing the amplitude modulation, error detection circuitry, and interunit communication concept used in the system. M.V.E.

A73-38757 The universal data link system for air/ground communications. J. B. Thoren (American Airlines, Inc., New York, N.Y.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2.

New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 34-5 to 34-7.

Review of the results of an evaluation of the use of the universal data link airborne air/ground communications terminal operated in the digital mode for air traffic control (ATC) and company purposes on a 747 aircraft during normal scheduled flights. The results indicate that digital communications offer a direct means for including the aircraft terminal in ground ATC and company automation systems and for reducing voice radio frequency congestion and air/ground communications bottlenecks. M.V.E.

A73-38758 The ARINC plan for implementing air/ground DATALINK. N. D. Steele, Jr. (Aeronautical Radio, Inc., Annapolis, Md.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2.

New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 34-8 to 34-10.

Review of the historical background and accomplished implementation progress of the advanced air/ground communications concept, the DATALINK program. This program is shown to have reached the stage of ongoing applications analyses and trials. Current forecasts predict that approximately 95% of the air carrier fleet will be implemented by 1978. M.V.E.

A73-38759 The ASTRO-DABS concept. L. Schuchman (Mitre Corp., McLean, Va.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 34-11 to 34-15.

Review of the current stage in the ongoing fundamental concept development work for a satellite-based advanced air traffic management system that is to provide three-dimensional positional accuracy of the order of a hundred feet together with universal coverage. ASTRO-DABS is a hybrid satellite and terrestrial Discrete Address Beacon System (DABS) concept affording very accurate surveillance and navigation together with a reliable data link, which is believed capable of realizing the satellite system potential in a cost-effective manner and with limited hazards due to hostile acts against the system. It is projected for introduction in the 1990s. M.V.E.

A73-38760 The utility of data link to military aircraft communication - An operational view. H. G. Raymond and J. H. Cragie (TRW Systems Group, Redondo Beach, Calif.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 34-16 to 34-21. 6 refs.

Review of the results of an analysis of the operational merits of the air/ground digital data link communications system in military aircraft applications. The results obtained indicate that the digital data link system can provide an important capability for transmitting a wide variety of Air Force aircraft messages. But it cannot completely supplant voice links. The utility of the data link in reducing channel congestion, improving link performance, and providing such capabilities as increased accuracy and security, is clear. Moreover, the input and output devices required for an aircrew to use the data link are not overly complex. M.V.E.

A73-38770 A rational basis for determining the EMC capability of a system. R. B. Schulz (Southwest Research Institute, San Antonio, Tex.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2. New York, Institute of Electrical and Elec-

tronics Engineers, Inc., 1973, p. 54-1 to 54-8. Research supported by the Southwest Research Institute.

A logical procedure is presented for determining the electromagnetic capability (EMC) of a system, based upon an analytical approach developed earlier. The procedure is illustrated using as a system an aircraft with a manageable number of electrical/electronic subsystems. The result is a single number which can be used in a weapon system effectiveness equation and is generally useful not only to EMC engineers, but also to other electronic engineers and managers. Byproducts of the procedure are enhanced highlighting of critical parameters for design purposes and a means for economic evaluation of EMC efforts. (Author)

A73-38771 Intrasystem electromagnetic compatibility analysis program. J. L. Bogdanor, C. E. Clark, M. D. Siegel, and G. L. Weinstock (McDonnell Aircraft Co., St. Louis, Mo.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 54-9 to 54-13. Contract No. F30602-72-C-0277.

The objective of the program described is to develop a computerized analysis program to allow the practical implementation of EMC at all stages of an Air Force system's life cycle, and the capability must be applicable for use in ground, aircraft, and space/missile systems. The major areas to which this program must address itself in order to attain this objective are specification generation, waiver analysis, design change evaluation, and tradeoff analysis. The program achieves its objective by incorporating state-of-the-art EMC analysis models into an efficiently running routine which quickly evaluates the possible transfer modes of electromagnetic energy from one equipment into another. The models are divided into four categories: emitter models to determine source outputs, transfer models to relate emitter outputs to receptor inputs, receptor models to determine input responses, and system models using the above three models to evaluate a complete weapon system. (Author)

A73-38776 * # Study of control system effectiveness in alleviating vortex wake upsets. W. A. Johnson (Systems Technology, Inc., Hawthorne, Calif.) and H. A. Redies (NASA, Flight Research Center, Vehicle Dynamics and Control Div., Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-833.* 10 p. 5 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS4-1952.

The problem of an airplane being upset by encountering the vortex wake of a large transport on takeoff or landing is currently receiving considerable attention. This paper describes the technique and results of a study to assess the effectiveness of automatic control systems in alleviating vortex wake upsets. A six-degree-of-freedom nonlinear digital simulation was used for this purpose. The analysis included establishing the disturbance input due to penetrating a vortex wake from an arbitrary position and angle. Simulations were computed for both a general aviation airplane and a commercial jet transport. Dynamic responses were obtained for the penetrating aircraft with no augmentation and with various command augmentation systems. The results of this preliminary study indicate that it is feasible to use an automatic control system to alleviate vortex encounter upsets. (Author)

A73-38777 * # An approach to the synthesis of separate surface automatic flight control systems. J. Roskam and S. Henry (Kansas, University, Lawrence, Kan.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-834.* 8 p. 6 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. NGR-17-002-095.

A method is presented for the analysis of separate surface automatic flight control systems. The feasibility of such systems is demonstrated by the analysis of an example system, a separate surface wing-leveler for a Cessna 172. This example system employs a

separate surface aileron with 15% of the basic airplane roll control power. A 90% reduction in bank-angle gust response can be obtained when compared with the basic airplane. The system does not feed back to the pilot's wheel. When failed (even ha.dover) the pilot retains more than adequate control of the airplane. (Author)

A73-38783 * # Digital flight control design using implicit model following. R. F. Stengel (Analytic Sciences Corp., Reading, Mass.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-844.* 14 p. 22 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS9-10268.

A design procedure for determining the control gains of a discrete-time ('digital') control system is presented. The method is separable into four distinct steps: (1) the definition of closed-loop response criteria, (2) the choice of a discrete-time model which provides the desired response, (3) the determination of control gains which implicitly force the actual system to follow the desired response, and (4) the reduction of the measurement state by the introduction of an 'observer' (a form of integral-differential compensation). It is shown that a single desired response does not completely define the 'ideal' system. The response criterion generally leaves some parameters of the model unspecified, allowing two courses for improving the model: (1) definition of additional response criteria, or (2) redefinition of the discrete-time model for improved implicit model-following with the actual closed-loop system. (Author)

A73-38785 # Redundant system design for advanced digital flight control. J. R. Sklaroff, F. G. Kilmer, and H. A. Padinha (IBM Electronics Systems Center, Owego, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-846.* 16 p. 14 refs. Members, \$1.50; nonmembers, \$2.00.

Description of redundancy management techniques for the data processing system used in digital fly-by-wire (DFBW) applications, including the presentation of a preferred system configuration which meets multiple fault tolerance and failure coverage requirements. Operational requirements are presented and translated into system design issues, from which candidate redundancy management techniques are developed. Technique evaluation is performed and includes considerations of failure coverage, impacts on software/hardware, detection and isolation of slow failures, and prevention of channel divergence. A redundancy management design for a DFBW data processing system is presented. (Author)

A73-38787 # An organized approach to the digital autopilot design problem. H. Berman and R. Gran (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-848.* 12 p. 5 refs. Members, \$1.50; nonmembers, \$2.00.

The design approach combines an orderly method for organizing the autopilot software, the integrated digital autopilot, with a newly developed set of digital control synthesis computer programs (known as DIGISYN). DIGISYN, based on stochastic control and estimation theory, accepts, as control requirements, upper bounds for the state vector error and the desired vehicle response to either control commands or external disturbances. Using a system dynamics model which includes parasitic modes, DIGISYN collectively considers system and sensor noise and external stochastic disturbances to determine the maximum permissible sample time, the optimal state estimator, and a set of feedback gains to yield the desired response characteristics. The unique feature of this approach is that sample time is determined by propagating the state covariance matrix until the specified error bounds are exceeded. (Author)

A73-38799 # Automatic control of adverse yaw in the landing environment using optimal control theory. D. Bischoff (U.S. Navy, Naval Air Test Center, Patuxent River, Md.), R. Duffy, and H. Kaufman (Rensselaer Polytechnic Institute, Troy, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-861.* 11 p. 14 refs. Members, \$1.50; nonmembers, \$2.00.

A73-38800 * # A 'type one' servo explicit model following adaptive scheme. I. Tiroshi and J. R. Elliott (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-862.* 8 p. Members, \$1.50; nonmembers, \$2.00.

This paper describes 'type 1' servo techniques applied to explicit model following systems. The advantages of using these are: (1) steady-state decoupling is provided for the controlled state variables as determined by a reference input (the pilot command for example), (2) overall stability of the decoupled adaptive scheme is guaranteed, (3) a zero steady-state error for those state variables incorporating integral feedback, to a constant input reference, and (4) improved transient performance. Example calculations have been performed using a mathematical model for a typical fighter aircraft and a desired performance reference model based on satisfactory aircraft flying qualities. Numerical results are given. (Author)

A73-38801 # A practical load relief control system designed with modern control techniques. A. J. VanDierendonck, C. R. Stone, and M. D. Ward (Honeywell, Inc., Minneapolis, Minn.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-863.* 12 p. 5 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-2008.

Practicalizing quadratic optimal control algorithms were used to design load relief systems for large flexible aircraft. In one example predicted rms stresses at the wing root were reduced by more than 40 percent. Handling qualities or stability were not compromised. The control is realized with a gyro and three accelerometers affecting ailerons and elevator - two accelerometers more than an existing SAS. This paper describes the design approach, which uses an optimization algorithm for limited measurement control and compensation filters. The quadratic performance index is defined to enforce good handling qualities and to limit the control system bandwidth. Some later developments and results are also presented with recommendations for future developments. (Author)

A73-38809 # Optimal filtering and smoothing simulation results for CIRIS inertial and precision ranging data. W. S. Widnall (Intermetrics, Inc., Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-872.* 9 p. 9 refs. Members, \$1.50; nonmembers, \$2.00. USAF-supported research.

A73-38811 # The evaluation of autonomous navigation systems for cruise vehicles. W. D. Lochrie (McDonnell Douglas Astronautics Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-874.* 7 p. 6 refs. Members, \$1.50; nonmembers, \$2.00.

The advent of small, low-weight Doppler radars and the development of automatic position-fixing schemes to augment inertial navigation systems have made precision autonomous navigation possible for cruise vehicles on extended missions. This paper presents numerical results of a detailed error analysis of a medium accuracy cruise vehicle inertial navigation system aided with a barometric altimeter, Doppler radar and/or position fixes. The covariance analysis technique was used to evaluate system performance as a function of mission description, environmental error

sources, system configuration, and sensor errors. The effect of using a suboptimal Kalman mechanization is also presented. (Author)

A73-38821 * # STOL ride control feasibility study. G. O. Thompson, D. L. Eslinger, C. K. Gordon, and R. O. Dodson (Boeing Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-885*. 9 p. 7 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS1-11683.

A study to determine the feasibility of developing a ride smoothing control system for a passenger STOL aircraft has been performed for NASA. The de Havilland DHC-6 Twin Otter was selected for the feasibility study, since it is the only STOL aircraft presently certificated and in use by a number of United States air carriers. The study indicated that a ride control system that significantly reduces vertical and lateral accelerations can be practically implemented on the Twin Otter with minimum airplane performance degradation. The system uses symmetrical ailerons, elevator, rudder and spoiler control surfaces, with accelerometers and rate gyros as motion sensors. (Author)

A73-38822 # Application of direct side force control to commercial transport. D. Mercier and R. Duffy (Rensselaer Polytechnic Institute, Troy, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-886*. 12 p. 17 refs. Members, \$1.50; nonmembers, \$2.00.

A preliminary investigation to determine the feasibility of the use of direct side force control (DSFC) by transport aircraft as a means for improvement in near-terminal area air traffic control has been completed. Idealized models of both the conventional lateral sidestep maneuver involving coordinated banks and a wings-level, zero-yaw sideslip maneuver possible with DSFC have been developed and compared. These idealizations, when subjected to various trajectories constraints indicate a potential improvement in down-range distance required to correct an initial lateral offset of the order of twenty per cent. (Author)

A73-38823 # Direct side-force control for STOL transport aircraft. M. W. M. Jenkins (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-887*. 12 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Research supported by the Lockheed-Georgia Independent Development Funds.

An exploratory analytical study, a simulation study, and a wind tunnel test have shown that direct side-force control is an effective augmentation to roll control for the lateral maneuvering of a four-engined STOL transport aircraft. In addition, direct side-force provides a good lateral trim device during approach and landings in cross-winds. Generation of sufficient side-force at the low speeds appropriate to STOL landing is not practical by normal aerodynamic means. It was found that lateral vectoring of the propulsive engines provided sufficient side-force without penalty to the field performance of the vehicle. (Author)

A73-38832 # Digital information management system of navigational and flight data for post-1975 fighter aircraft. G. W. Scott (Northrop Corp., Palos Verdes Peninsula, Calif.) and D. A. Williams (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-897*. 8 p. 5 refs. Members, \$1.50; nonmembers, \$2.00.

A73-38835 # Data compression in recursive estimation with applications to navigation systems. A. N. Joglekar and J. D. Powell

(Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-901*. 10 p. 19 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-72-C-1297.

Description of a data compression technique which averages batches of data. In this technique, preprocessing is accomplished by averaging a batch of measurements between successive Kalman filter updates. Guidelines are given for averaging such as, how often to sample the data, when to average, and how many data points to average. The averaging technique is applied to aircraft navigation using two DMEs and either air data or inertial data. The results demonstrate that significant computation time reductions are possible with little covariance degradation for many cases. VOR/DME flight data concerning aircraft landing approaches were used to verify the analysis and show good agreement with the analytical predictions. (Author)

A73-38837 # Nonlinear trajectory following in the terminal area - Guidance, control and flight mechanics concepts using the microwave landing system. P. Madden and M. Desai (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Key Biscayne, Fla., Aug. 20-22, 1973, Paper 73-903*. 15 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. U.S. Department of Transportation Contract No. TSC-551.

A73-39015 IAPs can solve V/STOL control problems. K. F. Becker and L. H. Mathis (Sperry Rand Corp., Vickers Div., Troy, Mich.). *Hydraulics and Pneumatics*, vol. 26, Aug. 1973, p. 93-95.

The integrated actuator package (IAP) is a flight control actuator in which a complete hydraulic power supply is integrated. Package electrical power is supplied from the aircraft electrical system, and is converted to hydraulic power at the control surface. A typical installation of an IAP for flap control on a V/STOL aircraft permits the IAP to function full-time as an aileron control regardless of flap position. When flaps are fully extended, the aileron still functions regardless of its position within the airstream. F.R.L.

A73-39026 Nitride inclusions in titanium ingots - A study of possible sources in the production of magnesium-reduced sponge. J. L. Henry, S. D. Hill, J. L. Schaller, and T. T. Campbell (U.S. Bureau of Mines, Albany, Ore.). *Metallurgical Transactions*, vol. 4, Aug. 1973, p. 1859-1864. 5 refs.

A73-39127 Investigation of microwave scattering by tall buildings. E. N. Bramley and S. M. Cherry (Science Research Council, Radio and Space Research Station, Slough, Bucks., England). *Institution of Electrical Engineers, Proceedings*, vol. 120, Aug. 1973, p. 833-842.

The paper describes measurements of the scattering coefficient of a number of tall buildings made at 9.4 GHz using a bistatic pulse-radar method. A helicopter-borne transmitter was flown near the building under investigation, and the direct and scattered signals were compared at a distant fixed receiver. At distances of a few hundred metres from a building, the scattered field was only a few decibels weaker than that incident on the building when specular conditions were satisfied. In nonspecular conditions, the scattering coefficient was typically of order -30 dB; scattering with vertical polarisation was generally a few decibels stronger than with horizontal polarisation owing to the difference between the corresponding reflection coefficients of the building materials. The geometrical factors determining the level of scattering have been considered theoretically, and it has been shown that in simple cases the measured absolute level, and its dependence on azimuth, elevation and range, can be reasonably well explained in terms of scattering from a number of smooth flat elements and corner reflectors. (Author)

A73-39210 Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Seminar sponsored by the Flight Safety Foundation, Arlington, Va., Flight Safety Foundation, Inc., 1973, 118 p. \$10.00.

The potential and actual capability of instrument landing monitor (ILM) systems is evaluated, and papers are presented on emergency equipment for total electric aircraft, oxygen safety in corporate aircraft, crew coordination, and cockpit discipline. Long-range views on executive aircraft operations, reducing the risk of corporate accidents, and problems with the aircraft/runway interface are treated.

F.R.L.

A73-39211 # The potential and actual capability of the ILM. R. C. Schilling (Swissair AG, Kloten, Switzerland). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 1-12.

An instrument landing monitor (ILM) evaluation program run by Swissair is described. The ILM concept goal is to restore the poor or missing natural visibility by synthetic visibility of sufficient accuracy and integrity, regardless of actual weather and surface conditions. The Texas Instruments ILM used is a special short-range high-resolution Ka-band radar designed for mapping the approaching runway. Results achieved to date confirm the ILM concept. They show that it is feasible to have a system fitting DC-9 dimensions and providing one to two nautical miles synthetic visibility.

F.R.L.

A73-39213 # Emergency equipment for total electric aircraft. G. Gullett. In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 22-25.

The introduction of jet aircraft into the corporate business fleet, coupled with the equipment changes that were made, resulted in aircraft where all instruments are electrically powered (in some cases all attitude instruments are ac-powered). Problems with static inverters and nickel-cadmium batteries are discussed, as well as possible emergency transmitters. The emergency power supply is the heart of the system. It is very important that there is a capability of testing the battery pack's capacity. Battery discharge times and methods of determining them are considered.

F.R.L.

A73-39214 # Presentation for the ground safety panel. C. E. Smith (Pan American World Airways, Inc., Teterboro Airport, N.J.). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 26, 27.

Application of the National Fire Protection Association pamphlet 409, which covers aircraft hangars, is discussed. The insurance rates for hangars are predicated on the type of construction and the degree of fire protection provided. The provision of fire protection in a hangar on an airport where sufficient water is available to support such systems can most often pay for itself over the term of occupancy by reduced insurance premiums.

F.R.L.

A73-39216 # Crew coordination and cockpit discipline panel. E. C. Montgomery (National Transportation Safety Board, Washington, D.C.). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 35-38.

The professional pilot and his relationship to the cause factor in aircraft accidents is discussed, and the safety records for air taxi, air carrier, and corporate/executive pilots are reviewed. The dilemma of the professional pilot is reflected in causal factors where he must

operate with a contradiction of attitudes, i.e., safety is demanded but delays are not tolerated. The accident rate for corporate/executive flying in 1970 was 3.92 times that of the air carriers. It is suggested that the differential can be narrowed by more exacting training and the development of greater cockpit discipline.

F.R.L.

A73-39217 # Crew coordination and cockpit discipline panel. W. Moran (American Airlines, Inc., New York, N.Y.). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 39-42.

American Airlines' philosophy on crew coordination and discipline during approach is described. What is needed is to create a climate wherein the facts, if they are worthwhile, are expressed in such a way that self-discipline will result. Procedures are taught to a specified level of proficiency, and this carries through ground school to the cockpit procedures trainer, to the flight simulator, into the airplane locally, on to the line during the line-training phase, and then through recurrent training to proficiency.

F.R.L.

A73-39218 # Long-range views on executive aircraft operations. W. von Braun (Fairchild Industries, Inc., Germantown, Md.). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 45-57.

It is considered likely that there will be executive jet transports flying before 1980 that are at least a hundred miles per hour faster than today's aircraft. Future aircraft will use the supercritical wing and the 'area-ruled' body to attain higher speed without using more fuel. These improvements in aerodynamics will be accompanied by further improvements in engines. Problems of neighborhood acceptance and of better designed airports are considered. Air traffic control jobs in high density areas can be carried out much more efficiently with equipment that is available today. Aspects of the operation of the Space Shuttle and training requirements for executive flight crews are treated. Attention is given to simulator training.

F.R.L.

A73-39219 # Reducing the risk of corporate accidents. C. A. McKinnon (Flight Safety Foundation, Inc., Arlington, Va.). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 58-78.

It is felt that nonprecision approaches represent a large proportion of corporate/executive aircraft accidents. It is part of the nature of corporate flying that there is involvement with airports that do not have full ILS. Corporate operators would be well advised to adopt the airline philosophy in regard to nonprecision approaches and add both ceiling and visibility to the minimums stated. There was a high incidence of accidents on nonproductive flights, and it is suggested that this is indicative of a lower level of cockpit discipline on this type of flying. Problems of hydroplaning and tire failure are examined.

F.R.L.

A73-39220 # Problems with the aircraft/runway interface. M. Volz (United Air Lines, Inc., Chicago, Ill.). In: Annual Corporate Aircraft Safety Seminar, 18th, Arlington, Va., April 1-3, 1973, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 79-96.

The discussion involves runway friction measuring research and the dissemination of this information, plus United Air Lines' approach to runway length requirements and procedures for landing on wet or slippery runways. Considerable formal research has been undertaken by a joint NASA-FAA-USAF team using a Boeing 727 and a Douglas DC-9. The general topics discussed dealing with approach and landing include the stabilized approach as an extension of UAL policy, a review of the pertinent rules which govern landing operations, some of the variables which affect an approach and landing, and directional control and stopping after touchdown.

F.R.L.

A73-39245 # A fatigue test program for the wing of the Jantar SZD-37 sailplane (Program próby zmęczeniowej skrzydła szybowca SZD-37 Jantar). W. Stafiej (Ośrodek Badawczo-Rozwojowy Szybownictwa, Bielsko-Biala, Poland). *Technika Lotnicza i Astronautyczna*, vol. 27, July 1973, p. 12-18, 23, 24, 40; 13 refs. In Polish.

Characteristic loads sustained by wing structures of competition sailplanes in various phases of operation are described together with a series of fatigue tests developed for the Jantar SZD-37 wing constructed exclusively of laminate composite materials. The test program is divided into loading phases corresponding to taxi conditions, takeoff, landing, gusts, launching, and aerobatic maneuvers. T.M.

A73-39248 # Needed - Rational testing of aerospace vehicles. A. M. Smith (General Electric Co., New York, N.Y.) and T. D. Matteson (United Air Lines, Inc., Chicago, Ill.). *Aeronautics and Astronautics*, vol. 11, Aug. 1973, p. 69-72.

Selected results are presented from a survey of the role of testing in achieving aerospace systems effectiveness. The survey clearly points to a need for a more scientific approach to the specification, planning, and conduct of test programs. It also indicates a need for rigorous industry-wide attack on the broader analysis and interpretation of test results, with the ultimate aim of defining test methods, techniques, and practices that will yield more return per test dollar. M.V.E.

A73-39249 Effects of thermal and mass diffusivities on the burning of fuel droplets. A. S. Kesten (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Chemical Engineers and American Society of Mechanical Engineers, National Heat Transfer Conference, 14th, Atlanta, Ga., Aug. 5-8, 1973, AIChE Preprint 22*. 9 p. 6 refs. Members, \$1.00; nonmembers, \$3.00.

Flames enveloping burning fuel droplets are established by the diffusion and reaction of fuel and oxidizer and the conduction of heat from the flame region to the vaporizing liquid. Various models of fuel droplet diffusion flames are founded upon the quasi-steady flame front model of Williams. This model considers the entire combustion reaction to take place at a flame surface with the rates of transport of fuel and oxidizer to the flame surface occurring in stoichiometric proportions. Reaction is assumed to occur instantaneously upon arrival of the reactants at the flame surface. Additional simplification in the representation of the droplet combustion process is achieved by assuming that thermal and mass diffusivities are equal. This restriction is removed in the model presented here in order to examine the effects of different thermal and mass diffusivities on the droplet burning process. The marked sensitivities of burning rate, flame front position and peak temperature to the ratio of thermal to mass diffusivity are noted. Variations in flame structure and oxygen concentration profiles with diffusivity ratio are illustrated for the case of ethanol droplet combustion. (Author)

A73-39274 Discourse on comparisons between commercial and military aircraft logistics. J. F. McDonald (Flying Tiger Line, Inc., Los Angeles, Calif.). *Logistics Spectrum*, vol. 7, Fall 1973, p. 19-26, 37.

Logistics planning operations in commercial and military aviation are compared in terms of support and maintenance practices dictated by different operational environments. The evolution of various logistics skills as dictated by increasing complexity of aircraft and their uses is summarized, and explanations are provided for such categories of maintenance as scheduled overhaul, on-condition inspection, and condition monitoring. Differences between military and civil aviation are pointed out with respect to avoidance of vehicle and system complexity through fundamental design analysis, economic aspects of optimum spare engine quantities, progressive divergence of basic designs, and the use of built-in test equipment. T.M.

A73-39275 Rationale of a new maintenance concept. B. H. Colmery (U.S. Naval Air Systems Command, Washington, D.C.). *Logistics Spectrum*, vol. 7, Fall 1973, p. 27-31, 37.

Previous aircraft preventive maintenance in both civilian and military operations had been performed on some fixed interval of calendar time, flight time, or number of cycles. New maintenance concepts described in this paper eliminate much of the prior inspection and perform most overhauls and replacements on a flexible schedule. While there are shades and variations of practices, the new airline maintenance concepts essentially determine the frequency necessary for preventive maintenance by two techniques termed on-condition maintenance and condition monitoring. Factors governing reliability are used to demonstrate why these two techniques are able to decrease preventive maintenance costs, to reduce failures, and at the same time to increase safety. T.M.

A73-39357 # Designing equal-life minimum-weight truss structures (Raschet ravnozhiuchikh sterzhnevyykh konstruktsii naimen'shego vesa). Iu. D. Safronov (Kazanskii Aviatsonnyi Institut, Kazan, USSR). *Problemy Prochnosti*, vol. 5, June 1973, p. 26-30. 6 refs. In Russian.

The principles of designing minimum-weight truss systems for lower than permissible fatigue crack propagation rates are examined. The principles of designing truss systems of prescribed weight for minimum fatigue crack propagation rates are also studied. Steady cyclic loads in the elastic region are assumed in each case. The concept of a permissible stress (with respect to service life) for which the fatigue crack propagation rate is equal to the permissible rate is introduced in the analysis. Examples of 'equal-life' beams and trusses, in which fatigue cracks (regardless of their location) will propagate at the permissible rate are presented. V.P.

A73-39374 # Longitudinal-torsional vibrations of rotors (Prodol'no-krutit'nye kolebaniia rotorov). B. F. Shorr, V. O. Bauer, and E. A. Kuznetsov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsonnogo Motorostroeniia, Moscow, USSR). *Problemy Prochnosti*, vol. 5, July 1973, p. 32-38. 6 refs. In Russian.

Consideration of the phenomenon of coupling of longitudinal and torsional vibrations in turbomachine rotors with bladed disks. The simplest cause of linear coupling of longitudinal and torsional vibrations of rotors lies in the setting of the working blades at an angle to the plane of rotation of the disks. To illustrate this cause, an elementary rotor scheme is considered, the shaft of which consists of two segments of constant cross section connecting three rigid disks. Another factor causing linear coupling is flexural compliance of real disks. This is illustrated by considering an elastic plate with a distributed mass along the perimeter. A situation is then described in which coupling of longitudinal-torsional vibrations in rotor systems can occur as a result of nonlinear effects. A system of nonlinear equations for the strains of a circular shaft is applied to an analysis of longitudinal-torsional vibrations of a rotor system consisting of a cantilevered shaft section with a bladed rigid disk. A.B.K.

A73-39406 Control requirements for sling-load stabilization in heavy lift helicopters. S. J. Asseo and R. F. Whitbeck (Calspan Corp., Buffalo, N.Y.). *American Helicopter Society, Journal*, vol. 18, July 1973, p. 23-31. 9 refs. Research supported by the Calspan Corp.; Grant No. DAAJ02-72-C-0027.

This paper discusses the control requirements for stabilizing externally slung loads in heavy lift helicopters. Linearized equations of motion of the helicopter/winch/cable/load complex are developed for a level flight condition at constant airspeed and for a variable suspension geometry. These equations are then used in conjunction with modern control theory to design several control systems, each of which stabilizes the load for a given type suspension. Load stability, winch power requirements and the dynamic performance of the winch controlled systems are then compared against (one, two or three) fixed point designs. (Author)

A73-39522 A new method of solving one-dimensional unsteady flow equations and its application to shock wave stability in sonic inlets. A. A. Fathy (Cairo University, Cairo, Egypt) and E. Lumsdaine (Tennessee, University, Knoxville, Tenn.). In: *Midwestern Mechanics Conference, 13th, Pittsburgh, Pa., August 13-15, 1973, Proceedings.* Pittsburgh, University of Pittsburgh, 1973, p. 153-166. 13 refs. NSF Grant No. GK-5030A1.

A73-39547 * Nonlinear response of plates subjected to inplane and lateral pressure pulses. L. J. Knapp (Westinghouse Electric Corp., Pittsburgh, Pa.). In: *Midwestern Mechanics Conference, 13th, Pittsburgh, Pa., August 13-15, 1973, Proceedings.* Pittsburgh, University of Pittsburgh, 1973, p. 733-744. 7 refs. Grant No. NGR-33-013-039.

The nonlinear response of a rectangular plate exposed to a far-field sonic boom disturbance is studied. The plate is subjected to both lateral and in-plane disturbances. The lateral disturbance is in the form of an N-shaped pressure pulse, and the in-plane disturbance is represented by a sinusoidal pulse. The equations of motion are reduced to a set of nonlinear coupled ordinary differential equations using Galerkin's method. These equations are solved numerically using Hamming's (1959) modified predictor-corrector integration method. The effects of in-plane boundary conditions and in-plane inertia are investigated. The nonlinear results, when compared to the linear theory, serve to delineate the realm of validity of the linear theory. (Author)

A73-39624 # Geophysical effects of Concorde sonic boom. F. H. Grover (U.K. Atomic Energy Authority, Brimpton, Berks., England). *Royal Astronomical Society, Quarterly Journal*, vol. 14, June 1973, p. 141-160. 18 refs.

Test flights which commenced in 1970 took place along an authorized route, the so-called 'Boom Corridor' which ran north to south down the west coast of Britain. The flights provided an opportunity for direct measurement of the acoustic pressure intensities produced at ground level by sonic booms from the Concorde, and of other effects such as the vibrations induced in buildings lying in the path of the boom. Ground motion associated with the overflights was recorded by seismographic instruments. The acoustic and seismic manifestations of the sonic boom can be much influenced by the topography and geology of the site of recording. Close range and distant acoustic and seismic effects are discussed, as well as the significance of the ground motion to structures. F. R. L.

A73-39637 Copper and silver corrosion by aviation turbine fuels. R. P. Tripathi, I. B. Gulati, S. S. Pandey, and H. S. Rohatgi (Indian Institute of Petroleum, Dehradun, India). *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 12, Sept. 1973, p. 227-231. 10 refs.

An investigation was conducted concerning the types of sulfur compounds which can cause corrosion, giving attention also to the maximum ratios of these compounds which can be tolerated without causing corrosion to either copper or silver strips under standard conditions of the tests. The variations in composition of sulfur compounds and the inhibiting effect of organic peroxides toward corrosion by elemental sulfur have also been studied. G. R.

A73-39659 Progress report on the L-1011 TriStar. J. P. Geddes (Interavia, Los Angeles, Calif.). *Interavia*, vol. 28, Aug. 1973, p. 851-855.

The first L-1011 began revenue service with Eastern Air Lines in April 1972. Aspects of TriStar production are discussed, giving attention to labor problems and a weight-saving program. One year after first service began, a fleet of 27 TriStars had accumulated 31,238 hours. TriStar sales are considered and the needs for a family of wide-body trijets for a number of different uses are examined. G. R.

A73-39660 RB.211 - The birth pains of a big engine. M. Nibloe (Interavia, S.A., Geneva, Switzerland). *Interavia*, vol. 28, Aug. 1973, p. 856-858.

The development of the RB.211 turbofan is considered, giving attention to the resumption of work after the shattered original Rolls-Royce company had been resuscitated with the formation of Rolls-Royce (1971) Ltd. Difficulties on account of disk failures could be overcome when it was found that the so-called A-disks, from the top half of the titanium billets were more prone to failure than the B-disks, from the bottom half of the billet. In-service problems and solutions are discussed together with the organization of the aerospace company, development aims regarding the RB.211, and modifications for improved engine performance. G. R.

A73-39661 Fire-fighting in the wide-body era. K. Höhle. *Interavia*, vol. 28, Aug. 1973, p. 859-864.

Questions of the evolution of fire-fighting equipment are considered, giving attention to the fast fire appliances with all-wheel drive introduced in the early fifties. The introduction of the Boeing 747 and other wide-bodied aircraft brought the latest innovations and also a clash in fire-fighting concepts. ICAO recommendations relating to the protection to be provided are discussed together with aspects of fire brigade reaction time and the types of fire-extinguishing agents to be used. G. R.

A73-39662 Flight deck evolution. II. L. F. E. Coombs. *Interavia*, vol. 28, Aug. 1973, p. 879-882.

In the early 1950s, attention was being given increasingly to the visual problems of the pilot during the final stage of an approach to land in poor visibility conditions. The number of instruments on the flight deck increased with the advances in aircraft performance. Questions of jet aircraft flight deck design are discussed together with developments regarding the supersonic aircraft flight deck and future flight decks making use of the digital computer and CRT interfaces. G. R.

A73-39663 Engineering aspects of variable pitch fan. D. G. M. Davis (Dowty Rotol, Ltd., Gloucester, England). *Interavia*, vol. 28, Aug. 1973, p. 885, 886.

The objective being sought is to synchronously rotate the blades of the single-stage axial compressor used at the front of a gas turbine engine about their pitch axis, while the fan itself is rotating. The basic objective is made more complex by the rate at which the blades must move, the angle range which must be catered for and the fail-safe features which must be provided. Efforts required to solve the blade retention problem on propellers are considered. G. R.

A73-38771 Intrasystem electromagnetic compatibility analysis program. J. L. Bogdanor, C. E. Clark, M. D. Siegel, and G. L. Weinstock (McDonnell Aircraft Co., St. Louis, Mo.). In: *International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record, Volume 2.* New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 54-9 to 54-13. Contract No. F30602-72-C-0277.

The objective of the program described is to develop a computerized analysis program to allow the practical implementation of EMC at all stages of an Air Force system's life cycle, and the capability must be applicable for use in ground, aircraft, and space/misile systems. The major areas to which this program must address itself in order to attain this objective are specification generation, waiver analysis, design change evaluation, and tradeoff analysis. The program achieves its objective by incorporating state-of-the-art EMC analysis models into an efficiently running routine which quickly evaluates the possible transfer modes of electromagnetic energy from one equipment into another. The models are divided into four categories: emitter models to determine source outputs, transfer models to relate emitter outputs to receptor

inputs, receptor models to determine input responses, and system models using the above three models to evaluate a complete weapon system. (Author)

A73-39807 **Instability of an elliptic jet.** D. G. Crighton (Imperial College of Science and Technology, London, England). *Journal of Fluid Mechanics*, vol. 59, Aug. 7, 1973, p. 665-672. 9 refs. Research supported by the Ministry of Defence.

The dispersion equation for waves on an infinite uniform jet column of elliptic cross section is derived, and approximated for large eccentricity with the aid of new asymptotics for the modified Mathieu functions. It is shown that the effect of appreciable eccentricity on lateral disturbances is greatly to reduce their growth rates, below those for a circular jet, regardless of whether the disturbance grows spatially or temporally. For 'vertical' disturbances it is shown that the behavior of waves of general length is qualitatively similar to that of long waves on a two-dimensional jet. Thus the mode symmetric about the major axis has small growth rate, whether the mode grows temporally or spatially, while the mode antisymmetric about the major axis has small growth rate if temporally growing, but large growth rate if spatially growing. (Author)

A73-39808 **Pressure fields over hypersonic wing-bodies at moderate incidence.** N. Malmuth (Rockwell International Science Center, Thousand Oaks, Calif.). *Journal of Fluid Mechanics*, vol. 59, Aug. 7, 1973, p. 673-691. 24 refs. Contract No. F44620-71-C-0021.

Delta wings with conically subsonic cone-bodies mounted on their compressive side are analyzed in the hypersonic small disturbance regime. The weakly three-dimensional conditions associated with slender parabolic Mach cones are used to validate a linearized rotational approximation of the flowfield. A combined integral-series representation is obtained for the pressure distribution between the wing-body and shock wave for arbitrary body cross sections, and is specialized to give analytical formulas for arbitrary-order polynomial transverse contours. Numerical results are presented for wedge, parabolic, and higher-order cross sections illustrating the dominant character of the cross-flow stagnation singularity associated with sharp wing-body intersections having a finite slope discontinuity. It is shown that the pressure has a logarithmic infinity at this secondary leading edge, as in corresponding Prandtl-Glauert irrotational flows. (Author)

STAR ENTRIES

N73-27886*# Scientific Translation Service, Ann Arbor, Mich.
THE INFLUENCE OF AN INCLINED JET ON THE FLOW FIELD IN THE VICINITY OF A LIFTING SURFACE AND ON ITS AERODYNAMIC COEFFICIENTS. PART 2: LITERATURE SURVEY

M. Seidel Washington NASA Jul. 1973 58 p refs Transl. into ENGLISH of "Der Einfluss eines geneigten Strahles auf das Atmungs-feld in der Umgebung eines Leitwerks sowie auf dessen Luftkraftbeiwerte. Teil 2: Literaturuebersicht", DFLR, Inst. for Aerodyn., West Germany, report DFLR-69/3, Jan. 1969 62 p

(Contract NASw-2483)
 (NASA-TT-F-14957; DFLR-69-3) Avail: NTIS HC \$5.00 CSCL 01A

An extensive literature survey on jet propagation and jet interference up to the year 1967 is presented. The report contains numerous figures from the most important references. Author

N73-27887*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FULL-SCALE EXPERIMENTS WITH AN EJECTOR TO REDUCE JET ENGINE EXHAUST NOISE

Bruce J. Clark Washington Aug. 1973 31 p refs
 (NASA-TM-X-2841; E-7445) Avail: NTIS HC \$3.75 CSCL 20A

Experiments with a modified J65 turbojet engine and ejector resulted in noise power reductions as large as 13 decibels in the low-frequency range. High-frequency noise power, which appeared to originate mainly from the mixing processes within the ejector, increased. Peak velocities at the ejector exit were reduced by one-half to two-thirds, although survey rakes showed that mixing was not complete. Acoustical lining inside the ejector would reduce the perceived noise level (in PNdB) by removing much of the high-frequency noise. Author

N73-27889*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
ON THE NUMERICAL SIMULATION OF THREE-DIMENSIONAL TRANSONIC FLOW WITH APPLICATION TO THE C-141 WING

Harvard Lomax, Frank R. Bailey, and William F. Ballhaus Washington Aug. 1973 51 p refs
 (NASA-TN-D-6933; A-4583) Avail: NTIS HC \$3.00 CSCL 01C

Results computed by a finite-difference, relaxation algorithm are presented for the supercritical flow ($M = 0.825$) about the C-141 airplane wing, which has sweep, taper, and twist. Comparisons with both wind-tunnel and flight data indicate that computed solutions of the classical transonic small disturbance equation can accurately simulate high Reynolds number flows when the shock sweep angle is small. It is also shown that this equation poorly approximates the complete potential equation when embedded shock waves are swept at angles greater than about 15 deg. Hence, a more consistent small disturbance equation is derived for use in more general cases. Author

N73-27890*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

ANALYTICAL METHOD FOR PREDICTING THE PRESSURE DISTRIBUTION ABOUT A NACELLE AT TRANSONIC SPEEDS. Final Report

J. S. Keith, D. R. Ferguson, C. L. Merkle, P. H. Heck, and D. J. Lahti Washington NASA Jul. 1973 156 p refs
 (Contract NAS1-10804)

(NASA-CR-2217) Avail: NTIS HC \$3.00 CSCL 01A

The formulation and development of a computer analysis for the calculation of streamlines and pressure distributions around two-dimensional (planar and axisymmetric) isolated nacelles at transonic speeds are described. The computerized flow field analysis is designed to predict the transonic flow around long and short high-bypass-ratio fan duct nacelles with inlet flows and with exhaust flows having appropriate aerothermodynamic properties. The flow field boundaries are located as far upstream and downstream as necessary to obtain minimum disturbances at the boundary. The far-field lateral flow field boundary is analytically defined to exactly represent free-flight conditions or solid wind tunnel wall effects. The inviscid solution technique is based on a Streamtube Curvature Analysis. The computer program utilizes an automatic grid refinement procedure and solves the flow field equations with a matrix relaxation technique. The boundary layer displacement effects and the onset of turbulent separation are included, based on the compressible turbulent boundary layer solution method of Stratford and Beavers and on the turbulent separation prediction method of Stratford.

Author

N73-27892*# Naval Postgraduate School, Monterey, Calif.
TRANSONIC AERODYNAMICS PAST PROGRESS AND CURRENT STATUS

Max F. Platzer Dec. 1972 34 p refs
 (AD-761551; NPS-57PL721201A) Avail: NTIS CSCL 20/4

A summary of the past progress, current status, and development trends of transonic aerodynamics is presented. The main methods of computing steady and unsteady transonic flows are reviewed. Recent advances in buffet prediction and transonic airfoil design are summarized and attention is drawn to the problems requiring additional research efforts. Author

N73-27893*# Advanced Technology Center, Inc., Dallas, Tex.
WIND TUNNEL TESTS OF A TRAPPED VORTEX-HIGH LIFT AIRFOIL. Final Report. 23 Feb. - 23 Dec. 1972

K. M. Krall and C. H. Haight 23 Dec. 1972 61 p refs
 (Contract N00019-72-C-0379)

(AD-762077; ATC-B-94300/3TR-10) Avail: NTIS CSCL 01/3
 Two-dimensional low speed wind-tunnel tests have demonstrated the feasibility of employing trapped vortex diffusion on a high lift airfoil configuration. All 11 percent supercritical airfoil was selected as the base contour employing both leading and trailing edge flaps. The leading edge flap was 25 percent chord, drooped 30 degrees with the rear flap, 27 percent chord, deflected 15 degrees and 30 degrees. Trapped vortex cavities, affording boundary layer control with rapid diffusion, are located at each of the flap knees. Because of the high trapped vortex efficiency, blowing requirements are minimal. Section lift coefficients, in excess of 6, were achieved in the test. (Modified Author Abstract) GRA

N73-27894 California Univ., Los Angeles.

DYNAMIC SOARING Ph.D. Thesis

Ferdinand Hendricks 1972 147 p
 Avail: Univ. Microfilms Order No. 73-10432

The behavior of a glider, or gliding bird, in a non-uniform wind is considered with emphasis on the question how to stay aloft. The glider is thought to be a mass point with realistic aerodynamic properties. Two idealized wind fields are considered: one with a uniform vertical shear, the other isotropically turbulent without mean non-uniformities. For two-dimensional glides in mean shear phaseplane descriptions of the motion are given.

By appropriate assembling of up- and downwind phaseplanes energy can be derived from the flow. Three-dimensional, weakly controlled motion is treated in three distinct perturbation procedures where the drag coefficient tends to zero. The main results are that the phugoid frequency must be the same as that of the horizontal turning motion and that beneficial shear effects are magnified as the wing loading increases. A numerical example shows that dynamic soaring for realistic shear and glider parameters is, mechanically speaking, possible. *Dissert. Abstr.*

N73-27895# Advisory Group for Aerospace Research and Development, Paris (France).
INFLUENCE OF PILOT AND AIRCRAFT CHARACTERISTICS ON STRUCTURAL LOADS IN OPERATIONAL FLIGHT

J. R. Sturgeon May 1973 29 p refs
(AGARD-R-608) Avail: NTIS HC \$3.50

Some aircraft handling problems met in operational conditions are described and compared with flight test conditions. It is concluded that errors in flight instrumentation and physiological cues have a substantial influence on control capability. A unified strategy for flight in all operational conditions is required to reduce these problems. A strategy, aimed at minimizing structural loads and aerodynamic problems in all flight conditions, is proposed that will restore to pilot and autopilot flying the positive stability in pitch and yaw which is a classic requirement for aircraft operating in the stick free mode. Proposals are made for improving the requirements of flight instruments to reduce control problems during complex maneuvers and flight in severe wind shear conditions. *Author*

N73-27897*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
NOISE TESTS OF A MODEL ENGINE-OVER-THE-WING STOL CONFIGURATION USING A MULTIJET NOZZLE WITH DEFLECTOR

William A. Olsen and Robert Friedman Washington Aug. 1973 26 p refs
(NASA-TM-X-2871; E-7459) Avail: NTIS HC \$3.00 CSCL 01C

Noise data were obtained with a small scale model stationary STOL configuration that used an eight lobe mixer nozzle with deflector mounted above a 32-cm-chord wing section. The factors varied to determine their effect upon the noise were wing flap angle, nozzle shape, nozzle location, deflector configuration, and jet velocity. The noise from the mixer nozzle model was compared to the noise from a model using a circular nozzle of the same area. The mixer nozzle model was quieter at the low to middle frequencies, while the circular nozzle was quieter at high frequencies. The perceived noise level (PNL) was calculated for an aircraft 10 times larger than the model. The PNL at 500 feet for the mixer nozzle turned out to be within 1 db of the PNL for the circular nozzle. For some configurations at highly directional broadband noise, which could be eliminated by changes in nozzle and/or deflector location, occurred below the wing. *Author*

N73-27898*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
LEADING EDGE SERRATIONS WHICH REDUCE THE NOISE OF LOW-SPEED ROTORS

Paul T. Soderman Aug. 1973 65 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TN-D-7371; A-4074) Avail: NTIS HC \$3.00 CSCL 01C

Acoustic effects of serrated brass strips attached near the leading edges of two different size rotors were investigated. The two bladed rotors were tested in hover. Rotor rotational speed, blade angle, serration shape, and serration position were varied. The serrations were more effective as noise suppressors at rotor tip speeds less than 135 m/sec (444 ft/sec) than at higher speeds: high frequency noise was reduced but the low frequency rotational noise was little affected. Noise reductions from 4 to 8 db overall sound pressure level and 3 to 17 db in the upper octave bands were achieved on the 1.52 m (5.0 ft) diameter

rotor. Noise reductions up to 4 db overall sound pressure level were measured for the 2.59 m (8.5 ft) diameter rotor at some conditions. *Author*

N73-27899*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY OF QUIET TURBOFAN STOL AIRCRAFT FOR SHORT-HAUL TRANSPORTATION. VOLUME 2: AIRCRAFT Final Report

Jun. 1973 448 p refs
(Contract NAS2-6994)
(NASA-CR-114607; MDC-J4371-Vol-2) Avail: NTIS HC \$24.50 CSCL 01C

A study of the quiet turbofan STOL aircraft for short haul transportation was conducted. The objectives of the study were as follows: (1) to determine the relationships between STOL characteristics and economic and social viability of short haul air transportation, (2) to identify critical technology problems involving introduction of STOL short haul systems, (3) to define representative aircraft configurations, characteristics, and costs, and (4) to identify high payoff technology areas to improve STOL systems. The analyses of the aircraft designs which were generated to fulfill the objectives are summarized. The baseline aircraft characteristics are documented and significant trade studies are presented. *Author*

N73-27900*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY OF QUIET TURBOFAN STOL AIRCRAFT FOR SHORT-HAUL TRANSPORTATION. VOLUME 3: AIRPORTS Final Report

Jun. 1973 523 p refs
(Contract NAS2-6994)
(NASA-CR-114608; MDC-J4371-Vol-3) Avail: NTIS HC \$28.25 CSCL 01C

The airport siting, design, cost, operation, and implementation aspects of a short takeoff aircraft transportation system are analyzed. Problem areas are identified and alternative solutions or actions required to achieve system implementation by the early 1980's are recommended. Factors associated with the ultimate community acceptance of the STOL program, such as noise, emissions, and congestion, are given special emphasis. *Author*

N73-27901*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY OF QUIET TURBOFAN STOL AIRCRAFT FOR SHORT-HAUL TRANSPORTATION. VOLUME 4: MARKETS Final Report

Jun. 1973 279 p refs
(Contract NAS2-6994)
(NASA-CR-114609; MDC-J4371-Vol-4) Avail: NTIS HC \$16.00 CSCL 01C

A marketing study to determine the acceptance and utilization of a STOL aircraft short-haul air transportation system was conducted. The relationship between STOL characteristics and the economic and social viability of STOL as a short-haul reliever system was examined. A study flow chart was prepared to show the city pair and traffic split analysis. The national demand for STOL aircraft, as well as the foreign and military markets, were analyzed. *Author*

N73-27902*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY OF QUIET TURBOFAN STOL AIRCRAFT FOR SHORT-HAUL TRANSPORTATION. VOLUME 5: ECONOMICS Final Report

Jun. 1973 333 p refs
(Contract NAS2-6994)
(NASA-CR-114610; MDC-J4371-Vol-5) Avail: NTIS HC \$18.75 CSCL 01C

The economic aspects of the STOL aircraft for short-haul air transportation are discussed. The study emphasized the potential market, the preferred operational concepts, the design characteristics, and the economic viability. Three central issues governing economic viability are as follows: (1) operator economics given the market, (2) the required transportation facilities, and (3) the external economic effects of a set of regional STOL transportation systems. *Author*

N73-27903*# Douglas Aircraft Co., Inc., Long Beach, Calif.
STUDY OF QUIET TURBOFAN STOL AIRCRAFT FOR
SHORT-HAUL TRANSPORTATION. VOLUME 6: SYSTEMS
ANALYSIS Final Report

Jun. 1973 534 p refs
 (Contract NAS2-6994)
 (NASA-CR-114611; MDC-J4371-Vol-6) Avail: NTIS HC \$28.75 CSCL 01C

A systems analysis of the quiet turbofan aircraft for short-haul transportation was conducted. The purpose of the study was to integrate the representative data generated by aircraft, market, and economic analyses. Activities of the study were to develop the approach and to refine the methodologies for analytic tradeoff, and sensitivity studies of propulsive lift conceptual aircraft and their performance in simulated regional airlines. The operations of appropriate airlines in each of six geographic regions of the United States were simulated. The offshore domestic regions were evaluated to provide a complete domestic evaluation of the STOL concept applicability. Author

N73-27904*# McDonnell-Douglas Corp., Long Beach, Calif.
THE RESULTS OF A LOW SPEED WIND TUNNEL TEST
TO INVESTIGATE THE EFFECTS OF INSTALLING REFAN
JT8D ENGINES ON THE MCDONNELL DOUGLAS DC-9-30
 H. E. Christenberry, P. G. Doss, A. E. Kressly, R. D. Prichard,
 and C. S. Thomdike Jun. 1973 41 p ref
 (Contract NAS3-16814)

(NASA-CR-121220; MDC-J5961) Avail: NTIS HC \$4.25 CSCL 01C

A low speed wind tunnel test was conducted to assess the effects of the larger JT8D refan nacelles on the stability and control characteristics of the DC-9-30; with emphasis on the deep stall regime. Deep stall pitching moment and elevator hinge moment data, and low angle of attack tail-on and tail-off pitching moment data are presented. The refan nacelle was tested in conjunction with various pylons of reduced span relative to the production DC-9-30 pylon. Also, a horizontal tail that was larger than the production tail was tested. The data show that the refan installation has a small detrimental effect on the DC-9-30 deep stall recovery capability, that recovery characteristics are essentially independent of pylon span, and that the larger horizontal tail significantly increases recovery margins. The deep stall characteristics with the refan installation, within the range of pylon spans tested, are acceptable with no additional design changes anticipated. Author

N73-27905*# National Aeronautics and Space Administration.
Flight Research Center, Edwards, Calif.
EFFECTS OF FLAPS ON BUFFET CHARACTERISTICS AND
WIND-ROCK ONSET OF AN F-8C AIRPLANE AT SUBSONIC
AND TRANSONIC SPEEDS

Richard C. Monaghan and Edward L. Friend Washington Aug. 1973 27 p refs
 (NASA-TM-X-2873; H-742) Avail: NTIS HC \$3.00 CSCL 01B

Wind-up-turn maneuvers were performed to establish the values of airplane normal force coefficient for buffet onset, wing-rock onset, and buffet loads with various combinations of leading- and trailing-edge flap deflections. Data were gathered at both subsonic and transonic speeds covering a range from Mach 0.64 to Mach 0.92. Buffet onset and buffet loads were obtained from wingtip acceleration and wing-root bending-moment data, and wing-rock onset was obtained from airplane roll rate data. Buffet onset, wing-rock onset, and buffet loads were similarly affected by the various combinations of leading- and trailing-edge flaps. Subsonically, the 12 deg leading-edge-flap and trailing-edge-flap combination was most effective in delaying buffet onset, wing-rock onset, and equivalent values of buffet loads to a higher value of airplane normal force coefficient. This was the maximum flap deflection investigated. Transonically, however, the optimum leading-edge flap position was generally less than 12 deg. Author

N73-27906# Advisory Group for Aerospace Research and Development, Paris (France).

V/STOL HANDLING-QUALITIES CRITERIA. PART 2:
DOCUMENTATION

Jun. 1973 88 p refs
 (AGARD-R-577-Pt-2) Avail: NTIS HC \$6.50

The factors which affect the handling characteristics of V/STOL aircraft are discussed. The criteria are based on several sources of information to include: (1) analytical studies, (2) piloted simulator tests, (3) flight tests, and (4) specially equipped variable stability aircraft and helicopters. The results of the tests involving handling and stability are presented in tabular form. Author

N73-27907*# Boeing Commercial Airplane Co., Seattle, Wash.
DESIGN INTEGRATION AND NOISE STUDIES FOR JET
STOL AIRCRAFT. TASK 7A: AUGMENTOR WING CRUISE
BLOWING VALVELESS SYSTEM. VOLUME 2: DESIGN
EXPLORATION

Oct. 1972 131 p ref
 (Contract NAS2-6344)
 (NASA-CR-114570; D6-40829-Vol-2) Avail: NTIS HC \$8.75 CSCL 01C

A design integration study program was conducted to determine size and performance parameters of an augmentor wing cruise blowing (valveless) system in a 150-passenger STOL airplane for the purpose of defining size and configuration of static rig, flow duct, and wind tunnel test hardware. The studies encompassed blowing systems powered by low-pressure (single stage) and high-pressure (three and four stage) engine fans. A range of wing aspect ratios, wing thicknesses, and duct flow velocity effects were investigated to establish airplane characteristics which minimize takeoff gross weight while achieving sideline noise requirements for an advanced commercial STOL airplane. Author

N73-27908*# Translation Consultants, Ltd., Arlington, Va.
EXTERNAL LOADS AND AIRCRAFT STRENGTH

A. I. Gudkov and P. S. Leshakov Washington NASA Jul. 1973 392 p refs Transl. into ENGLISH of the book "Vneshniye Nagruzki i Prochnost Letatelnykh Apparatov" Moscow, Mashinostroyeniye Press, 1968 p 1-204, 270-444
 (Contract NASw-2038)

(NASA-TT-F-753) Avail: NTIS HC \$6.00 CSCL 01C

The fundamentals of oscillation theory and mathematical statistics applicable to problems of the dynamics of aircraft structures and aerodynamic loads on aircraft and missiles during various stages of flight are presented. Data is included on the elasticity of structures in gusts of rough air when taking off and landing, vibrations of aircraft and helicopter parts, and the effect of these parameters on the strength of the structure and the performance of aircraft equipment. An analysis of the structural parameters influencing flutter and the methods used to study flutter characteristics is provided. The fatigue strength of aircraft structures and the basic trends in the use of computers to study the dynamic strength of aircraft structures are reported. Author

N73-27909*# Massachusetts Inst. of Tech., Cambridge. Dept.
of Electrical Engineering.

A PRACTICAL SCHEME FOR ADAPTIVE AIRCRAFT FLIGHT
CONTROL SYSTEMS.

Michael Athans and Dieter Willner Apr. 1973 24 p refs
 Printed at the Symp. on Parameter Estimation Tech. and Appl. in Aircraft Flight testing, Edwards AFB, Calif., 24-25 Apr. 1973
 (Grants AF-AFOSR-2273-72; NGL-22-009-124)
 (NASA-CR-133416; AD-760790; AFOSR-73-0909TR) Avail:
 NTIS HC \$3.25 CSCL 01/3

The purpose of the report is to present a flight control system design, that can be implemented by analog hardware, to be used to control an aircraft with uncertain parameters. The design is based upon the use of modern control theory. The ideas are illustrated by considering control of STOL longitudinal dynamics. Author (GRA)

N73-27910# Institut Franco-Allemand de Recherches, St. Louis (France).

DESTRUCTIVE BOOM EFFECTS ON LIGHT PARTITIONS. PRELIMINARY STUDY [EFFETS DESTRUCTIFS DU BANG SUR DES CLOISONS LEGERES. ETUDE PRELIMINAIRE SAP HC \$4.50]

D. Hellstern 4 Sep. 1972 49 p refs In FRENCH (Contract DRME-72/184) (ISL-23/72) Avail: NTIS

In order to predict the reaction to shock of light partitions subjected to sonic boom generated by the ISL shock tube, the sonic boom effect on partitions and ceiling of a room was investigated using shock waves penetrating into the enclosure (room) through the apertures (windows, doors). The theoretical response of an enclosure to pressure waves was studied. Experimental work carried out on scale models agree with the theory. It is however impossible to estimate the influence and importance of the incident wave degradation, and therefore the acoustic response of the real enclosure (4 x 3 x 2.5 cu cm).

ESRO

N73-27911# Max-Planck-Institut fuer Stroemungsforschung; Goettingen (West Germany).

FURTHER DEVELOPMENT OF NOISE DATA WITH REGARD TO THE RESULTS OF AIRCRAFT NOISE INVESTIGATIONS OF THE DFG AT MUNICH [ZUR WEITERENTWICKLUNG VON LAERMINDIZES UNTER BERUECKSICHTIGUNG DER ERGEBNISSE DER FLUGLAERMUNTERSUCHUNG DER DEUTSCHEN FORSCHUNGSGEMEINSCHAFT IN MUENCHEN]

K. Matschat, E. A. Mueller, and G. Zimmermann Mar. 1973 37 p refs In GERMAN (Rept-3/1973) Avail: NTIS HC \$4.00; Max-Planck-Inst. fuer Stroemungsforsch. 10,90 DM

A general statement is given for a noise index L as a further development of the noise indexes presently used, which for the most part are based on the concept of intensity averaging. The statement was developed from spectral analysis of the level characteristic L(t) during a reference time range T, and frequency evaluation thereof. By special choice of the evaluation curve one perceives that fast level variations produce a higher noise index than slow variations (for equal intensity mean value). The statement for L contains a constant t, the inverse of which indicates the limit, from the time the amount of level variation velocity dL/dt appreciably adds to the noise index. It is shown that the noise index L satisfies certain normalization and tolerance conditions generally necessary for a noise index. L was tested with data of aircraft noise measurements. An approximation of $1/t$ was found to be 2 db/sec.

ESRO

N73-27912# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE TECHNOLOGY OF CEMENTING PARTS IN AIRCRAFT CONSTRUCTION

I. I. Kapelyushnik and I. I. Mikhalev 23 Apr. 1973 317 p refs Transl. into ENGLISH from the monograph "Tekhnologiya Skleivaniya Datali v Samoletostroenii" Moscow, 1972 p 1-224

(AD-761496; FTD-MT-24-14-73) Avail: NTIS CSCL 01/3

The book describes the technology of joining metals and nonmetallic structural materials with the aid of gluing, providing high strength, service life, airtightness and good corrosion resistance of surfaces being glued. The physicomaterial and technical characteristics of glue, and also the types of glue joints used in airplane constructions are given. Primary attention is given to the selection of rational production processes of gluing, industrial equipment, preparation and testing of glue, quality control of gluing and safety techniques in working with glues.

GRA

N73-27913# Raven Industries, Inc., Sioux Falls, S.Dak. Flight Operations Dept.

SKYHOOK CHURCHILL 1972 Interim Report

Paul S. White and Thomas Pappas 2 Apr. 1973 176 p

(Contract N00014-72-C-0400; NR Proj. 211-181) (AD-761657; R-0473002) Avail: NTIS CSCL 04/1

The program was funded to conduct balloon field operations from Fort Churchill, Manitoba, Cape Girardeau, Missouri, and Red Deer, Alberta. The report describes individual flights, equipment used, flight data, and various program information. (Modified Author Abstract)

GRA

N73-27914# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

PRELIMINARY STUDY OF OPTIMAL WAVE-OFF CONTROL: A PARAMETRIC APPROACH Phasco Report

Mark E. Reigle and Ralph H. Smith 23 Apr. 1973 37 p refs (AD-761617; NADC-72079-VT) Avail: NTIS CSCL 01/2

The feasibility of optimizing the wave-off performance of Naval aircraft is briefly considered. A simple, parametric approach to the problem is employed as a means of evaluating the potential of optimal control while avoiding the mathematical difficulties. It is concluded that the performance benefits from the use of optimal control are considerable in principle but may be difficult to realize in practice.

Author (GRA)

N73-27916# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Airframe Div.

DEVELOPMENT OF A ROLLING MANEUVER SPECTRUM FROM STATISTICAL FLIGHT LOADS DATA

John W. Rustenburg Apr. 1973 52 p refs (AD-761491; ASD-TR-72-113) Avail: NTIS CSCL 01/3

Absence of clearly defined antisymmetrical fatigue load spectra in military specifications has resulted in questions regarding the validity of rolling maneuver spectra applied to the B-1 design. In response, multiparameter flight loads data measured on the F-5A and F/105D aircraft were evaluated and used in the development of a probability of exceedance curve for the normalized wing tip helix angle. The normalized probability curve can be used in conjunction with any specified normal load factor spectrum and the airplanes maximum $pb/2V$ capabilities to determine the occurrence rate of rolling velocity peaks. The approach should provide at least a first order estimate of possible rolling velocity spectra which can be applied in aircraft fatigue design for antisymmetrical maneuver conditions. Author (GRA)

N73-27918# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A STATE VARIABLE DESIGN APPROACH FOR A HIGH PERFORMANCE AEROSPACE VEHICLE PITCH ORIENTATION SYSTEM WITH VARIABLE COEFFICIENTS M.S. Thesis

Richard A. Roy Mar. 1973 137 p refs (AD-761493; GGC/EE/73-15) Avail: NTIS CSCL 01/3

The purpose of the thesis was to design a simple state-variable feedback system to control a linear plant with variable coefficients. The solution of the problem was to determine the values of the constant feedback gains based on a desired transfer function. This transfer function met all required time responses. One of the state-variables is an internal state and not available for measurement. This state is reconstructed using a minor-loop feedback circuit. A nominal set of conditions was selected for the plant and the feedback coefficients determined as a function of the nominal plant parameters and coefficients of the desired transfer function. Using the values of feedback coefficients determined above, the response of the control system was simulated at several flight conditions. (Modified Author Abstract)

GRA

N73-27917# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

LOW SPEED AERODYNAMIC CHARACTERISTICS OF AN A-4 AIRCRAFT WITH AN AIR CUSHION LANDING SYSTEM

David G. Lee and H. Dulany Davidson, Jr. Feb. 1973 52 p refs (ARPA Order 2121)

(AD-761621; Evaluation-AL-99) Avail: NTIS CSCL 01/3

The effect of a twin trunk air cushion landing gear system on the stability and control of an A-4 type aircraft was evaluated through an exploratory wind tunnel program. The active air cushion in ground effect conditions was found to reduce both drag and the static margin and markedly degrade the directional stability characteristics of the 22 percent scale wind tunnel model. However, the modified aircraft retains adequate longitudinal stability and both the flaps and stabilizer controls are effective and adequate for trimming the aircraft. Author (GRA)

N73-27918# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL AND FORCE DIAGRAMS OF THE LANDING GEAR

V. L. Belskii and I. P. Vlasov 16 May 1973 42 p Transl. into ENGLISH from the monograph "Konstruktsiya Latatelnykh Apparatov" Moscow, 1963 p 507-532 (AD-761644; FTD-MT-24-1826-72) Avail: NTIS CSCL 01/3
Contents: Structural and force diagrams of landing gear-- External landing-gear loads; The structural and force diagrams of landing gear; Landing-gear computation for strength; Diagram of landing-gear retracting mechanism. GRA

N73-27919# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF FLYING TIME ON RESIDUAL LIFE OF MAIN MEMBERS OF AN AIRFRAME

K. D. Mirtov, G. I. Nastarenko, V. G. Petukhov, and M. L. Skripka 17 May 1973 26 p Transl. into ENGLISH from Vopr. Ekspluatatsionnoi Prochnosti Nadezhnosti Aviats. Konstrukt. (Riga), v. 6, no. 191, 1971 p 14-38 (AD-761468; FTD-HT-23-254-73) Avail: NTIS CSCL 01/3
Results are given for two series of tests of wind fastening knee plates on one of the transport aircraft having varying accrued operating time under operational conditions. Data obtained can be used to estimate wing fatigue life. GRA

N73-27920# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
OBSERVATIONS OF SURFACE EFFECT VEHICLE PERFORMANCE

R. A. Liston Apr. 1973 65 p (ARPA Order 1615) (AD-762169; CRREL-TR-240) Avail: NTIS CSCL 01/3
A series of tests conducted in the vicinity of Houghton, Michigan, utilizing the SK-5 surface effect vehicle are discussed. The tests represent a continuation of an earlier study to investigate the interaction between surface effect vehicle and arctic terrain. The following tests were conducted and are reported on: evaluation of air cushion vehicle operations on railroad beds and on secondary roads; the identification of maneuver requirements as a function of vehicle characteristics; evaluation of air cushion vehicle operations on inland waterways; measurement of water speed, craft weight, and skirt drag; and analysis of dynamic response to geometric obstacles. Author (GRA)

N73-27921# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF TECHNICAL DIAGNOSTICS FOR THE DETERMINATION OF THE REPLACEMENT DATES OF AIRCRAFT ACCESSORIES

N.N. Smirnov, A.A. Itskovich, and V.I. Zagrebeinyi Transl. into ENGLISH from Tr. Vses. Soveshshanie Tekhn. Diagnostike (USSR), 1972 p 69-73 (AD-762226; FTD-HT-23-515-73) Avail: NTIS CSCL 01/3
The report develops a mathematical model for determining replacement criteria for aircraft structural components. GRA

N73-27922# McDonnell Aircraft Co., St. Louis, Mo.
COMPATIBILITY OF MANEUVER LOAD CONTROL AND RELAXED STATIC STABILITY APPLIED TO MILITARY

AIRCRAFT Final Report, Jan. 1971 - Feb. 1973
Roger L. Berger, James P. Hess, and Daniel C. Anderson Apr. 1973 193p refs (Contract F33615-71-C-1234; AF Proj. 8226) (AD-762299; AFFDL-TR-73-33) Avail: NTIS CSCL 01/3

The purpose of the research program was to determine the performance benefits which can be obtained for a fighter aircraft through the application of maneuver load control (MLC) and relaxed static stability (RSS), and to evaluate the resulting impact on aircraft handling qualities. Analytical results were to be obtained in this study to indicate whether significant fighter aircraft performance benefits can be realized through the use of MLC and RSS, and whether these aircraft design concepts are compatible for all configurations selected for study. These study results were to show whether desirable handling qualities and adequate stability margins are attainable using existing fly-by-wire flight control system hardware with relatively minor modifications. (Modified Author Abstract) GRA

N73-27923# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SUPERSONIC JET NOISE INVESTIGATION USING JET FLUCTUATING PRESSURE PROBES
Terry D. Scharton, Pritchard H. White, and Peter E. Rentz Jun. 1973 131 p refs (Contract F33615-71-C-1661) (AD-762296; BBN-2220; AFAPL-TR-73-35) Avail: NTIS CSCL 20/1

Various mechanisms of jet noise generation are modeled using the fluctuating jet pressures to characterize the sources. The subsonic mixing mechanism is shown to dominate for sonic and mildly supersonic jets. An input-output relation between the jet pressure and sound pressure spectral densities is derived and verified. Fluctuating pressure probes are developed to measure sources of noise generation in sonic and supersonic jet exhausts. Jet exhausts with total temperatures as high as 3500F may be measured. Definitive data are obtained regarding the percentage of the sound radiated at a given angle and frequency by each region of the jet exhaust. Simple laser refraction experiments support the fluctuating pressure measurements. (Modified Author Abstract) GRA

N73-27924# ARO, Inc., Arnold Air Force Station, Tenn.
TRANSONIC SCALING EFFECT ON A QUASI, TWO-DIMENSIONAL C-141 AIR FOIL MODEL Final Report, Feb. 1970 - Jun. 1972
C. F. Lo and W. E. Carleton AEDC Jun. 1973 71 p refs (ARO Proj. PW3087; ARO Proj. PW3110) (AD-762285; ARO-PWT-TR-73-13; AEDC-TR-73-61) Avail: NTIS CSCL 01/3

The transonic scaling effect of shock wave/boundary-layer interaction on a quasi, two-dimensional C-141 airfoil was investigated. Data were obtained from the AEDC Propulsion Wind Tunnel Facility Aerodynamic Wind Tunnel (4T) and Propulsion Wind Tunnel (16T) and from the NASA Marshall Space Flight Center High Reynolds Number Tunnel with 6-in. and 24-in.-chord airfoils for a range 0.70 to 0.85. In addition to the investigation of the effect of Reynolds number on the airfoil pressure distribution, the effect of fixed boundary-layer transition was evaluated using grit-type transition strips on the airfoil surface. The significant parameters affecting the shock wave/boundary-layer interaction are identified. The data indicate that simulation of higher Reynolds number data on the C-141 airfoil model is feasible by use of a fixed-boundary-layer-transition strip. Author (GRA)

N73-27925# Goodyear Aerospace Corp., Akron, Ohio.
COMPARISON OF ANALYTICALLY AND EXPERIMENTALLY DETERMINED DYNAMIC BEHAVIOR OF TETHERED BALLOONS
Jerome J. Vorachek and George R. Doyle, Jr. 30 Mar. 1973 70 p refs (Contract F19628-72-C-0219) (AD-762210; GER-15932; SR-1; AFCRL-TR-73-0284) Avail: NTIS CSCL 01/3

Mathematical tools were developed previously to analyze

the dynamic behavior of tethered balloon systems. The model for the tethered balloon system consists of the streamlined balloon and a tether made up of three discrete links. The tools consist of the linearized characteristic equations which incorporate the physical, aerodynamic and mass characteristics of the system and the dynamic simulation computer program which determines the response of the tethered balloon system to wind disturbances. A tethered balloon system consisting of a 70,000 cubic foot aerodynamically shaped balloon and a 0.52 inch diameter Nolaro tether was flown at Fair Site on White Sands Missile Range to obtain experimental motion data. (Modified Author Abstract)

GRA

N73-27926# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

EXPENDABLE MAIN ROTOR BLADE STUDY Final Report
John A. Longobardi and Everett Fournier Apr. 1973 312 p refs

(Contract DAAJ02-71-C-0046; DA Proj. 1F1-622205-A-119) (AD-762198; SER-50748; USAAMRDL-TR-72-47) Avail: NTIS CSCL 01/3

The report presents Sikorsky's study of expendable blade designs applicable to the Army's UH-1H helicopter with its teetering rotor system. The program included design, reliability, maintainability and cost analysis studies. Reliability and maintainability parameters were developed which were subsequently inserted into cost model equations to determine life cycle cost comparisons of the new blade designs with the present UH-1H blade. More than fifteen configurations were investigated and reduced to six viable blade designs. They included aluminum, steel, and composite configurations. The study covered two time frames: 1972 and 1980. The results showed that a low-cost aluminum extrusion (Configuration I) with a fiberglass composite skin was the most cost effective for 1972. The 1980 time frame showed that an all-composite blade (Configuration V) was the most cost effective. (Modified Author Abstract)

GRA

N73-27927# Boeing Vertol Co., Philadelphia, Pa.
FLIGHT TEST OF ADVANCED-GEOMETRY BORON BLADES Final Technical Report

Donald J. Hoffstedt, Harold E. Bishop, and Herbert H. Steinmann Feb. 1973 214 p refs

(Contract DAAJ02-72-C-0010; (AD-762199; D210-10486-1; USAAMRDL-TR-72-65) Avail: NTIS CSCL 01/3

The report presents the results of an exploratory flight test program conducted on a CH-47C Army helicopter for the purpose of investigating the structural performance of boron-reinforced epoxy aft rotor blades and the associated effects on the helicopter system. The program demonstrated the flightworthiness of boron-reinforced epoxy main rotor blades in the demanding environment of the aft rotor on a tandem-rotor helicopter. No structural problems were encountered. There were no restrictive 3/rev vibrations despite a first-elastic-mode, flap-bending natural frequency of 3.21 times rotor speed. The torsional stiffness of the boron blade provided excellent blade-to-blade track conformance throughout the program after minimal initial adjustment.

Author (GRA)

N73-28042# Radiation, Inc., Melbourne, Fla.
WIDEBAND COMMAND AND CONTROL MODEM Final Technical Report, 14 Jun. - 14 Dec. 1972

Albert R. Martin, Jay D. Knoner, and Raymond F. Cobb Griffiss AFB, Ohio RADC Dec. 1972 271 p

(Contract F30602-72-C-0498; ARPA Order 2154) (AD-762281; RADC-TR-73-91) Avail: NTIS CSCL 17/2

The report contains the tradeoffs and resultant baseline design for a Wideband Command and Control Modem. The waveform design for this modem provides uplink command data from a master ground station to each of 25 vehicles and receives status data in return. In addition, wideband imagery information is received from up to five of the vehicles in the target area. The application of this modem to remote pilotless vehicle (RPV) missions requires jam-resistant communications, especially for

the command uplink, and requires a modem design with extremely low recurring costs for the vehicle electronics. (Modified Author Abstract)

GRA

N73-28129# Mitre Corp., McLean, Va.
REDUCTION OF PARALLEL RUNWAY REQUIREMENTS Final Report

Andrew L. Haines Jan. 1973 58 p refs
(Contract DOT-FA70WA-2448)

(MTR-6282; FAA-EM-73-9) Avail: NTIS HC \$5.00

Results and recommendations are presented concerning the relaxation of spacing requirements for independent IFR parallel approaches into closely spaced runways. All results presented were derived by analyzing what system design or performance changes are required (either airborne or ground based) so as to result in safety equal to the current system's, but at closer spacing. A set of system changes and improvements are specified which, based on analysis, will permit closer runway spacing. Author

N73-28136# Naval Postgraduate School, Monterey, Calif.
ESTIMATION OF A COST FUNCTION FOR A NAVAL AIR REWORK FACILITY M.S. Thesis

W. C. Trafton Mar. 1973 76 p refs
(AD-761475) Avail: NTIS CSCL 15/5

The objective of the study was to estimate a cost function from a Constant Elasticity of Substitution production function and a Cobb-Douglas production function for the aircraft rework and engine repair programs at the Naval Air Rework Facility, North Island, San Diego, California. The cost functions were estimated by multiple regression analysis from data aggregated from actual data taken from production records of the two programs. An attempt was made to validate the two cost functions that were obtained, and a methodology was outlined for comparing predicted costs to actual production costs at the Naval Air Rework Facility.

Author (GRA)

N73-28137# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

EVALUATION AND MAINTENANCE OF EXPEDIENT-SURFACED AIRFIELD FACILITIES Final Report

Philip J. Vedros, Jr. May 1973 28 p refs

(AD-762126; AEWES-Instruction-S-73-1) Avail: NTIS CSCL 01/5

The instruction report presents a reference of suggested guidelines on the evaluation and maintenance of expedient-surfaced airfield facilities. The expedient surfacing materials covered in this discussion are aluminum and steel landing mats and a neoprene-coated nylon membrane. Methods of repair that have performed satisfactorily for the landing mats and T17 membrane are presented.

Author (GRA)

N73-28142# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

EVALUATION OF THE SOLID STATE SIMULATOR FOR THE A-7B AIRCRAFT ELECTRICAL SYSTEM Technical Report, Oct. 1970 - Jun. 1972

Glenn M. Kevern Apr. 1973 151 p refs
(AF Proj. 3145)

(AD-762295; AFAPL-TR-72-88) Avail: NTIS CSCL 01/3

The report describes the program for comparative evaluation of conventional and solid state A-7B aircraft electrical system simulators to determine advantages, find and correct deficiencies, and thereby guide research and development which will result in application of solid state technology to AF aircraft, providing significant improvements in weight, reliability, wiring simplification, power quality, and electrical system flexibility. (Modified Author Abstract)

GRA

N73-28150 New York Univ., N.Y.
INVESTIGATION OF PARTICLE SEEDING ON JET EXHAUST NOISE Ph.D. Thesis

Toyohiko Suzuki 1972 96 p
 Avail: Univ. Microfilms Order No. 73-9088

The equations describing the motion of a string-like particle under shear motion of the ambient fluid are derived. These are extended to the equations of two phase continuum flow. The applications to jet noise reduction are given. The effect of the suspension of these particles in the fluid is described by parameters, mass distribution ratio, $m_{sub o}/m_{sub t}$, concentration of the particles, $\rho_{sub o}/\rho_{sub a}$, the ratio $\tau_{sub o}/\tau_{sub s}$ of the relaxation time which depends on the shape parameters of the particles and the characteristic shear frequency, Ω_{omega}/ω , respectively. It is shown that under a certain choice of these parameters, the particles have an appreciable effect on sound transmission. Decay factor is computed as a function of the frequency of the sound for various values of parameters. Mass distribution ratio was found to be a very important parameter. Dissert. Abstr.

N73-28174* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DISPERSION OF TURBOJET ENGINE EXHAUST IN FLIGHT
 James D. Holdeman Washington Aug. 1973 23 p refs
 (NASA-TN-D-7382; E-7479) Avail: NTIS HC \$3.00 CSCL 20D

The dispersion of the exhaust of turbojet engines into the atmosphere is estimated by using a model developed for the mixing of a round jet with a parallel flow. The analysis is appropriate for determining the spread and dilution of the jet exhaust from the engine exit until it is entrained in the aircraft trailing vortices. Chemical reactions are not expected to be important and are not included in the flow model. Calculations of the dispersion of the exhaust plumes of three aircraft turbojet engines with and without afterburning at typical flight conditions are presented. Calculated average concentrations for the exhaust plume from a single engine jet fighter are shown to be in good agreement with measurements made in the aircraft wake during flight. Author

N73-28177* Michigan State Univ., East Lansing, Div. of Engineering Research.
PRELIMINARY RESULTS FOR A LARGE ANGLE OBLIQUE JET IMPINGEMENT AND FLOW AND FOR THE EFFECT OF INITIAL CONDITIONS ON THE NEAR FIELD OF AN AXISYMMETRIC JET Semiannual Report
 John F. Foss and Stanley J. Kleis 25 May 1973 61 p refs
 (Grant NGR-23-004-068)
 (NASA-CR-121257; SAR-3) Avail: NTIS HC \$5.25 CSCL 20D

The structure of an axisymmetric jet in the near field is discussed for jet noise and for jet impingement schemes for STOL aircraft. It is inferred from previous studies, and the inference is supported by analysis, that the scale and intensity of the turbulence structure at the jet exit plane are the important boundary conditions which effect the development of the flow in the near field. The techniques to study these effects while maintaining a uniform mean flow and the results which document the range of the initial conditions are presented. The large angle, oblique jet impingement condition is of interest in terms of the jet/flap interaction. Detailed turbulence data can be obtained with the specially constructed facility. The development of the flow and instrumentation system and initial data from the new facility are presented. Author

N73-28198# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.
APPLIED GAS DYNAMICS. THIRD EDITION
 G. N. Abramovich 21 May 1973 1042 p refs Transl. into ENGLISH from the monograph "Prikladnaya Gazovaya Dinamika" Moscow, 1969 p 1-437, 516-824
 (AD-762307; FTD-MT-24-35-73) Avail: NTIS CSCL 20/4

The bases of gas dynamics are set forth in application to the theory of jet engines and other gas machines and apparatuses.

A detailed analysis is made of the theory of one-dimensional gas flows on which rest largely the contemporary methods of calculation of jet engines, vane machines, ejectors, wind tunnels, and test stands. Separate chapters are dedicated to the boundary-layer theory and theory of jets lying at the basis of the determination of the friction drag, velocity fields, and temperatures in nozzles, diffusers, combustion chambers, ejectors, etc. GRA

N73-28197# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.
GENERALIZED DEPENDENCES FOR THE PARAMETERS AT THE FLOW SEPARATION BOUNDARY IN COMPRESSOR CASCADES

E. Z. Madorskii 1 Jun. 1973 13 p refs Transl. into ENGLISH from *Energomashinostroenie* (USSR), no. 2, 1973 p 39-40
 (AD-762238; FTD-HT-23-530-73) Avail: NTIS CSCL 21/5

One of the peculiarities of axial compressors is the presence of a boundary of separation modes. Operation beyond this boundary, in the unstable area, is excluded due to the low efficiency and the vibration of the blades, which can cause their breakdown. The structural and gas-dynamic parameters of the cascades of blading rings are selected from the point of view of the optimum angles of rotation of flow and extent of pressure losses. In the report the structural and gas-dynamic parameters of the cascades are connected with the boundary of non-separated flow around the cascades. GRA

N73-28449* Boeing Commercial Airplane Co., Seattle, Wash.
RESEARCH STUDY ON ANTISKID BRAKING SYSTEMS FOR THE SPACE SHUTTLE
 J. A. Auselmi, L. W. Weinberg, R. F. Yurczyk, and W. G. Nelson [1973] 226 p
 (Contract NAS8-27864)
 (NASA-CR-124349; D6-41115) Avail: NTIS HC \$13.50 CSCL 22B

A research project to investigate antiskid braking systems for the space shuttle vehicle was conducted. System from the Concorde, Boeing 747, Boeing 737, and Lockheed L-1011 were investigated. The characteristics of the Boeing 737 system which caused it to be selected are described. Other subjects which were investigated are: (1) trade studies of brake control concepts, (2) redundancy requirements trade study, (3) laboratory evaluation of antiskid systems, and (4) space shuttle hardware criteria. Author

N73-28518* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
WELDING BLADES TO ROTORS Patent
 Kenneth H. Hoklo and Thomas J. Moore, inventors (to NASA)
 Issued 10 Jul. 1973 5 p Filed 15 Apr. 1971 Supersedes N71-34423 (09 - 21, p 3433)
 (NASA-Case-LEW-10533-1; US-Patent-3,745,300;
 US-Patent-AppI-SN-134658; US-Patent-Class-219-107;
 US-Patent-Class-29-497.5; US-Patent-Class-27-498;
 US-Patent-Class-219-62) Avail: US Patent Office CSCL 13H

A process is described to form T-joints between dissimilar thickness parts by magnetic force upset welding. This type of resistance welding is used to join compressor and turbine parts which thereby reduces the weight and cost of jet engines.

Official Gazette of the U.S. Patent Office

N73-28539# Air Force Systems Command, Wright-Patterson AFB, Ohio, Foreign Technology Div.
FATIGUE STRENGTH OF BOLT AND RIVET JOINTS IN AIRPLANE FRAME
 G. I. Nesterenko 16 May 1973 15 p refs Transl. into ENGLISH from *Vopr. Eksploataatsionnoi Prochnosti i Nadezhnosti Aviats. Konstrukts. (Riga)*, v. 6, no. 191, 1971 p 3-13
 (AD-761446; FTD-HT-23-253-73) Avail: NTIS CSCL 13/5

The author examined the effect of friction forces on the nature of fatigue breakdown of bolt and rivet joints in aircraft structures. GRA

N73-28507# Battelle Columbus Labs., Ohio.
ENGINEERING DATA ON NEW AEROSPACE STRUCTURAL MATERIALS Final Summary Report, Apr. 1972 - Apr. 1973

Omar L. Deel, Paul E. Ruff, and H. Mindlin Jun. 1973 149 p
 (Contract F33615-72-C-1280; AF Proj. 7381)
 (AD-762305; AFML-TR-73-114) Avail: NTIS CSCL 11/6

The major objectives of the research program were to evaluate newly developed materials of interest to the Air Force for potential structural airframe usage, and to provide data sheet type presentations of engineering data for these materials. The effort covered in the report has concentrated on X2048-T851 plate, 7050-T73651 plate, 21-6-9 annealed sheet, Ti-8Mo-8V-2Fe-3Al STA sheet, Ti-6Al-2Zr-2Sn-2Mo-2Cr STA plate, and Ti-6Al-8V-2Sn STA isothermal die forgings. The properties investigated include tension, compression, shear, bend, impact, fracture toughness, fatigue, creep and stress-rupture, and stress corrosion at selected temperatures. Author (GRA)

N73-28604# Army Natick Labs., Mass.
SUSCEPTIBILITY OF MIL-L-23699 (ACFT TURBOSHAFT ENGINE, SYNTHETIC LUBE OIL) AND MIL-L-7808 LUBRICATING OIL ACFT TURBINE ENGINE, SYNTHETIC BASE) OILS TO MICROBIAL ATTACK
 Morris R. Rogers, Arthur M. Kaplan, and Joseph J. Vitaliano Apr. 1973 26 p refs
 (DA Proj. 1TO-62110 A-031)
 (AD-762176; USA-NLABS-TR-73-54-PRI) Avail: NTIS CSCL 11/8

A 6-month tropic service test of the OH-58A Helicopter System conducted at Fort Clayton, Canal Zone revealed that the tail rotor transmission oil level sight gage did not indicate the correct oil level because fungal growth plugged the sight gage drain holes. A sample of the MIL-L-23699 oil revealed it would readily support fungal and bacterial growth. A survey and test program to determine the microbial susceptibility of the MIL-L-23699 and MIL-L-7808 synthetic engine and transmission lubricants was undertaken. Of the 33 QPL samples of new and used lubricants obtained, only three were found to be resistant to microbial attack. The test microorganisms appeared to attack both the pentaerythritol and trimethylolpropane major basestock components with equal ease. The three microbially resistant products were all manufactured by one company and microbial resistance was probably due to either a side-effect of the gear load carrying additive employed or its instability in the test system employed. (Modified Author Abstract) GRA

N73-28631# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
FOG MODIFICATION: A TECHNOLOGY ASSESSMENT Air Force Surveys in Geophysics.
 Bernard A. Silverman and Alan I. Weinstein 12 Mar. 1973 46 p refs
 (AF Proj. 7605)
 (AD-762207; AFCRL-TR-73-0159; AFCRL-AFSIG-261) Avail: NTIS CSCL 04/2

The report is a comprehensive review of fog modification. It includes discussions of the physical structure and climatological characteristics of various types of fog. The three different methods of fog modification, that is, removal, evaporation and prevention are discussed, as are the general requirements of fog dispersal. In depth descriptions are given of the techniques used to modify supercooled, warm, and ice fog. Author (GRA)

N73-28635# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
PROPANE DISPENSER FOR COLD FOG DISSIPATION SYSTEM Final Report
 J. R. Hicks and T. E. Lukow Jan. 1973 38 p refs Sponsored by AF
 (AF Proj. 5559; AF Proj. 433L)
 (AD-762292; ESD-TR-73-208) Avail: NTIS CSCL 04/2

The following topics are discussed: Nozzle design; Pressurization system design; Amount of propane needed to clear airfields; and Cost analysis. GRA

N73-28643# Army Electronics Command, Fort Monmouth, N.J.

DATA FROM A FOG DISPERSAL EXPERIMENT USING HELICOPTER DOWNWASH

W. S. Nordquist May 1973 267 p refs

(DA Proj. 1TO-61102-B-53A)

(AD-762189; ECOM-5456) Avail: NTIS CSCL 04/2

Data from a series of helicopter downdraft fog-clearing experiments are presented in tabular form, one set for each of six test days. This information has been prepared in this format to allow analysis of the experiments without recourse to original data and to make available time histories of the meteorological characteristics of advection fogs of the type to be found along the northern California coast. Author (GRA)

N73-28647# Federal Aviation Administration, Washington, D.C.

ENGINEERING AND DEVELOPMENT PROGRAM PLAN: AIR TRAFFIC CONTROL TECHNOLOGY

1 Jul. 1973 47 p

(FAA-ED-16-1) Avail: NTIS HC \$4.50

The Technology Program Plan which is published to document the engineering and development activities of the Federal Aviation Administration is presented. It described current and planned activities to examine advanced concepts and techniques and to evaluate their application in the air traffic control environment. The program is divided into two major categories: data entry and display technology and advanced computer technology. Author

N73-28648# Stanford Research Inst., Menlo Park, Calif.
ANALYSIS OF AUTOMATIC AIRCRAFT ALTITUDE REPORTING USING THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM Final Report, Jun. 1972 - Apr. 1973

G. J. Couluris Apr. 1973 116 p refs

(Contract DOT-FA70WA-2142; SRI Proj. 8181)

(FAA-RD-73-44) Avail: NTIS HC \$8.00

Work measuring the degree of relative correspondence between simultaneous automatic aircraft altitude reports and oral altitude reports from pilots recorded on magnetic tape at two FAA terminal area ATC facilities and one enroute ATC facility is reported. The frequency of occurrence of the resulting observed deviations between automatic and pilot reports are tabulated by deviation magnitude and by phase of operation (i.e., climb, descent, and level) and control facility; probable causes of observed deviations are identified. Author

N73-28650# National Aerospace Lab., Amsterdam (Netherlands).

SIMULATION PROGRAMS FOR AIR TRAFFIC SURVEILLANCE

C. R. Traas Paris ESRO Feb. 1973 62 p refs

(Contract ESTEC-1341/71)

(ESRO-CR-81) Avail: NTIS HC \$5.25

Programs were developed for simulating the determination of airplane positions from radar range observations via a pair of stationary satellites, and for simulating the determination of these satellite orbits from radar range and range-rate observations. The program, SPATS 1, for calculating aircraft positions from range measurements between a ground station and each of the airplanes via the satellites, and SPATS 2, for calculating the initial state vector of a pair of stationary satellites from a set of range measurements or from a set of range and range-rate measurements, are described. Concerning SPATS 1 and SPATS 2 program, at each measurement both stationary satellites and two ground stations are involved. ESRO

N73-28661# Naval Electronics Lab. Center, San Diego, Calif.
VLF NAVIGATION

E. Swanson and F. C. Robie 1 Jan. 1973 38 p

(Contract DOT-FA73WAI-343; NELC Proj. A206)
(AD-781498; NELC-TD-233) Avail: NTIS CSCL 17/7

Very-low-frequency (VLF) radio signals offer potential advantages for aircraft area navigation. This document defines the aircraft navigation problem from the operational viewpoint and describes pertinent aspects of VLF propagation. Advantages and disadvantages of promising approaches to system design are noted. It is concluded that many system designs will provide true continental area navigation capability with redundancy and reliability. Author (GRA)

N73-28731*# Boeing Commercial Airplane Co., Seattle, Wash.
INVESTIGATION OF NOISE SUPPRESSION BY SONIC INLETS FOR TURBOFAN ENGINES. VOLUME 1: PROGRAM SUMMARY

F. Kluijber, J. C. Bosch, R. W. Demetrick, and W. L. Robb. Jul. 1973 221 p.

(Contract NAS3-15574)
(NASA-CR-121126; D6-40855-Vol-1) Avail: NTIS HC \$13.25
CSCL 20A

Results of a program for sonic inlet technology development are presented. This program includes configuration and mechanical design selection of concepts, aerodynamic design description of the models, and results of test evaluation. Several sonic inlet concepts were tested and compared for aerodynamic and acoustic performance. Results of these comparative evaluations are presented. Near-field measurements were taken inside several of the inlet models. Results of these tests are discussed with respect to the effect of Mach number gradients on noise attenuation and rotor shock wave attenuation, and boundary layer effects on noise propagation. The test facilities and experimental techniques employed are described briefly. Author

N73-28732*# Boeing Commercial Airplane Co., Seattle, Wash.
INVESTIGATION OF NOISE SUPPRESSION BY SONIC INLETS FOR TURBOFAN ENGINES. VOLUME 2: APPENDICES

F. Kluijber, J. C. Bosch, R. W. Demetrick, and W. L. Robb. Jul. 1973 219 p refs

(Contract NAS2-15574)
(NASA-CR-121127; D6-40855-1-Vol-2) Avail: NTIS HC \$13.00 CSCL 20A

For abstract, see N73-28731

N73-28733*# Boeing Commercial Airplane Co., Seattle, Wash.
INVESTIGATION OF NOISE SUPPRESSION BY SONIC INLETS FOR TURBOFAN ENGINES. VOLUME 3: AN EXPERIMENTAL INVESTIGATION OF THE INTERNAL NOISE FIELD OF TWO AXISYMMETRIC SONIC INLET MODELS

F. Kluijber and J. Lousse. Jul. 1973 261 p refs

(Contract NAS3-15574)
(NASA-CR-121128; D6-40818-Vol-3) Avail: NTIS HC \$15.25
CSCL 20A

For abstract, see N73-28731

N73-28734*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.
FLIGHT INVESTIGATION OF ACOUSTIC AND THRUST CHARACTERISTICS OF SEVERAL EXHAUST NOZZLES INSTALLED ON UNDERWING NACELLES ON AN F105 AIRPLANE

Richard R. Burley, Raymond J. Karabinus, and Robert J. Freedman
Washington Aug. 1973 49 p refs

(NASA-TM-X-2854; E-7319) Avail: NTIS HC \$3.00 CSCL 21E

To determine flyover noise and thrust and to investigate whether flight velocity significantly affects the noise of exhaust nozzles, a series of flight tests was conducted on three different exhaust nozzles of a type suitable for supersonic transport aircraft. The tests were conducted using an F-105B aircraft modified to carry two underwing nacelles, each containing a calibrated turbojet engine. A flyover altitude of 91 meters

(300 ft) and a Mach number of 0.4 provided acoustic data that were repeatable to within + or - 1.5 PNdB. Flyover results showed that an auxiliary inlet ejector nozzle was the quietest of the nozzles tested; flight velocity appeared to reduce its noise.

Author

N73-28735*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.

FLYOVER AND STATIC TESTS TO STUDY FLIGHT VELOCITY EFFECTS ON JET NOISE OF SUPPRESSED AND UNSUPPRESSED PLUG NOZZLE CONFIGURATIONS

Roger Chamberlin Washington Aug. 1973 34 p refs
(NASA-TM-X-2856; E-7186) Avail: NTIS HC \$3.00 CSCL 21E

Two spoke-type suppressor plug nozzles and a basic plug nozzle were tested for noise and thrust performance. The nozzles were mounted on an underwing nacelle on an F-105B aircraft, and tests were made both statically and in flyovers at Mach 0.4 at an altitude of 91 meters (300 ft). The flight and static data were adjusted to common reference conditions so that direct comparisons could be made. The noise characteristics that these nozzles would have on a large multiengine aircraft at a 640-meter (2100-ft) sideline distance are also presented. Flight noise levels for all three nozzles were higher than static at comparable conditions; and a shift in the frequency spectra was seen from static to flight, indicating the presence of a forward velocity effect on the noise characteristics. Author

N73-28740*# Naval Postgraduate School, Monterey, Calif.
A REVISED DESIGN CONCEPT FOR THE A-7E APPROACH POWER COMPENSATOR SYSTEM M.S. Thesis

David Haley Finney Mar. 1973 92 p refs

(AD-761764) Avail: NTIS CSCL 21/5

The present concept of automatic throttle control, as employed in Navy carrier-based aircraft, was investigated. The aircraft chosen for study was the A-7E. The powerplant was the TF41-A-2, a turbofan engine with a relatively slow throttle response in the approach power range. The effects of additional inputs to the approach power compensator were evaluated. It was shown that a considerable increase in performance could be achieved through the incorporation of longitudinal feedback. In addition, the limitations imposed on performance by large engine lags were found to be much less severe for systems with longitudinal feedback. The modifications suggested require a redesign of the approach power compensator system currently in use by the Navy. Author (GRA)

N73-28741*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.

TURBINE ENGINE ADVANCED ACCESSORY DRIVE SYSTEM STUDY Final Report, 1 Feb. 1972 - 31 Jan. 1973
Donald C. Colvin Wright-Patterson AFB, Ohio AFAPL Jun. 1973 293 p

(Contract F33615-72-C-1170; AF Proj. 3066)
(AD-761527; PWA-FR-6540; AFAPL-TR-73-26) Avail: NTIS CSCL 21/5

Turbine engine accessory drive techniques were investigated to establish potential systems for a lightweight low profile package. The frame of reference was provided by three classes of advanced engines for the 1975 to 1980 time period: the (1) low bypass turbofan (fighter), (2) high bypass turbofan (transport), and (3) small turbofan (remoté-piloted vehicle). Design study information is presented and used to establish a ranking of candidate system attractiveness against defined and weighted criteria. Conceptual design drawings, depicting a selected system for each study engine class, are provided and development recommendations are given. (Modified Author Abstract) GRA

N73-28742*# Naval Postgraduate School, Monterey, Calif.
A REVISED DESIGN CONCEPT FOR THE A-7E APPROACH POWER COMPENSATOR SYSTEM M.S. Thesis

David H. Finney and Ronald A. Hess Mar. 1973 91 p refs
(AD-781458; NPS-57HE73031A) Avail: NTIS CSCL 21/5

The present concept of automatic throttle control, as employed

in Navy carrier-based aircraft, was investigated. The aircraft chosen for study was the A-7E. The powerplant was the TF41-A-2, a turbofan engine with a relatively slow throttle response in the approach power range. The effects of additional inputs to the approach power compensator were evaluated. It was shown that a considerable increase in performance could be achieved through the incorporation of longitudinal feedback. In addition, the limitations imposed on performance by large engine lags were found to be much less severe for systems with longitudinal feedback. The modifications suggested require a redesign of the approach power compensator system currently in use by the Navy. Author (GRA)

N73-28746# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE USE OF VARIABLE PITCH IN ALIGNMENT UNITS OF A COMPRESSOR FOR REDUCING ROTOR VIBRATIONS

I. L. Meyerson, Yu. Kh. Gazaryan, and M. E. Gorodetskii 6 Jun. 1973 20 p refs Transl. into ENGLISH from Prochnost Din. Aviats. Dvigateli (USSR), no. 5, 1969 p 102-112 (AD-762228; FTD-HT-23-339-73) Avail: NTIS CSCL 21/5

The report describes a mathematical analysis of variable pitch compressor rotor blades designed to alleviate vibration. GRA

N73-28747# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
PERFORMANCE OF THE CRYPTOSTEADY FLOW ENERGY SEPARATOR

Joseph V. Foa Jul. 1972 46 p refs (Contract N00019-72-C-0122)

(AD-762030; TR-ES-722) Avail: NTIS CSCL 21/5

Performance equations are developed for the cryptosteady-flow energy separator in its most general form and over the widest range of operating conditions considered so far, including bearing friction or other rotor torque, and unequal discharge pressures, peripheral velocities, flow losses, prerotation velocities, and discharge angles. Equations are also developed for the proportioning of rotor nozzles in accordance with performance specifications. Convenient performance and design charts are also presented. Author (GRA)

N73-28751# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.

CRYPTOSTEADY-FLOW ENERGY SEPARATION

Joseph V. Foa Oct. 1972 35 p refs (Contract N00019-72-C-0122)

(AD-762031; TR-ES-723) Avail: NTIS CSCL 21/5

The mechanism of cryptosteady-flow energy separation is described and analyzed in its most general form, with full consideration of the effects of bearing friction or other rotor torque, and of such asymmetries as unequal discharge pressures, peripheral velocities, flow losses, prerotation velocities, and discharge angles. Equations are also developed for the proportioning of rotor nozzles in accordance with performance specifications. Author (GRA)

N73-28752# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.

FURTHER CONSIDERATION ON THE DESIGN OF A FOA CRYPTOSTEADY ENERGY SEPARATOR FOR USE IN SUPERSONIC AIRCRAFT

David Sobel and Arshad Nawaz Mar. 1973 26 p refs (Contract N00019-72-C-0122)

(AD-762032; TR-ES-7) Avail: NTIS CSCL 21/5

It is shown in the report that a fixed geometry Foa Energy Separator can satisfy the cooling requirements of the F-8U aircraft without an external heat exchanger or staged configuration. A possible solution involves a hot to cold side nozzle area ratio of 0.283, dual prerotation at one half the rotor speed, and regenerative precooling at the Energy Separator entrance. Author (GRA)

N73-28883*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

EXPERIMENTS TO STUDY STRAIN GAGE LOAD CALIBRATIONS ON A WING STRUCTURE AT ELEVATED TEMPERATURES

Richard C. Monaghan and Roger A. Fields Washington Aug. 1973 26 p refs (NASA-TN-D-7390; H-763) Avail: NTIS HC \$3.00 CSCL 20K

Laboratory experiments were performed to study changes in strain-gage bridge load calibrations on a wing structure heated to temperatures of 200 F, 400 F, and 600 F. Data were also obtained to define the experimental repeatability of strain-gage bridge outputs. Experiments were conducted to establish the validity of the superposition of bridge outputs due to thermal and mechanical loads during a heating simulation of Mach 3 flight. The strain-gage bridge outputs due to load cycle at each of the above temperature levels were very repeatable. A number of bridge calibrations were found to change significantly as a function of temperature. The sum of strain-gage bridge outputs due to individually applied thermal and mechanical loads compared well with that due to combined or superimposed loads. The validity of superposition was, therefore, established. Author

N73-28884# Advisory Group for Aerospace Research and Development, Paris (France).

TECHNICAL EVALUATION REPORT ON THE AGARD SYMPOSIUM ON RANDOM LOAD FATIGUE

Walter Schuetz (Industrieanlagen-Betriebsgesellschaft m.b.H.) Jun. 1973 13 p refs

(AGARD-AR-54) Avail: NTIS HC \$3.00

Brief summaries of the papers presented to the AGARD Symposium are presented. Conclusions and recommendations are included. Topics discussed include: full scale fatigue testing, crack propagation under flight-by-flight loading, fatigue life prediction, measurement and estimation of fatigue loads, damage accumulation, and service experience. F.O.S.

N73-28918*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF AN ANNUAL COMBUSTOR DESIGNED FOR A LOW-COST TURBOJET ENGINE

James S. Fear Washington Aug. 1973 43 p refs

(NASA-TM-X-2857; E-7424) Avail: NTIS HC \$3.00 CSCL 21E

Performance tests were conducted on a combustor designed for use in a low-cost turbojet engine. Low-cost features included the use of very inexpensive simplex fuel nozzles and combustor liners of perforated sheet material. Combustion efficiencies at the altitude-cruise and sea-level design points were approximately 94 and 96 percent, respectively. The combustor isothermal total-pressure loss was 8.8 percent at the altitude-cruise-condition diffuser-inlet Mach number of 0.335. The combustor-exit temperature pattern factor was less than 0.3 at the altitude-cruise, sea-level-cruise, and sea-level-static design conditions. The combustor-exit average radial temperature profiles at all conditions were in very good agreement with the design profile. The intense mixing required because of the very high combustor heat-release rate had an adverse effect on ignition capability at altitude windmilling design conditions. Author

N73-28933# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

[CONTINUING STUDIES IN AERODYNAMICS, LARGE WIND TUNNELS, ENERGETICS, PHYSICS, AND MATERIALS] 1972 Activities

1972 144 p refs

Avail: NTIS HC \$9.25

After some general remarks on management and administrative problems, brief descriptions of activities of the systems, aerodynamics, Modane large wind tunnels, structures, energetics, physics, and materials departments are reported. Patents, published documents, and memoranda are listed. Author

N73-28942*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. Inst. of Governmental Studies.

THE SOCIAL IMPACTS OF TECHNOLOGY: TOWARD AN ASSESSMENT OF STOL AIRCRAFT POTENTIAL Semiannual Report, 1 Dec. 1972 - 30 May 1973

Todd R. LaPorte 30 May 1973 26 p ref

(Grant NGR-05-003-0471)

(NASA-CR-133356) Avail: NTIS HC \$3.50 CSCL 05K

Progress of the work done on STOL assessment relating to (1) the mobility and social change aspect of research and (2) analysis of data relating to public attitudes toward technology outlined. Author

N73-28947# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

MAINTENANCE SCHEDULING LIMITATIONS

Joseph E. Boyett, Jr. 24 Apr. 1973 26 p

(AD-761494: AU-AFIT-SL-2-73) Avail: NTIS CSCL 15/5

The paper discusses maintenance scheduling problems which must be resolved during phase 2 of the STALOG development. Performance measures associated with scheduling are identified as being extremely critical since they must be clearly established prior to developing specific scheduling techniques. A brief review of sequencing techniques allows the reader to visualize, how different heuristics might be used in a dispatching model developed for specific applications. Recommendations are tentative since very little research has been conducted on complex problems of this type. Author (GRA)

N73-28951# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A HIERARCHY OF OBJECTIVES AND RELATED PERFORMANCE INDICATORS FOR AIRCRAFT MAINTENANCE ORGANIZATIONS. M.S. Thesis

Larry L. Ullrey and Clark R. Penas 15 Sep. 1972 176 p refs (AD-762270: SLSR-18-72) Avail: NTIS CSCL 01/3

There were three main objectives which the authors intended to accomplish in the thesis. The first thesis objective was to formulate the hierarchy of maintenance objectives by determining the primary objective of the base level aircraft maintenance organization and the subordinate objective which must be achieved prior to the achievement of the primary maintenance objective. The second thesis objective was to identify those measurable performance indicators that would permit maintenance managers to monitor, via the exception principle, progress toward the accomplishment of the maintenance objectives. The third and final thesis objective was to establish the frequency with which the identified performance indicators should be observed to insure timely correction of out-of-tolerance performance. GRA

N73-28956# Vector Research, Inc., Ann Arbor, Mich. **ANALYTIC MODELS OF AIR CAVALRY COMBAT OPERATIONS, VOLUME 1 Final Report**

May 1973 141 p

(Contract DAAG25-71-C-0407)

(AD-762432: SAG-1-Vol-1; FR-73-1-Vol-1) Avail: NTIS CSCL 15/7

This is the first of two volumes reporting the research activities on analytic modeling of air cavalry combat. The volume contains an introduction to and summary of the research and modeling performed, a summary description of the differential models of attack helicopters supporting a battalion task force (which are fully documented in Volume II), and a description of the stochastic models of attack helicopters independently attacking ground targets, the program implementing these models, and a sample run of the program. (Modified Author Abstract) GRA

N73-28957# Vector Research, Inc., Ann Arbor, Mich.

ANALYTIC MODELS OF AIR CAVALRY COMBAT OPERATIONS, VOLUME 2 Final Report

May 1973 657 p refs

(Contract DAAG25-71-C-0407)

(AD-762433: SAG-1-Vol-2: FR-73-1-Vol-2) Avail: NTIS CSCL 15/7

This is the second of two volumes reporting the research activities on analytic modeling of air cavalry combat. The volume describes the work done in including attack helicopters and air defense weapons in the differential models of battalion task force combat. It includes a review of the basic mathematical structure of the differential combat models, complete descriptions of the mathematical models used to describe the activities and effects of attack helicopters and air defense weapons within the models, a review of the IUA versions of the models and the associated computer programs, and a complete programmer's guide to the augmented battalion task force programs. (Modified Author Abstract) GRA

N73-28958# Sacramento Air Materiel Area, McClellan AFB, Calif.

LOGISTIC PERFORMANCE DATA BOOK FOR F-111A AIRFRAME SYSTEM

Jack F. Bussio Mar. 1973 154 p refs

(AD-762213: F-111-A-11000/73-13) Avail: NTIS CSCL 15/5

The principal purpose of the report is to impart sufficient Logistics Support Cost history on the F-111A Airframe System to a design engineer of a similar functional capability to permit technical analysis of the good and bad design features of that system. The report contains four sections: AFLC organizations/personnel knowledgeable, Logistic Support cost by component, reliability/maintainability summary, and problem history narrative. Author (GRA)

N73-28959# Sacramento Air Materiel Area, McClellan AFB, Calif.

LOGISTIC PERFORMANCE DATA BOOK FOR F-111D BOMB NAVIGATION MARK 2 AVIONICS

Jack F. Bussio Mar. 1973 144 p refs

(AD-762214: F-111-D-73000/73-14) Avail: NTIS CSCL 15/5

The principal purpose of the report is to impart sufficient logistics support cost history on the F-111D Bomb Navigation Mark 2 avionics to a design engineer of a similar functional capability to permit technical analysis of the good and bad design features of that system. The report contains four sections: AFLC organizations/personnel knowledgeable, logistic support cost by component, reliability/maintainability/summary and problem history narrative. Author (GRA)

N73-28960# Oklahoma City Air Materiel Area, Tinker AFB, Okla.

LOGISTIC PERFORMANCE DATA BOOK FOR A-7D BOMB NAVIGATION SYSTEM

Mar. 1973 84 p refs

(AD-762215: A-7D-73000/73-1) Avail: NTIS CSCL 15/5

The report presents the reliability, maintainability, logistic support cost, and general product performance information on the A-7D bomb navigation system. Its purpose is to impart sufficient logistics support history on the bomb navigation system to the engineering/design community represented by AFSC and the contractors engaged in the design of similar systems/sub-systems for Air Force use. Author (GRA)

N73-28961# Oklahoma City Air Materiel Area, Tinker AFB, Okla.

LOGISTIC PERFORMANCE DATA BOOK FOR B-52G ELECTRONIC COUNTERMEASURES SYSTEM

Mar. 1973 109 p

(AD-762216: B-52G-76000) Avail: NTIS CSCL 15/5

The document presents the reliability, maintainability, logistic support cost, and general product performance information on the B-52G electronic countermeasures system. Its purpose is to impart sufficient logistics support history on the electronic countermeasures system to the engineering/design community represented by AFSC and the contractors engaged in the design of similar systems/sub-systems for Air Force use. Author (GRA)

N73-28962# Oklahoma City Air Materiel Area, Tinker AFB, Okla.

LOGISTIC PERFORMANCE DATA BOOK FOR KC-135 PROPULSION SYSTEM

Mar. 1973 194 p refs
(AD-762217; KC-135-23000/73-2) Avail: NTIS CSCL 15/5

The report presents the reliability, maintainability, logistic support cost, and general product performance information on the KC-135 propulsion system. Its purpose is to impart sufficient logistics support history on the propulsion system to the Engineering/design community represented by AFSC and the contractors engaged in the design of similar systems/sub-systems for Air Force use. Author (GRA)

N73-28963# San Antonio Air Materiel Area, Kelly AFB, Tex.
LOGISTIC PERFORMANCE DATA BOOK FOR C-5A LANDING GEAR SYSTEM Summary Report, Mar. 1966 - Dec. 1972

Choice O. Harper Dec. 1972 321 p refs
(AD-762248; C-5A-13000/73-6) Avail: NTIS CSCL 01/3

The purpose of the report is to transmit C-5A landing gear system reliability, maintainability, logistic support cost and general performance information from the Air Force Logistic Command (AFLC) to the engineering/design community represented by the Air Force System Command and the contractors engaged in the design of systems, subsystems, equipment, and components for Air Force use. The book is divided into four sections. Section A provides a listing of the AFLC organizations and personnel most knowledgeable of the book. Section B provides logistic support costs for every work unit code contained in the airframe system. Section C provides twelve months of Maintainability Reliability Summaries by work unit code on components experiencing one or more maintenance action in 1000 flight hours. Section D provides a synopsis of problems encountered on the landing gear system during the testing and operations phase through 28 February 1973. (Modified Author Abstract) GRA

N73-28964# Warner Robins Air Materiel Area, Robins AFB, Ga.

LOGISTIC PERFORMANCE DATA BOOK FOR C-130E PROPULSION SYSTEM Final Report

Albert L. Garmto Mar. 1973 136 p refs
(AD-762249; WRAMA-C-130E-22000/73-7) Avail: NTIS CSCL 21/5

The Logistic Performance Data Book provides reliability, maintainability, logistic support cost, and general performance information on the C-130E aircraft propulsion system. This historical type data was prepared for the use of Government agencies and contractors who design and manufacture aircraft engine propulsion systems. It is the intent by submitting this data to permit a technical analysis of good and bad design features of engines and thus influence and cause improvement in design of subsequent aircraft engines to be utilized by the United States Air Force. Author (GRA)

N73-28965# Warner Robins Air Materiel Area, Robins AFB, Ga.

LOGISTIC PERFORMANCE DATA BOOK FOR UH-1F AIRFRAME SYSTEM Final Report

George L. Jones Mar. 1973 120 p refs
(AD-762251; WRAMA-UH-1F-11000/73-15) Avail: NTIS CSCL 15/5

The Logistic Performance Data Book provides reliability, maintainability, logistic support cost, and general performance information on the UH-1F Helicopter Airframe System. This historical type data has been prepared for the use of Government agencies and contractors who design and manufacture aircraft and helicopter airframes. It is the intent by submitting this data to permit a technical analysis of good and bad design features of airframes and thus influence and cause improvement in design of subsequent airframe structures to be utilized by the United States Air Force. Author (GRA)

N73-28966# San Antonio Air Materiel Area, Kelly AFB, Tex. Directorate of Materiel Management.

LOGISTIC PERFORMANCE DATA BOOK FOR C-5A AIRFRAME SYSTEM Summary Report, Mar. 1966 - Dec. 1972

Choice O. Harper Dec. 1972 408 p
(AD-762233; C-5A-11000/73-5) Avail: NTIS CSCL 01/3

The purpose of the report is to transmit C-5A Airframe System reliability, maintainability, logistic support cost and general performance information from the Air Force Logistic Command (AFLC) to the Engineering/Design Community represented by the Air Force System and the contractors engaged in the design of systems, subsystems, equipment, and components for Air Force use. The book is divided into four sections. Section A provides a listing of the AFLC organizations and personnel most knowledgeable of the book. Section B provides logistic support costs for every work unit code contained in the airframe system. Section C provides twelve months of Maintainability Reliability Summaries by work unit code on components experiencing one or more maintenance action in 1000 flight hours. Section D provides a synopsis of problems encountered on the airframe system during the testing and operational phase through 28 February 1973. (Modified Author Abstract) GRA

N73-28969# Ogden Air Materiel Area, Hill AFB, Utah.
LOGISTIC PERFORMANCE DATA BOOK FOR F-4D FIRE CONTROL SYSTEM

Orin D. Hubbard 2 Apr. 1973 75 p refs
(AD-762229; F-4D-74000/73-9) Avail: NTIS CSCL 15/5

The data presented is based on the best available information and the purpose is to transmit the reliability, maintainability, logistic support cost and general performance information from the Air Force Logistic Command to the engineering/design community represented by the Air Force Logistic Command and the contractors engaged in the design of systems, sub-systems, equipment and components for Air Force use. The information is composed of logistic support costs for every work unit code contained in the subject sub-system. These costs are generated quarterly in the Increase Reliability Operational Systems (IROS) and are formatted to display average monthly support costs for a one-year period. (Modified Author Abstract) GRA

N73-28970# Ogden Air Materiel Area, Hill AFB, Utah.
LOGISTIC PERFORMANCE DATA BOOK FOR RF-4C LANDING GEAR SYSTEM

Orin D. Hubbard 2 Apr. 1973 114 p refs
(AD-762231; RF-4C-13000/73-11) Avail: NTIS CSCL 15/5

The data presented is based on the best available information and the purpose is to transmit the reliability, maintainability, logistic support cost and general performance information from the Air Force Logistic Command to the engineering/design community represented by the Air Force Logistic Command and the contractors engaged in the design of systems, sub-systems, equipment and components for Air Force use. The information is composed of logistic support costs for every work unit code contained in the subject sub-system. These costs are generated quarterly in the Increase Reliability Operational Systems (IROS) and are formatted to display average monthly support costs for a one-year period. (Modified Author Abstract) GRA

N73-28971# Warner Robins Air Materiel Area, Robins AFB, Ga. Directorate of Materiel Management.

LOGISTIC PERFORMANCE DATA BOOK FOR C-141A RADIO NAVIGATION SYSTEM Final Report

James R. King Mar. 1973 153 p
(AD-762250; WRAMA-C-141A-71000/73-8) Avail: NTIS CSCL 15/5

The Logistic Performance Data Book provides reliability, maintainability, logistic support cost, and general performance information on the C-141A Aircraft Radio Navigation System. This historical type data has been prepared for the use of Government agencies and contractors who design and manufacture Aircraft Radio Navigation Systems. It is the intent by submitting this data to permit a technical analysis of good and

bad design features of equipment and thus influence and cause improvement in design of subsequent equipment to be used by the United States Air Force. Author (GRA)

N73-28972# Oklahoma City Air Materiel Area, Tinker AFB, Okla. Directorate of Materiel Management.
LOGISTIC PERFORMANCE DATA BOOK FOR KC-135 ELECTRICAL POWER SYSTEM Summary Report, Calendar Year 1972
 Mar. 1973 110 p
 (AD-762225; KC-135A-42000/73-3) Avail: NTIS CSCL 01/3

The document presents the reliability, maintainability, logistic support cost, and general product performance information on the KC-135 electrical power system. Its purpose is to impart sufficient logistics support history on the electrical power system to the Engineering/Design Community represented by AFSC and the Contractors engaged in the design of similar systems/sub-systems for Air Force use. Author (GRA)

N73-28973# Ogden Air Materiel Area, Hill AFB, Utah. Directorate of Materiel Management.
LOGISTIC PERFORMANCE DATA BOOK FOR F-4E FLIGHT CONTROL SYSTEM

Orin D. Hubbard 2 Apr. 1973 91 p refs
 (AD-762230; F-4E-14000/73-10) Avail: NTIS CSCL 15/5

The data presented is based on the best available information and the purpose is to transmit the reliability, maintainability, logistic support cost and general performance information from the Air Force Logistic Command to the Engineering/Design Community represented by the Air Force Logistic Command and the Contractors engaged in the design of systems, sub-systems, equipment and components for Air Force use. The information is composed of logistic support costs for every work unit code contained in the subject sub-system. These costs are generated quarterly in the Increase Reliability Operational Systems (IROS) and are formatted to display average monthly support costs for a one-year period. Maintainability/reliability summaries provide 12 months of data on the subject sub-systems, and is presented in work unit code sequence. These summaries are designed to present maintenance and failure rate data on items, sub-systems, and systems within a weapon. (Modified Author Abstract) GRA

N73-28974# Ogden Air Materiel Area, Hill AFB, Utah.
LOGISTIC PERFORMANCE DATA BOOK FOR RF-4C PHOTOGRAPHIC RECONNAISSANCE SYSTEM
 Orin D. Hubbard 2 Apr. 1973 119 p
 (AD-762232; RF-4C-77000/73-12) Avail: NTIS CSCL 15/5

The data presented is based on the best available information and the purpose is to transmit the reliability, maintainability, logistic support cost and general performance information from the Air Force Logistic Command to the Engineering/Design community represented by the Air Force Logistic Command and the contractors engaged in the design of systems, sub-systems, equipment and components for Air Force use. The information is composed of logistic support costs for every work unit code contained in the subject sub-system. These costs are generated quarterly in the Increase Reliability Operational Systems (IROS) and are formatted to display average monthly support costs for a one-year period. Maintainability/reliability summaries provide 12 months of data on the subject sub-systems, and is presented in work unit code sequence. These summaries are designed to present maintenance and failure rate data on items, sub-systems, and systems within a weapon. (Modified Author Abstract) GRA

N73-28976*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va. Dept. of Solid Mechanics, Structures, and Mechanical Design.
STUDIES IN TILT-ROTOR VTOL AIRCRAFT AERO-ELASTICITY, VOLUME 1 Ph.D. Thesis - Case Western Reserve Univ.

Raymond George Kvaternik Jun. 1973 394 p refs
 (NASA-TM-X-89497) Avail: NTIS HC \$21.75 CSCL 01A

Aeroelastic and dynamic studies which complement and extend various aspects of technology applicable to tilt-rotor VTOL

aircraft are discussed. Particular attention is given to prop rotor/pylon whirl instability, a precession-type instability akin to propeller/nacelle whirl flutter. The blade flapping and pitch-change freedoms of a prop rotor are shown to lead to a fundamentally different situation as regards the manner in which the precession-generated aerodynamic forces and moments act on the pylon and induce whirl flutter relative to that of a propeller. The implication of these forces and moments with regard to their capacity for instigating a whirl instability is examined, demonstrating why a prop rotor can exhibit whirl flutter in either the backward or forward directions in contrast to a propeller which is found to always whirl in the backward direction. Analytical trend studies delineating the effect of several system design parameters on prop rotor/pylon stability and response are shown. Author

N73-28977*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va. Dept. of Solid Mechanics, Structures, and Mechanical Design.

STUDIES IN TILT ROTOR VTOL AIRCRAFT AEROELASTICITY, VOLUME 2 Ph.D. Thesis - Case Western Reserve Univ.

Raymond George Kvaternik Jun. 1973 278 p refs
 (NASA-TM-X-69496) Avail: NTIS HC \$16.00 CSCL 01A

Two methods for natural mode vibration analysis are discussed. The first consists of a direct approach based on a finite element representation of the complete structure as an entity. The mass and stiffness matrices for the complete structure are assembled by properly combining the mass and stiffness matrices of the individual elements into which the structure has been divided. The second approach is that of component mode synthesis. This method is based on the concept of synthesizing the natural modes of the complete structure from modes of conveniently defined substructures, or components, into which the structure has been partitioned. In this way the expedient of reducing the system degrees of freedom, and thus the size of the eigenvalue problem, can be introduced by partial modal synthesis. Author

N73-28978# Aeronautical Research Associates of Princeton, Inc., N.J.

ON THE RESPONSE OF AIRPLANES IN A THREE-DIMENSIONAL GUST FIELD

John C. Houbolt Nov. 1972 32 p refs
 (Contract F44620-72-C-0022; AF Proj. 9782)
 (AD-762511; ARAP-161; AFOSR-73-1043TR) Avail: NTIS CSCL 01/1

The response of an airplane in a 3-dimensional gust field is examined with the intent of reducing the problem to the simplest terms. It is shown that response evaluation may be reduced to separate treatment of the longitudinal and lateral response cases. The longitudinal case reduces to considering the vertical gust velocities only, and generally the degrees of freedom of vertical motion, pitch, and vertical bending modes; vertical motion is the prime degree of freedom. The lateral case reduces to side gust velocities only, with degrees of freedom of side motion, yaw, and side bending; yaw is the prime degree-of-freedom in this case. The longitudinal gusts are found to be unimportant. The analysis show that the results from the separate longitudinal and lateral response evaluations must be combined to obtain the fuselage loads and loads on T-type tails. Author (GRA)

N73-28979# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.

[RESEARCH ON AEROELASTIC STABILITY AND RESPONSE PROBLEMS]

Ronald O. Stearman Jan. 1973 24 p refs
 (Grant AF-AFOSR-1998-71; AF Proj. 9782)
 (AD-762568; AFOSR-73-1071TR) Avail: NTIS CSCL 01/3

Research on aeroelastic stability and response problems have been carried out this past year in several areas. It includes an investigation of compressible flow induced instabilities on thin shell structures, the suppression of interfering lifting surface phenomenon, and the active control of vehicle responses thru an active suspension system concept. A brief review of this research is presented. Author (GRA)

N73-28980*# Kanner (Leo) Associates, Redwood City, Calif.
VISUAL PROBLEMS CONCERNING LANDING ACCIDENTS

Norifusa Iwataki Washington NASA Aug. 1973 14 p refs
 Transl. into ENGLISH from Koku Igaku Jikkentai Hohoku (Japan),
 v. 9, no. 1, Jun. 1968 p 70-75

(Contract NASw-2481)

(NASA-TT-F-15054) Avail: NTIS HC \$3.00 CSCL 01B

Undershoot accidents caused by pilot errors are among the most important types of landing accidents. Overshoot accidents occur much less frequently than undershoot accidents. Among the factors possibly causing such landing accidents may be: (1) reduced visibility caused by fog, (2) reduced visibility caused by veiling glare of fog, (3) presence of layers of smog, rain on the windshield, (4) misjudgement of distance with altitude, illusions of altitude accompanying changing intensity of illumination, (5) glare of lights, (6) illusions of altitude accompanying changes in the size of the runway, and (7) illusions of altitude accompanying inclination of the terrain surface. Even during instrument landing, there is danger of undershooting the runway if the pilot adopts an unnecessarily abrupt descent ratio without forming an accurate judgement of the altitude and distance. Output controls and steering must therefore be performed with great care. Author

N73-28981*# Kanner (Leo) Associates, Redwood City, Calif.
COMPUTATION OF UNSTEADY AERODYNAMIC FORCES ON HELICOPTER ROTOR BLADES

J. J. Costes Washington NASA Aug. 1973 34 p refs
 Transl. into ENGLISH from La Rech. Aerosp. (Paris), no. 2, 1972 p 91-106

(Contract NASw-2481)

(NASA-TT-F-15039) Avail: NTIS HC \$3.75 CSCL 01C

Numerical methods for determining the unsteady aerodynamic forces on helicopter rotor blades are presented. The calculation of the velocity potential induced by a lifting surface element when its position, orientation, and lift are known is developed as a function of time. The collocation method makes it possible to express the lift distribution as a function of the velocity component normal to the blades on a network of collocation points distributed on the rotor disc. A comparison between theory and experiment in the case of forward flight is provided. Author

N73-28982*# Kanner (Leo) Associates, Redwood City, Calif.
TUPOLEV: ITS 'MOUSTACHES' WERE TOO LONG AND FRAGILE

Dominique Walter Washington NASA Aug. 1973 7 p Transl. into ENGLISH of "Tupolev: Ses 'moustaches' etaient trop longues et fragiles" Science et Vie, Aug. 1973 p 44-47

(Contract NASw-2481)

(NASA-TT-F-15062) Avail: NTIS HC \$3.00

The aircraft accident involving the crash of a TU-144 aircraft during the 1973 Paris Air Show is reported. The cause of the crash is given as structural failure of the canard lifting surfaces with resulting instability of the main wing. The cause of the canard surface failure was considered to be caused by overstressing during a climbing turn. Author

N73-28983# Douglas Aircraft Co., Inc., Long Beach, Calif.
A FLIGHT SIMULATOR STUDY OF STOL TRANSPORT LONGITUDINAL CONTROL CHARACTERISTICS Final Report

Robert A. Berg and W. Allen Shirley Jul. 1972 97 p refs
 (Contract DOT-FA70WA-2395)

(MDC-J5575L; FAA-RD-72-56) Avail: NTIS HC \$7.00

An investigation of STOL transport terminal area characteristics was conducted in order to identify factors that may be significant in the establishment of longitudinal handling qualities criteria. The test program utilized the NASA Ames Research Center S-16 Moving Cab Transport Simulator. The investigation was broad in scope, covering a wide range of longitudinal characteristics representative of STOL aircraft and STOL operating conditions. The use of a three-axis STOL flight director, a pitch stability augmentation system, and a direct-lift control device were also examined. This undertaking represents the third in a series of STOL simulation studies, the first two of which were

devoted to lateral and directional characteristics. Results of this study indicate that acceptable levels of certain longitudinal characteristics are functions of the piloting technique used for flight-path and speed control, and although pilots tend to adapt well to a wide variety of configurations, they still have definite control preferences based on their flight experience. Author

N73-28984# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: EASTERN AIRLINES, INCORPORATED, L-1011, N310EA, MIAMI, FLORIDA, 29 DECEMBER 1972

14 Jun. 1973 46 p refs

(NTSB-AAR-73-14) Avail: NTIS HC \$4.50

An aircraft accident involving the crash of a Lockheed L-1011 aircraft near Miami, Florida on 29 December, 1972 is reported. Following a missed approach, because of suspected nose gear malfunction, the aircraft climbed to 2,000 feet while the trouble was investigated. During the investigation the aircraft was allowed to descend until impact with the ground occurred. The cause of the accident was the preoccupation of the crew with the malfunction and failure to observe the dangerous flight situation. Author

N73-28985# Cranfield Inst. of Technology (England). Centre for Transport Studies.

AN APPRAISAL OF THE RIGID AIRSHIP IN THE UK FREIGHT MARKET Final Report

S. Coughlin Mar. 1973 108 p refs Sponsored by Sci. Res. Council

(Cranfield-CTS-3) Avail: NTIS HC \$7.50

The use of rigid airships for commercial freight operations in the United Kingdom was studied. The subjects discussed are: (1) capabilities of the airships, (2) economic aspects of freight market, (3) typical design specifications, (4) cost effectiveness, and (5) possible application to international trade. The supporting data are presented in the form of tables and graphs. Mathematical models are developed to show the relationship of the various parameters. Author

N73-28986# Northern Research and Engineering Corp., Cambridge, Mass.

ASSESSMENT OF AIRCRAFT EMISSION CONTROL TECHNOLOGY

E. K. Bastrass, R. C. Baker, C. F. Robertson, R. D. Siegel, and G. E. Smith Sep. 1971 206 p refs

(Contract EPA-68-OH-0011)

(NREC-1168-1) Avail: NTIS HC \$12.50

Investigations to provide information necessary for establishing standards on emissions from aircraft were conducted. The information is required on control methods in order to establish the levels to which is feasible to reduce aircraft emissions. Four categories of information are provided: (1) methods for controlling emissions from aircraft activities, (2) instrumentation for measuring aircraft emissions, (3) rates of emission of various pollutants at airports from aircraft activities, and (4) impact of emissions from aircraft activities in airport vicinities. The methodology for conducting the investigation is described. Recommendations for controlling various types of emissions are submitted. Author

N73-28987*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

FORE AND AFT ELASTIC RESPONSE CHARACTERISTICS OF SIZE 34X9.9, TYPE 7, 14 PLY-RATED AIRCRAFT TIRES OF BIAS PLY, BIAS BELTED, AND RADIAL BELTED DESIGN M.S. Thesis - George Washington Univ., Washington, D. C. John Albert Tanner 6 May 1973 65 p refs

(NASA-TM-X-69570) Avail: NTIS HC \$5.25 CSCL 01C

An investigation was conducted to determine the fore-and-aft elastic response characteristics of aircraft tires of bias ply, bias-belted, and radial-belted design. The investigation consisted of: (1) static and rolling tests, (2) a statistical analysis which related the measured tire elastic characteristics to variations in the

vertical load, inflation pressure, braking force and/or tire vertical deflection, and (3) a semi-empirical analysis which related the tire elastic behavior to measured wheel slippage during a steady-state braking. The results of this investigation indicate that the bias-belted tire has the largest spring constant value for most loading conditions and the radial-belted tire has the smallest spring constant value. Author

N73-28983*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
NUMERICAL SOLUTION OF EQUATIONS GOVERNING LONGITUDINAL SUSPENSION LINE WAVE MOTION DURING THE PARACHUTE UNFURLING PROCESS Ph.D. Thesis - George Washington Univ., Washington, D. C. Lamont Rozelle Poole May 1973 64 p refs (NASA-TM-X-69498) Avail: NTIS HC \$5.25 CSCL 01B

Equations are presented which govern the dynamics of the lines-first parachute unfurling process, including wave motion in the parachute suspension lines. Techniques are developed for obtaining numerical solutions to the governing equations. Histories of tension at test data, and generally good agreement is observed. Errors in computed results are attributed to several areas of uncertainty, the most significant being a poorly defined boundary condition on the wave motion at the vehicle-suspension line boundary. Author

N73-28989*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.
INVESTIGATION OF COAXIAL JET NOISE AND INLET CHOKING USING AN F-111A AIRPLANE Terrill W. Putnam Washington Aug. 1973 32 p refs (NASA-TN-D-7376; H-685) Avail: NTIS HC \$3.00 CSCL 01C

Measurements of engine noise generated by an F-111A airplane positioned on a thrustmeasuring platform were made at angles of 0 deg to 160 deg from the aircraft heading. Sound power levels, power spectra, and directivity patterns are presented for jet exit velocities between 260 feet per second and 2400 feet per second. The test results indicate that the total acoustic power was proportional to the eighth power of the core jet velocity for core exhaust velocities greater than 300 meters per second (985 feet per second) and that little or no mixing of the core and fan streams occurred. The maximum sideline noise was most accurately predicted by using the average jet velocity for velocities above 300 meters per second (985 feet per second). The acoustic power spectrum was essentially the same for the single jet flow of afterburner operation and the coaxial flow of the nonafterburning condition. By varying the inlet geometry and cowl position, reductions in the sound pressure level of the blade passing frequency on the order of 15 decibels to 25 decibels were observed for inlet Mach numbers of 0.8 to 0.9. Author

N73-28980*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
COMPUTER SIMULATION OF AIRCRAFT MOTIONS AND PROPULSION SYSTEM DYNAMICS FOR THE YF-12 AIRCRAFT AT SUPERSONIC CRUISE CONDITIONS Stuart C. Brown Aug. 1973 65 p refs (NASA-TM-X-62245; A-4840) Avail: NTIS HC \$5.25 CSCL 01C

A computer simulation of the YF-12 aircraft motions and propulsion system dynamics is presented. The propulsion system was represented in sufficient detail so that interactions between aircraft motions and the propulsion system dynamics could be investigated. Six degree-of-freedom aircraft motions together with the three-axis stability augmentation system were represented. The mixed compression inlets and their controls were represented in the started mode for a range of flow conditions up to the inlet unstart boundary. Effects of inlet moving geometry on aircraft forces and movements as well as effects of aircraft motions on the inlet behavior were simulated. The engines, which are straight subjects, were represented in the afterburning mode, with effects of changes in aircraft flight conditions included. The simulation was capable of operating in real time. Author

N73-28991*# Technology, Inc., Dayton, Ohio.
MECHANICAL STRAIN GAGE AND VGH DATA COLLECTION PROGRAM ON F-5A/B AIRCRAFT AT WILLIAMS AFB Final Report, Oct. 1970 - Oct. 1972 James A. Strohn, Daniel O. Tipps, and Curtis A. Jackson Oct. 1972 200 p refs (Contract F33657-70-C-1161)

(AD-760567; ASD-TR-72-52) Avail: NTIS CSCL 01/3

To collect a substantial amount of VGH and stress data from current F-5 tactical training missions in a timely and economical manner, a combination of mechanical strain gages and oscillograph recorders were selected for this program. The data results will be used by Northrop to update service life estimates for F-5A/B series aircraft. Five F-5A and five F-5B aircraft at Williams AFB, Arizona, were each initially equipped with a 3-inch mechanical strain gage, and one aircraft in each group was further equipped with a VGH recording system and electrical strain gages. Later in a reliability study each of these aircraft was also equipped with a 6-inch mechanical strain gage. (Modified author abstract) GRA

N73-28992*# Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.
NAVY DIGITAL FLIGHT CONTROL SYSTEM DEVELOPMENT Final Report, 1 Sep. 1971 - 30 Sep. 1972 M. S. Borow, R. O. Gaabo, R. C. Hendrick, A. F. Konar, T. G. Lahn, D. L. Markusen, F. L. Smith, H. G. Schmitz, and D. J. Sowada Dec. 1972 444 p refs (Contract N62269-72-C-0141) (AD-762521; HONEYWELL-21857-FR) Avail: NTIS CSCL 01/3

A 12-month engineering study was conducted to define a digital flight control system capable of performing pilot-assist (augmentation) and pilot-relief (autopilot) functions. Basic control laws were synthesized and analyzed to satisfy current and projected requirements for high-performance naval aircraft. Software analysis procedures were applied to determine sample rates, word lengths, and memory capacity. A redundancy and monitoring approach was identified to further assess computer characteristics. Implementation options in areas of processor structure, input/output, and instruction repertoire were resolved. Representative portions of the overall flight control system were programmed on a small airborne computer (HDC-201) and verified by open- and closed-loop testing in conjunction with an analog simulation of the aircraft. A partial system specification was prepared reflecting overall study results. (Modified author abstract) GRA

N73-28993*# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
FLIGHT TEST EVALUATION OF FOLDING SIDEWALL EXPANDABLE TIRES ON THE C-131B AIRCRAFT Technical Report, 17 Mar. 1970 - 13 Oct. 1971 Larry A. Roberts and Paul M. Wagner Jan. 1973 147 p refs (AF Proj. 1396) (AD-762730; ASD-TR-73-1) Avail: NTIS CSCL 01/3

A C-131B aircraft was equipped with modified, instrumented main landing gear assemblies, and type III (low pressure), folding sidewall, 38.5/28 x 13.0-16 aircraft tires were mounted on the main landing gear wheels. Takeoffs, landings and taxi runs were made at four different aircraft weights and at both 35% and 50% tire deflection. Braking intensity varied from light to heavy both with and without reverse pitch. The test aircraft was equipped with an inflation/deflation system and the tires were deflated each time the landing gear was retracted and inflated each time it was extended. The tires could normally be deflated and folded within 15 seconds and reinflated within 10 seconds. Two rollouts were made with the test tires flat and the tires demonstrated excellent runflat capability at ground speeds of up to approximately 100 knots. Directional control was good and no damage to the aircraft or to the landing gear was sustained. (Modified author abstract) GRA

N73-28994# Naval Air Development Center, Warminster, Pa.
Air Vehicle Technology Dept.

**INVESTIGATION OF THE T-34B NOSE GEAR RETRACTION
LINKAGE LOADS Final Report**

Robert J. Mcavoy 19 Jan. 1973 17 p
(AD-762729; NADC-73014-30) Avail: NTIS CSCL 01/3

The T-34 nose gear retraction system was instrumented to determine the loads in the system during cycling of the nose landing gear. The results of the investigation showed which mechanical adjustments are critical and which parts should be replaced. Author (GRA)

N73-28995# Air Force Academy, Colo.
**SOME DESCRIPTIVE STATISTICS ON SIX YEARS OF FIELD
MAINTENANCE AND OPERATIONAL DATA ON THE F4
AIRCRAFT WITH IMPLICATIONS FOR IRAN INTERVALS
Final Report**

Charles R. Mitchell Apr. 1973 100 p refs
(AD-762747; USAFA-RR-73-1) Avail: NTIS CSCL 01/3

Six years of field maintenance and operational data were examined on various selected models of the F4. The data were investigated relative to IRAN interval variations and base location history, and in terms of each previously performed IRAN. Certain statistically significant, but weak, relationships were discovered to describe field maintenance and/or operational variables in terms of months from last IRAN. The original intent was to use any defined relationships in a cost model to provide management information on an optimal IRAN interval; however, development of a cost model would duplicate the work of another study which is presently being conducted. The report also includes numerous statistics on field maintenance which should interest aircraft weapon systems management personnel. (Modified author abstract) GRA

N73-28996# General Dynamics/Fort Worth, Tex. Convair
Aerospace Div.

**DESIGN, DEVELOPMENT, AND FLIGHT TEST OF MULTI-
PLEXING HARDWARE FOR USE IN A FLY-BY-WIRE FLIGHT
CONTROL SYSTEM. Final Report, 5 Apr. 1971 - 5 May
1973**

Jerry G. Mrazek and Richard O. Roberts Apr. 1973 111 p
(Contract F33615-71-C-1147; AF Proj. 8225)
(AD-763111; FZE-1260; AFFDL-TR-73-43) Avail: NTIS CSCL
01/3

The report contains a description of the design, development, airworthiness testing and flight test of multiplexing hardware for use in a fly-by-wire flight control system. The multiplexing concept employed makes use of By-phase Manchester baseband modulation of pulse coded digital data. Each analog value to be transmitted is converted to a digital format serially and transmitted over a twisted-shielded-pair cable. A party line transmission concept was employed to permit two transmitters to share the same transmission line. The air-worthy equipment was used to transmit signals in the fly-by-wire flight control system of the Total In-Flight Simulator (TIFS) aircraft. (Modified author abstract) GRA

N73-28997# Air Force Weapons Lab., Kirtland AFB, N.Mex.
**THE BIRD-AIRCRAFT STRIKE HAZARD IN THE CANAL
ZONE Technical Report, 18 Oct. 1971 - 7 Nov. 1972**

Robert C. Beason Jun. 1973 28 p refs
(AF Proj. 683M)
(AD-763112; AFWL-TR-73-16) Avail: NTIS CSCL 01/3

A serious bird-aircraft strike hazard exists within the Canal Zone and the Republic of Panama. Even though Panama has a very large resident bird population, a dramatic increase occurs during the migration period when transients cross between the North and South American Continents. The greatest hazards result from large aggregations of vultures and hawks migrating, and the soaring of these migrants in thermals and updrafts. There is no effective method known for dispersing either raptor concentrations or the thermals. Therefore, control recommendations are to maintain the airfield in a manner that is undesirable to the birds and to schedule flying missions when the raptors will not be active. Author (GRA)

N73-28998# Air Force Flight Dynamics Lab., Wright-Patterson
AFB, Ohio.

**EXAMINATION OF THE VOICE COMMAND CONCEPT FOR
APPLICATION TO AIR FORCE COCKPITS**

John M. Reising 5 Feb. 1973 61 p refs
(AF Proj. 6190)
(AD-762922; AFFDL-TR-72-108) Avail: NTIS CSCL 01/3

Voice command holds potential for off-loading many manual switching tasks from the pilot. The report surveys the state-of-the-art in voice command, discusses cockpit applications, and identifies primary manufacturers/government agencies doing research. Such factors as the functional specifications of an airborne voice command system and concern for the pilot in relation to voice command are stressed. An analysis of the overall situation leads to the conclusion that voice command is on the threshold of application into cockpits, given that certain restrictions are acceptable. Author (GRA)

N73-28999# Air Force Aero Propulsion Lab., Wright-Patterson
AFB, Ohio.

**DEVELOPMENT OF FEASIBILITY DEMONSTRATION
HARDWARE FOR AN INTEGRATED FIRE AND OVERHEAT
DETECTION SYSTEM Final Report, Jun. 1970 - Dec. 1971**

Duane G. Fox May 1973 41 p refs
(AD-762919; AFAPL-TR-72-105) Avail: NTIS CSCL 01/3

The report summarizes the results of an in-house effort to develop and demonstrate the feasibility of an integrated fire and overheat detection system for an aircraft engine nacelle. The integrated system was conceived in 1965 as a means of decreasing the number of nondetected engine nacelle fires and the incidence of false fire warnings on operational Air Force aircraft. Analysis of the reported engine nacelle fires and fire warnings shows that approximately 50% of the fires were not detected by the fire or overheat detection system during the six-year period 1965-1970, and 83% of the fire and overheat warnings were false. Two integrated systems were developed to demonstrate total system feasibility, and these systems were further evaluated on flight test aircraft. The report presents the results of this evaluation. (Modified author abstract) GRA

N73-29000# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Flight
Research Dept.

**A PRELIMINARY ANALYSIS ON THE PILOT-STOL AIR-
CRAFT SYSTEM IN LANDING APPROACH**

Robert T. N. Chen 11 Feb. 1972 31 p refs
(Contract F33615-71-C-1722)
(AD-762566; CAL-VTOL-HQ-TM-30) Avail: NTIS CSCL 01/2

The modal structure was first examined to gain insight into the dynamics of the basic STOL aircraft in landing approach. The basic STOL airframe together with the control aspect of the pilot activities was then briefly analyzed, including a brief treatment of the thrust-control inner loop. The guidance aspect was then briefly examined and formulae for generating coordinated control commands derived. Recommended further work was described to complete the study. Author (GRA)

N73-29002# Dayton Univ., Ohio. Research Inst.
**SIMULATED LOADINGS OF THE MEDIUM STOL TRANS-
PORT AIRCRAFT Technical Report, Jul. 1972 - May 1973**

Robert P. Boehmer May 1973 107 p
(Contract F33615-73-C-4011)
(AD-762918; UDRI-TR-73-26; ASD/XRO-73-4) Avail: NTIS
CSCL 15/5

The report contains the results of a computer-simulated loading of an Army Brigade in each of five medium STOL transport aircraft cargo compartment designs. The computer program utilized a CONARC (COMPASS H-Series) unit movement data listing for a Separate Infantry Brigade to select the loadable items for the cargo compartment design being considered. The number of sorties required for the loadable items and the utilization factors of floor area and weight are averaged for the sorties. Author (GRA)

N73-29014# George Washington Univ., Washington, D.C.
PERFORMANCE EVALUATION OF ENERGY SEPARATORS
 Final Report, 1 Sep. 1971 - 31 Mar. 1973

Joseph V. Foa Mar. 1973 26 p refs
 (Contract N00019-72-C-0122)
 (AD-762590; TR-ES-726) Avail: NTIS CSCL 13/1

A study was conducted of the potential merits of a new kind of energy separator for aircraft environment control applications. The new energy separator is considerably smaller and more efficient than the Ranque-Hilsch vortex tube, in that its operation is based on the utilization of interface pressure, rather than viscous, forces. It is also much smaller and lighter, for any given refrigeration capacity, than conventional refrigeration turbomachines, and has the added advantage of not requiring an external heat sink, thus eliminating one of the major problems of environment control in high-speed aircraft. GRA

N73-29015# George Washington Univ., Washington, D.C.
PRELIMINARY DESIGN OF A FOA CRYPTOSTEADY ENERGY SEPARATOR FOR USE IN SUPERSONIC AIRCRAFT

David Sobel and Arshad Nawaz Sep. 1972 59 p refs
 (Contract N00019-72-C-0122)
 (AD-762579; TR-ES-724) Avail: NTIS CSCL 13/1

The report deals with the design of a Foa Energy Separator for use in a supersonic aircraft, the LTV F-8U Crusader. Calculations are carried out to obtain a range of exit nozzle area ratios compatible with a variety of operating conditions. The effects of variations of the peripheral rotor velocity and discharge pressures on both the hot and cold outputs are analyzed. The potential merit of using a heat exchanger in conjunction with the separator, or of using ram air rather than bleed air, is also discussed. (Modified author abstract) GRA

N73-29094# National Aviation Facilities Experimental Center, Atlantic City, N.J.

TECHNICAL EVALUATION OF WEATHER CLUTTER FEASIBILITY MODEL Interim Report, Jun. 1970 - Feb. 1972

Ronald S. Bassford Aug. 1973 63 p refs
 (FAA-NA-73-48) Avail: NTIS HC \$5.25

An ASR-5 weather clutter feasibility model was developed and evaluated to determine its capability to provide air traffic controllers with a weather display (clutter free) of air traffic and a contour depiction of weather detected by radar. The technical tests included the determination of technical characteristics of each of four modifications (narrow transmitter pulse width, noncoherent moving target indicator, dual frequency diversity, and logarithmic/fast time constant) which comprised the weather rejection portion of the system along with their capabilities to provide clutter rejection and target detection in weather. The four modifications were then tested in unison to determine the system's overall capability. The weather channel portion of the equipment was tested to determine its capability to provide weather clutter formatting in the form of isoamplitude contours. The results of the test demonstrated that the weather clutter feasibility model does not effectively perform the designed functions of weather clutter rejection and weather clutter contouring. Its capability to provide weather clutter contouring ranges from good for high-level well-defined weather cells to poor for low-level scattered cells. The equipment is not acceptable for use in the air traffic control system. Author

N73-29102# Royal Aircraft Establishment, Farnborough (England).

MEASUREMENTS ON HIGH AND LOW GAIN L-BAND AIRCRAFT AERIALS USING TRANSMISSIONS FROM A HIGH ALTITUDE BALLOON

W. T. Blackburn and M. J. Sidford Mar. 1973 43 p refs
 (RAE-TR-73008) Avail: NTIS HC \$4.25

An account is given of the flying trails with the Hastings aircraft. The purpose of the trails was primarily to check the performance of the electronically steered L-band aerial using transmissions from the ESRO transponder carried in a stratospheric balloon. At the same time, measurements were made

on an experimental slot-dipole aerial. Results on the narrow beam aerial showed little disturbance due to ground and airframe reflections; fluctuations between four and eight db were recorded for the wider beam slot-dipole aerial. Author

N73-29139# National Aviation Facilities Experimental Center, Atlantic City, N.J.

CAPABILITIES, NECESSARY CHARACTERISTICS AND EFFECTIVENESS OF PILOT GROUND TRAINERS. PHASE 2: VISUAL REFERENCE FLIGHT MANEUVERS Final Report, Dec. 1971 - Jan. 1973

Robert J. Ontiveros Aug. 1973 53 p refs
 (FAA-NA-73-15) Avail: NTIS HC \$4.25

The establishment of guidelines for the development of standards to determine the acceptability of pilot ground trainers was conducted. The pilot ground trainers are used as primary pilot training devices in place of flight instruction in an aircraft. The subjects discussed are: (1) presolo flight maneuvers, (2) criteria for ground trainer assessment, (3) pilot ground trainer maneuvers and procedures, and (4) ground training and aircraft maneuver performance trials. Author

N73-29141# California Univ., Berkeley, Institute of Transportation and Traffic Engineering.

HISTORICAL SUMMARY OF ACTIVITIES IN THE U-FAA FOR CHAMBER UNDER CONTRACT ARDS-434 Final Report 1962 - 1971

Don O. Horning and D. M. Finch Aug. 1971 45 p
 (Contract FAA-ARDS-434)

(FAA-RD-71-94) Avail: NTIS HC \$4.25

A historical summary of the activities and abstracts of reports developed by use of the UC-FAA Chamber are presented. The 1000 ft long building which constitutes the chamber is described in detail. The 10th scale runway lighting system and its control are described. The fog producing system is explained as well as the means for uniform fog density control. Information on basic instrumentation is included. Author

N73-29146# ARO, Inc., Arnold Air Force Station, Tenn.

A METHOD TO INCREASE THE FULL-SCALE INLET/ENGINE SYSTEM TESTING CAPABILITY OF THE AEDC 16 FOOT TRANSONIC WIND TUNNEL Final Report, Jan. 1971 - Jul. 1972

R. L. Palko AEDC Jun. 1973 137 p refs

(AD-762912; ARO-PWT-TR-72-121; AEDC-TR-73-9) Avail: NTIS CSCL 21/5

A study was conducted of a new testing technique using flow shaping that together with some modifications of the AEDC 16-ft Transonic Propulsion Wind Tunnel will provide the capability to test full-scale inlet/engine configurations with forebody effects at high maneuvering angles at transonic velocities. The method used to obtain the flow simulation for high maneuvering angles utilized auxiliary flow shaping and geometric pitch. An analytical potential flow method was used to determine the configuration of devices necessary to produce the required flow fields, these devices were then checked experimentally to verify the results. (Modified author abstract) GRA

N73-29147# Mitre Corp., McLean, Va.

A PRELIMINARY REQUIREMENTS ANALYSIS FOR AIRPORT SURFACE TRAFFIC CONTROL Interim Report, Apr. 1972 - Jan. 1973

G. Baran, R. A. Bales, J. F. Koetsch, and R. E. LeVan Jan. 1973 182 p refs

(Contract DOT-TSC-378)

(AD-762442; MTR-6273; FAA-RD-73-6) Avail: NTIS CSCL 01/5

The report summarizes the results of a preliminary ASTC (Airport Surface Traffic Control) requirements analysis. The study concentrated on the analysis of the ASTC requirements at three airports (Boston-Logan, Los Angeles and Chicago O'Hare) to obtain baseline data, and extrapolated these results to an additional six airports (Seattle-Tacoma, Bradley, Cleveland, Detroit, Pittsburgh and Philadelphia) using data-of-record and the results

of the baseline airport analysis. The results of the study indicate a need for immediate improvement of the ASTC system in the 1970-1980 period at the baseline airports, with the need for improvements during peak periods at the Chicago O'Hare Airport under all visibility conditions, and at Boston and Los Angeles in poor visibility conditions. A preliminary evaluation of the value of potential ASTC improvements indicates that surveillance improvement, coupled with procedural changes, would result in the greatest capability increase. This is followed, in terms of potential payoff, by automation of the conflict-resolution function. GRA

N73-29148# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

INSTALLATION OF XM19 AIRFIELD LANDING MAT AND ANCILLARY ITEMS. APPENDIX B: PLACEMENT OF XM19 SPECIAL SURFACING LANDING MAT

G. L. Carr Jun. 1973 13 p
(AD-762137; AEWES-Instruct-S-69-4-App-B) Avail: NTIS CSCL 01/5

The Qualitative Materiel Requirement (QMR) for prefabricated airfield surfacing specifies that medium-duty landing mat must sustain two aircraft arresting hook impacts in the same spot without structural failure due to rupture of the top surface of the mat. Also, this type of mat must withstand 20 roll-overs of an F-4C aircraft loading on the 1-inch diameter hook-arresting cable without structural failure due to rupture of the top surface of the mat. XM19 special surfacing landing mat was developed for use in the critical areas of runways where these types of operations occur. The XM19 special surfacing was initially designed with connectors identical with those on the standard XM19 mat. The purpose of the appendix is to furnish installation instructions for placement of the XM19 special surfacing mat when the mats are placed in conjunction with standard XM19 mat. GRA

N73-29149# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

EVALUATION OF STRUCTURAL LAYERS IN FLEXIBLE PAVEMENT Final Report

Robert W. Grau May 1973 139 p refs
(AD-762131; AEWES-Misc-Paper-S-73-26) Avail: NTIS CSCL 01/5

The investigation was conducted to evaluate the effectiveness of stabilized structural layers (lime and cement-stabilized layers) in pavement performance and to determine the comparative performance between a full-depth high-quality crushed stone and the stabilized layers during simulated aircraft traffic. The comparative performance between the stabilized layers and similar pavements consisting of unbound granular base and subbase materials previously tested in the Multiple Wheel Heavy Gear Load (MWHGL) test section was also determined. A test section was constructed within two items of the existing MWHGL test section at the U. S. Army Engineer Waterways Experiment Station in order to use the existing 4-CBR clay subgrade. GRA

N73-29150# Naval Civil Engineering Lab., Port Hueneme, Calif.

PRELIMINARY ANALYSES OF POSSIBLE FACTORS ASSOCIATED WITH ASPHALTIC CONCRETE AIRFIELD PAVEMENT DEFECTS

Hisao Tomita Apr. 1973 32 p refs
(YF38534001)
(AD-762404; NCEL-TN-1271) Avail: NTIS CSCL 01/5

Aircraft traffic parameters, natural environment, and asphaltic concrete pavement properties and defect density values for 11 Naval and Marine Corps airfields were compiled for preliminary statistical analyses. The purpose of the analyses which involved correlation and regression was to determine what traffic, environment, and pavement factors were significantly associated with the various defects. Results of the analyses indicated that most of the factors are not significantly associated with pavement defects. Many of the factors appeared to be related to pavement defects in a manner opposite to what is considered logical from a physical or engineering standpoint. (Modified author abstract) GRA

N73-29182# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COMPUTER PROGRAMS FOR CALCULATING POTENTIAL FLOW IN PROPELLSION SYSTEM INLETS

Norbert O. Stockman and Susan L. Button [1973] 224 p
(NASA-TM-X-88278) Avail: NTIS HC \$13.25 CSCL 20D

In the course of designing inlets, particularly for VTOL and STOL propulsion systems, a calculational procedure utilizing three computer programs evolved. The chief program is the Douglas axisymmetric potential flow program called EOD which calculates the incompressible potential flow about arbitrary axisymmetric bodies. The other two programs, original with Lewis, are called SCIRCL AND COMBYN. Program SCIRCL generates input for EOD from various specified analytic shapes for the inlet components. Program COMBYN takes basic solutions output by EOD and combines them into solutions of interest, and applies a compressibility correction. Author

N73-29183# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

VELOCITY DECAY AND ACOUSTIC CHARACTERISTICS OF VARIOUS NOZZLE GEOMETRIES WITH FORWARD VELOCITY

U. VonGlahn, D. Groesbeck, and J. Goodykoontz 1973 42 p refs Presented at 6th Fluid and Plasma Dyn. Conf., Palm Springs, Calif., 16-18 Jul. 1973, sponsored by AIAA
(NASA-TM-X-68259; E-7547) Avail: NTIS HC \$4.25 CSCL 20D

Utilizing a static test stand, 6- by 9-foot wind tunnel and 13-inch circular free jet, aerodynamic and acoustic data were obtained with a convergent circular nozzle, bypass nozzle, 6-tube mixer nozzle, and velocity decay surveys with and without forward velocity. The acoustic data include total sound power, directivity and frequency spectra obtained statically and with forward velocity. The relation of aerodynamic and acoustic measurements statically and in forward flight for the various nozzle configurations are discussed. Author

N73-29191# ARO, Inc., Arnold Air Force Station, Tenn.

APPLICATION OF THE VORTEX-LATTICE METHOD TO REPRESENT A JET EXHAUSTING FROM A FLAT PLATE INTO A CROSSFLOWING STREAM Final Report, 1 Jul. 1970 - 30 Jun. 1971

F. L. Heitsley and R. L. Parker, Jr. AEDC Jun. 1973 73 p refs
(AD-762502; AEDC-TR-73-57; ARO-OMD-TR-72-173) Avail: NTIS CSCL 20/4

A study was conducted to develop a mathematical model of a jet exhausting from a flat plate into a crossflowing stream. The modeling was accomplished using the vortex-lattice method. Analytical streamlines and pressure distributions on the flat-plate surface as well as vector data in the field above the plate are compared with available experimental data. Recommendations are made for further improvement of vortex-lattice jet-modeling techniques. Author (GRA)

N73-29446# Instrument Flight Center, Randolph AFB, Tex.

EVALUATION OF THE BENDIX AAU 19A/A AIMS ALTIMETER Technical Report, Oct. 1972 - Feb. 1973

Manuel H. Tapia Feb. 1973 14 p refs
(AD-762523; IFC-TR-73-2) Avail: NTIS CSCL 01/4

The Bendix AAU 19A/A altimeter is a standard 3 inch counter-drum-pointer altimeter which provides two modes of operation -- servoed (reset) mode and standby mode. In the servoed mode, the altimeter is an electronic repeater of the information received from the CPU-46A altitude computer. The information received by the altimeter has been corrected by the computer for static system error. In the standby mode, the altimeter operates as a normal barometric pressure altimeter. The pilot can select the mode of operation desired by use of the Reset/Stby switch located on the lower right corner of the instrument case. GRA

N73-29455# Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).

ULTRASONIC INSPECTION OF WING SPAR ATTACHMENTS - TOP AND BOTTOM BOOM JOINTS AND LUGS
L. X. Nepomuceno 13 Nov. 1972 10 p
(TR-7211,621) Avail: NTIS HC \$3.00

Ultrasonic inspection procedures for examining the wing spar attachments on a Viscount aircraft are presented. Procedures are applied primarily to the top and bottom boom joints and lugs. Author

N73-29463# AiResearch Mfg. Co., Phoenix, Ariz.
SMALL, HIGH-PRESSURE RATIO COMPRESSOR MECHANICAL ACCEPTANCE TEST, VOLUME 2
G. R. Metty and W. I. Shoup Jun. 1973 99 p 2 Vol.
(Contract NAS3-14306)
(NASA-CR-121193; APS-5404-R-vol-2) Avail: NTIS HC \$7.00 CSCL 131

The fabrication and mechanical testing of the high-pressure-ratio compressor are reported. Mechanical testing was performed to demonstrate overspeed capability, adequate rotor dynamics, electrical isolation of the gas bearing trunnion mounted diffuser and shroud and the effect of operating parameters (speed and pressure ratio) on clearance of the compressor test rig. The speed range covered was 20 to 120 percent of rated speed (80,000 rpm). Following these tests an acceptance test which consisted of a 6 hour run at 80,000 rpm was made with approximately design impeller to shroud clearances. Author

N73-29673# Federal Aviation Administration, Washington, D.C. Weather and Flight Service Station Branch.
STATISTICAL ANALYSIS OF METEOROLOGICAL PARAMETERS DURING FOG AT 45 US AIRPORTS Final Report
John K. Marut, Edward VanDuyne, Frank V. Melewicz, Kenneth A. Kraus, and Frank G. Coons May 1972 264 p
(FAA-RD-72-39) Avail: NTIS HC \$15.25

Pertinent climatological data are analyzed for fog conditions (prevailing visibility 1/2 mile and less without precipitation) at 45 U.S. airports for the ten year period 1956-1965. These data are considered essential for use in the design of systems to disperse and/or prevent fog at airports. Tables and statistical values are included for: wind speed vs frequency, wind direction vs frequency, wind direction vs wind speed, visibility vs frequency, temperature vs frequency and cumulative totals for all airports. An additional analysis is included for fog at temperatures less than 33 F. to include wind direction vs frequency, wind direction vs wind speed, wind rose data and temperature vs frequency. Monthly fog frequencies are stated for both cold and warm fog. Author

N73-29690# United Aircraft Corp., East Hartford, Conn.
ANALYSIS OF JET ENGINE TEST CELL POLLUTION ABATEMENT METHODS Technical Report, 21 Feb. 1972 - 21 Feb. 1973
F. L. Robson, A. S. Kesten, and R. D. Lessard Kirtland AFB, N. Max. AFWL May 1973 231 p refs
(Contract F29601-72-C-0049; AF Proj. 683M)
(AD-763119; AFWL-TR-73-18) Avail: NTIS CSCL 13/2

In order to ascertain what methods of effluent treatment would be applicable to jet engine test cells, a study was undertaken to assess current and projected exhaust gas treatment technology and to establish that technology which results in the most effective cleanup per dollar. Emission factor data for the most prevalent Air Force engines were gathered to determine what levels of pollutants were to be dealt with. A theoretical model of a test cell augmentor tube with liquid injection was developed to aid in estimating total system flow rates as a function of engine operating parameters. The Air Force test cell emission reduction program can be characterized as having three goals which are discussed. The first or immediate goal is one of reducing visible emissions. The second or near-term goal involves meeting particulate mass criteria such as might be promulgated by the Environmental Protection Agency. The third or future goal would

be concerned with meeting the mass emission regulations for NOx. (Modified author abstract) GRA

N73-29699# Environmental Technical Applications Center (Air Force), Washington, D.C.
SHORT-RANGE WEATHER FORECASTING: RECENT DEVELOPMENTS IN AIR WEATHER SERVICE, SUGGESTED TECHNIQUES

Robert E. Clark May 1973 30 p refs
(AD-762938; USAFETAC-TN-73-5) Avail: NTIS CSCL 05/2
The report examines the capabilities of Air Weather Service detachments as concerns short-range terminal forecasting. Techniques are suggested for furthering the accuracy of these forecasts and a case study using the suggested techniques is presented as guidance for the forecaster in the field. An AWS Test Form No. 52 is discussed and its practical applications are indicated. Author (GRA)

N73-29703# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATC SURVEILLANCE/COMMUNICATION ANALYSIS AND PLANNING Quarterly Technical Summary, 1 Mar. - 31 May 1973

1 Jun. 1973 14 p
(Contract DOT-FA72WAI-242)
(FAA-RD-73-100) Avail: NTIS HC \$3.00
FAA-funded ATC Surveillance/Communication Analysis and Planning activities during the period 1 March 1973 to 31 May 1973 are reported. During this period, work was limited to Task B: ASR improvement Program. The Phase 1 hardware and software are described. During this phase, a general-purpose Fast Digital Processor (FDP) will be used to process a limited sector of ASR coverage using filtering techniques to be built into hardware during Phase 2. Author

N73-29705# National Aviation Facilities Experimental Center, Atlantic City, N.J.
DETECTION OF SMALL AIRCRAFT BY A TERMINAL RADAR PROCESSOR Interim Report, Mar. 1973
Marvin Holtz Aug. 1973 15 p
(FAA-NA-73-50; FAA-RD-73-106) Avail: NTIS HC \$3.00

The test methods employed and the results obtained for tests conducted to determine detection of small aircraft by a terminal radar processor are discussed. Flight tests consisting of radials, over-the-station passes, and orbits were conducted with various aircraft. The radar returns from each of the aircraft were processed by the Radar Video Processor and the percent of detection as a function of range and altitude was obtained. Author

N73-29706# Mitre Corp., McLean, Va.
EXTRAPOLATED METHODOLOGY USED IN THE LOS ANGELES BASIN STANDARD TRAFFIC MODEL Final Report
Saul Cohen and Frank Maginnis Apr. 1973 17 p refs
(Contract DOT-FA70WA-2448)
(MTR-6386; FAA-RD-73-86) Avail: NTIS HC \$3.00

The Los Angeles Basin Standard Traffic Model is a computer model of the air traffic expected in the basin in 1982. This report explains the methodology used to project into the 1982 time frame a similar model of 1972 traffic. A technique known as time compression was used to make the projection. This report also defines the two types of models produced, the snapshot and scan-by-scan models, and it explains how the former was extracted from the latter. Author

N73-29707# California Univ., Berkeley, Institute of Transportation and Traffic Engineering.
FAA ALL WEATHER LANDING SIMULATION STUDIES DEVELOPMENT OF PILOT ORIENTATION FILM FOR LOW VISIBILITY LANDINGS Final Report

Don O. Horning and Alvah J. Miller May 1973 43 p
(Contract DOT-FA72WA-2698)
(FAA-RD-73-61) Avail: NTIS HC \$4.25

The development of a film suitable for pilot orientation in low visibility landings is reported. The degree of realism that could be obtained in the fog chamber was greatly heightened by modifications to the runway surface, providing 6 degrees of motion to the 35 mm camera on a programmable basis in order that aircraft flight trajectories could be matched from simulator to Fog Chamber, and improvement in the fog control system for uniform high and low density fogs. Techniques were developed to use existing aircraft training simulators to provide filmed instrumented approaches to be used as the basis for (1) The aircraft flight trajectory information, and (2) showing by visual means the actual aircraft performance under approach conditions as indicated by the instruments. Also described is the film library for the FAA of 72 fog chamber approaches matching the simulator approaches.

Author

N73-29709# IIT Research Inst., Chicago, Ill.
STUDY OF NOISE IN AIR ROUTE TRAFFIC CONTROL, CONTROL CENTER, FLIGHT SERVICE STATION, AIR TRAFFIC CONTROL TOWER AND REMOTE FACILITIES
Final Report, 18 May - 18 Nov. 1971

A. Semmelink and J. M. Clinch Dec. 1971 57 p refs
(Contract DOT-FA71WA-2587)
(FAA-RD-72-47) Avail: NTIS HC \$5.00

The development of a noise standard for permissible noise levels in FAA Air Traffic Control and Navigational Facilities is described. The contents of the report include noise definitions, theory of sound, sound measuring instrumentation, noise surveys, reference publications, and noise criteria. Criteria are given for noise environments which permit safe and satisfactory performance of tasks in the following facilities: (1) traffic control centers, including important communication areas, (2) air traffic control tower cabs, (3) flight service stations, and (4) remote facilities. Criteria for each of these facilities are described and justifications for the selection of noise criteria are given.

Author

N73-29709# Resalab, Inc., Dallas, Tex. Advanced Systems Dept.

LATERAL SEPARATION. VOLUME 2: STUDY APPROACH
Final Report, Jun. 1971 - Jul. 1972
Jul. 1972 565 p refs

(Contract DOT-FA71WA-2609; Proj. 142-177-031)
(FAA-RD-72-58-Vol-2) Avail: NTIS HC \$30.25

The Lateral Separation Study provides a means of establishing the feasibility of minimizing runway spacings for the purpose of increasing terminal instrument flight rules operational capacity. The data essential to the determination of minimum runway spacings are presented including probability of collision data, normal operating zone data, and blunder recovery data, and the techniques used to generate this data are developed. Probability density functions, which describe the location errors of aircraft operating under IFR conditions, were used to generate the probability of collision data and normal operating zone data. The Fokker-Planck equation was used to generate the lateral error probability density functions. Generation of the blunder recovery data was accomplished using a parametric variation on the pertinent system parameters.

Author

N73-29710# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.

VOR-TACAN LOW ALTITUDE FLIGHT CHECK SUMMARY
Final Report

Frank W. Bassett Jul. 1972 43 p
(FAA-RD-72-73) Avail: NTIS HC \$4.25

A summary of flight check data of VOR-TACAN facilities during the time period of 1961 thru 1969 is presented. The data shown are taken from bearing error curves contained in the flight inspection reports at the Flight Standards Service office in the Washington Headquarters. The mean and one sigma values were calculated from eight points.

Author

N73-29711# Mitre Corp., Ballays Crossroads, Va.
STATUS OF CATEGORY 3 IN EUROPE Final Report
Thomas L. Croswell Jun. 1972 88 p refs
(Contract DOT-FA70WA-2448)
(MTR-6211; FAA-RD-72-89) Avail: NTIS HC \$6.50

The status of civil airline implementation of all-weather landings, based on information collected during the visit of an FAA Team to Europe during the latter half of October 1971 is discussed. In France, Air Inter operates Caravelle aircraft with passengers to four airports in Category IIIa conditions with runway visual range as low as 150 meters and a 50-foot decision height. In the U.K., British European Airlines are implementing Category IIIa operations with Trident aircraft. Development details, operational procedures and equipment characteristics are described.

Author

N73-29712# Collins Radio Co., Cedar Rapids, Iowa.
EVALUATION OF EXISTING VOR, LOCALIZER, AND GLIDESLOPE RECEIVING EQUIPMENT, VOLUME 2, BOOK 1 Final Report

W. O. Ashby Feb. 1973 324 p
(Contract DOT-FA72WA-2772)
(Rept-523-0764695-00111M-Vol-2; FAA-RD-73-1-Vol-2-Bk-1)
Avail: NTIS HC \$18.25

An evaluation of VHF omnirange navigation, localizer, and glideslope receiving equipment were evaluated under various conditions of interference in a simulated environment. Approximately 61 types of receivers were tested representing all user groups. The objective of the test was to provide data on which to base geographic facility separations. The test plan and basic test results for each individual test are presented.

Author

N73-29713# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.
GROUND AND FLIGHT EXPERIENCE WITH A STRAPDOWN INERTIAL MEASURING UNIT AND A GENERAL PURPOSE AIRBORNE DIGITAL COMPUTER

Thomas D. Wolf and Robert C. McCracken Washington Aug. 1973 34 p refs
(NASA-TM-X-2848; H-735) Avail: NTIS HC \$3.00 CSCL 17G

Ground and flight tests were conducted to investigate the problems associated with using a strapdown inertial flight data system. The objectives of this investigation were to develop a three axis inertial attitude reference system, to evaluate a self-alignment technique, and to examine the problem of time-sharing a general purpose computer for the several tasks required of it. The performance of the strapdown platform/computer system that was developed was sufficiently accurate for the tasks attempted. For flights on the order of 45 minutes duration, attitude angle errors of + or -.035 radian (+ or -2 deg) in all axes were observed. Laboratory tests of the self-alignment technique gave accuracies of + or -.00075 radian in pitch and roll axes and + or -.00045 radian in the yaw axis. Self-alignment flight results were inconsistent, since a stable solution was not obtained on windy days because of aircraft rocking motions.

Author

N73-29721# Wyle Labs., Inc., El Segundo, Calif.
FAR FIELD NOISE GENERATION BY COAXIAL FLOW JET EXHAUSTS. VOLUME 1: DETAILED DISCUSSION Final Report, Mar. 1968 - Nov. 1971

Kenneth M. Eldred Nov. 1971 253 p refs
(Contract DOT-FA68WA-1889)

(FAA-RD-71-101-Vol-1) Avail: NTIS HC \$14.75

Model scale air jets were used in an anechoic room to conduct a parametric study on the sound produced by coaxial circular jets. The following parameters were varied: (1) primary nozzle Mach numbers (from 0.85 to 1.47); (2) primary flow total temperature (60 to 800 F); (3) ratio of secondary flow velocity to primary flow velocity (zero to sonic secondary velocity); (4) ratio of secondary nozzle area to primary nozzle area (zero to 10); and (5) axial position of primary nozzle relative to secondary velocity (+11 primary nozzle diameters). The results from these model tests were analyzed and scaled to give the overall sound power output, directivity indices the sideline sound

pressure spectra, and perceived noise levels for engine thrusts ranging from 10,000 pounds to 80,000 pounds. The results were used to determine the reduction in overall sound power and maximum sideline perceived noise level as a function of the ratio of the secondary nozzle area to primary nozzle area and the ratio of secondary velocity to primary velocity. Author

N73-29802# General Applied Science Labs., Inc., Westbury, N.Y.

THE EFFECTS OF ADDITIVES ON HIGH SPEED IGNITION AND COMBUSTION CHARACTERISTICS OF STORABLE FUELS

Stephen N. Schmotolocha and Raymond B. Edelman Dec. 1972
52 p refs
(Contract F44620-71-C-0014; AF Proj. 9711)
(AD-762615; GASL-TR-779; AFOSR-73-1082TR) Avail: NTIS
CSCL 21/4

The report describes studies performed on mixing, ignition and combustion of high density fuels. Ignition and combustion augmentation of slurries using magnesium and lithium fluoride, respectively, is included. Experiments were conducted in a direct connect constant area combustor supplied by Mach 2 airstream at a pressure level of about 1 atmosphere covering a stagnation airstream temperature range from about 600 to 1600K. The results indicate that the autoignition limit for the lithium impregnated boron slurry appears to be about 1500K. It was found that within the piloting regime the boron slurry with and without the lithium fluoride involves four characteristic zones: no ignition, initial flame, staged burning, and propagating flame zone. These studies substantiate that the lithium fluoride mechanism of combustion enhancement involves chemical removal of the boron oxide barrier, rather than having a direct thermal effect. (Modified author abstract) GRA

N73-29804# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

HYDROGEN CONTENT AS A MEASURE OF THE COMBUSTION PERFORMANCE OF HYDROCARBON FUELS

Charles R. Martel and Leonard C. Angello May 1973 51 p refs
(AD-763097; AFAPL-TR-72-103) Avail: NTIS CSCL 21/4

Previous work by various investigators has shown that the hydrogen content of a hydrocarbon jet fuel is the primary variable affecting the combustion performance of the fuel; i.e. the amount of heat radiated during the combustion of the fuel within the jet engine combustor. The results of statistical correlations of fuel data are presented wherein the hydrogen content of fuels is correlated with other fuel combustion measurements including smoke point, luminometer number, and net heat of combustion. Also, the hydrogen content of fuel is correlated with the specific gravity and aniline point measurements. The report concludes that the fuels' hydrogen content can be calculated with sufficient accuracy to eliminate the need for measuring smoke points, luminometer numbers, and net heat of combustion. For conventional jet fuels (JP-4, JP-5, JP-8, Jet A, Jet A-1, and Jet-B) a minimum allowable hydrogen content of 13.5% by weight is recommended. Author (GRA)

N73-29806# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

STEADY-STATE AND DYNAMIC PRESSURE PHENOMENA IN THE PROPULSION SYSTEM OF AN F-111A AIRPLANE

Frank W. Burcham, Donald L. Hughes, and Jon K. Holzman Washington Jul. 1973 99 p refs
(NASA-TN-D-7328; H-741) Avail: NTIS HC \$3.00 CSCL 21E

Flight tests were conducted with two F-111A airplanes to study the effects of steady-state and dynamic pressure phenomena on the propulsion system. Analysis of over 100 engine compressor stalls revealed that the stalls were caused by high levels of instantaneous distortion. In 73 percent of these stalls, the instantaneous circumferential distortion parameter, k sub theta, exhibited a peak just prior to stall higher than any previous

peak. The k sub theta parameter was a better indicator of stall than the distortion factor, k sub d, and the maximum-minus-minimum distortion parameter, d , was poor indicator of stall. Inlet duct resonance occurred in both F-111A airplanes and is believed to have been caused by oscillations of the normal shock wave from an internal to an external position. The inlet performance of the two airplanes was similar in terms of pressure recovery, distortion, and turbulence, and there was good agreement between flight and wind-tunnel data up to a Mach number of approximately 1.8. Author

N73-29807# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF NOISE REQUIREMENTS ON STOL PROPULSION SYSTEM DESIGNS

Raymond J. Rulis 1973 14 p refs Presented at the 42nd Meeting of the Propulsion and Energetics Panel of the Advisory Group for Aerospace Res. and Develop., NATO, Schliersee, Germany, 17-21 Sep. 1973
(NASA-TM-X-68280; E-7601) Avail: NTIS HC \$3.00 CSCL 21E

The severity of proposed noise goals for STOL systems has resulted in a new design approach for aircraft propulsion systems. It has become necessary to consider the influence of the noise goal on the design of engine components, engine systems, and the integrated nacelle, separately and collectively, from the onset of the design effort. This integrated system design approach is required in order to effect an optimization of the propulsion and aircraft system. Results from extensive design studies and pertinent test programs are presented which show the effect of noise specifications on component and system design, and the trade offs possible of noise versus configuration and performance. The design optimization process of propulsion systems for powered lift systems is presented beginning with the component level and proceeding through to the final integrated propulsion system. Designs are presented which are capable of meeting future STOL noise regulations and the performance, installation and economic penalties are assessed as a function of noise level. Author

N73-29809# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF TURBOJETS WITH ROTARY FLOW INDUCTORS FOR A LOW-NOISE SUPERSONIC TRANSPORT

James F. Dugan Apr. 1973 25 p refs
(NASA-TM-X-68233; E-7450) Avail: NTIS HC \$3.25 CSCL 21E

In a simplified airplane-mission study for a Mach 2.61 supersonic transport, dry turbojets with and without real suppressors and dry turbojets with ideal rotary flow inductors were studied for sideline noise levels as low as FAR 36-20. Compressor pressure ratio was varied from 5 to 30 and turbine temperature from 1800 to 3000 F. For no noise constraint and without a suppressor, the best dry turbojet gave a payload of 9.0 percent of gross weight and a sideline noise of 126 effective perceived noise decibels. Payload dropped rapidly for lower noise goals, becoming 6.3 percent of gross weight at FAR 36. At FAR 36, the turbojet with suppressor gave a payload of 8.3 percent and the turbojet with ideal rotary flow inductor, 7.3 percent. Below FAR 36, the ideal inductor was far superior to the real suppressor, giving payloads of 6.6 percent at FAR 36-10 and 5.7 percent at FAR 36-20. Author

N73-29810# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CONCEPTUAL STUDY OF FOUR SUBSONIC VTOL PROPULSION SYSTEMS

W. C. Strack [1973] 33 p refs
(NASA-TM-X-68279) Avail: NTIS HC \$3.75 CSCL 21E

Typical ejector wing, remote fan-in-wing, remote lift/cruise fan, and lift plus lift/cruise propulsion concepts are parametrically studied on the basis of airplane weights (gross, empty, and propulsion) for three types of airplanes, a Carrier-Onboard Delivery/Search and Rescue airplane for the U.S. Navy, a military

utility transport, and a business jet. None of the four systems led to airplanes substantially lighter than the others, and therefore no heat system is selected. Author

N73-29812* General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
AERO-ACOUSTIC DESIGN AND TEST OF A MULTIPLE SPLITTER EXHAUST NOISE SUPPRESSOR FOR A 0.914m DIAMETER LIFT FAN
 D. L. Stimpert Jan. 1973 296 p refs
 (Contract NAS3-15556)
 (NASA-CR-121108; R73AEG282) Avail: NTIS HC\$7.00 CSCL 21E

A lift fan exhaust suppression system to meet future VTOL aircraft noise goals was designed and tested. The test vehicle was a 1.3 pressure ratio, 36 inch (91.44 cm) diameter lift fan with two chord rotor to stator spacing. A two splitter fan exhaust suppression system thirty inches (76.2 cm) long achieved 10 PNdB exhaust suppression in the aft quadrant compared to a design value of 20 PNdB. It was found that a broadband noise floor limited the realizable suppression. An analytical investigation of broadband noise generated by flow over the treatment surfaces provided very good agreement with the measured suppression levels and noise floor sound power levels. A fan thrust decrement of 22% was measured for the fully suppressed configuration of which 11.1% was attributed to the exhaust suppression hardware. Author

N73-29814# Pratt and Whitney Aircraft, East Hartford, Conn.
HEAT TRANSFER INVESTIGATION FOR MULTIHOLE AIRCRAFT TURBINE BLADE COOLING Final Technical Report, 1 May 1972 - 28 Feb. 1973
 R. E. Mayle and F. J. Camarata Wright-Patterson AFB, Ohio AFAPL Jun. 1973 77 p refs
 (Contract F33615-72-C-1902; AF Proj. 3066)
 (AD-762527; PWA-4705; AFAPL-TR-73-30) Avail: NTIS CSCL 21/5

Adiabatic film effectiveness and heat transfer measurements with injection of coolant air through arrays of holes in a flat plate into a uniformly moving mainstream are presented. Measurements were taken both within and downstream of the multihole pattern. The hole configurations considered are regular patterns of staggered holes. The holes are angled 30 degrees to the plate's surface with the projection of the hole axis on the surface forming a 45 degree angle to the mainstream. A semi-empirical relation for the adiabatic film effectiveness is presented. Also an empirical correlation of the Stanton number is presented for flow conditions where the coolant flow dominates the fluid mechanics near the surface. Author (GRA)

N73-29805# Advisory Group for Aerospace Research and Development, Paris (France).
SYMPOSIUM ON ACOUSTIC FATIGUE
 May 1973 273 p refs Partly in FRENCH; mostly in ENGLISH
 Papers presented at 35th Meeting of the Structures and Mater. Panel, Toulouse, 26-27 Sep. 1972
 (AGARD-CP-113) Avail: NTIS HC\$15.75

The proceedings of a conference on acoustic fatigue and methods for reducing the effects of acoustic fatigue are presented. The subjects discussed include: (1) dynamic loading of aircraft surfaces due to jet exhaust impingement, (2) response of structures to aerodynamic loads, (3) design data for acoustic fatigue, (4) damping and composite structures, (5) sonic fatigue of bonded sandwich structures, and (6) assessment of test techniques for determining extent of acoustic fatigue

N73-29807 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany)
INFLUENCE OF THE GROUND ON THE NEAR FIELD NOISE LEVELS OF JET-SUPPORTED V/STOL AIRCRAFT

Rudolf Scholten *In* AGARD Symp. on Acoustic Fatigue May 1973 12 p refs

A method for calculating the near field noise level of a free jet (no ground effect) by means of a modified Lighthill theory using measured reference sound fields is explained. The shortcomings of the reference fields presently used, as well as a means to eliminate them, are shown. In addition, determining frequency spectra in the near sound field by means of a modified Strouhal number is described. The validity of the modified Lighthill theory is proven by means of two different engine jets. Wall jet sound fields (sound fields of an engine jet directed vertically towards the ground) and the influence of the essential parameters affecting the sound field are discussed. Increased noise levels due to ground effect are examined using V/STOL aircraft operation as an example. Author

N73-29908* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
DYNAMIC LOADING OF AIRCRAFT SURFACES DUE TO JET EXHAUST IMPINGEMENT

D. L. Lansing, J. A. Drischler, T. J. Brown, and J. S. Mixson *In* AGARD Symp. on Acoustic Fatigue May 1973 9 p refs

CSCL 01C

High-lift wing concepts being considered for application to commercial STOL transports are discussed. The flow patterns which produce dynamic loads on these wings are indicated. Measurements of surface pressure and acceleration on a one-half-scale model of an externally blown double-slotted flap are reported. Root-mean-square values, power spectra, and scaling parameters are shown. Author

N73-29909 National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.

SURFACE PRESSURE FLUCTUATIONS FROM JET IMPINGEMENT ON AN INCLINED FLAT PLATE
 R. Westley, J. H. Woolley, and P. Brosseau *In* AGARD Symp. on Acoustic Fatigue May 1973 18 p refs

The influence of jet impingement pressure fluctuations on the structural design of short takeoff aircraft that use externally blown flaps is discussed. An experiment is described in which the surface pressure fluctuations on a flat plate were measured when an impinging cold air jet was blown at the plate with various speeds, inclination angles, and separation distances. The measured surface sound pressure levels and their spectra are reported. Author

N73-29912 British Aircraft Corp. (Operating) Ltd., Bristol (England). Structural Acoustics Group.
RESPONSE AND FATIGUE CHARACTERISTICS OF LIGHT ALLOY MACHINED PLANK STRUCTURES

D. C. G. Eaton *In* AGARD Symp. on Acoustic Fatigue May 1973 17 p refs

The response and fatigue characteristics of light alloy integrally machined planks are discussed. The vibration characteristics are compared with those of equivalent fabricated conventional structures. The characteristics are reviewed with emphasis on the related acoustic fatigue implications. Methods of predicting dynamic stresses are considered and comparisons are made with practical results. A research program for obtaining information to be used in preparing design guides is discussed. Problems associated with noise induced crack propagation in machined plank structures are reported. Author

N73-29913 Societe Nationale Industrielle Aerospatiale, Toulouse (France). Bureau d'Etudes.

EXPERIMENTAL RESEARCH ON THE RESPONSE OF AIRCRAFT STRUCTURES TO ACOUSTIC FATIGUE [RECHERCHE EXPERIMENTALE DE LA TENUE DES STRUCTURES D'AVION A LA FATIGUE ACOUSTIQUE]

Jean Gay *In* AGARD Symp. on Acoustic Fatigue May 1973 9 p *In* FRENCH

Data are presented on conditions known to cause acoustic fatigue and test conditions necessary for treating or correcting the problem. Data cover source of excitation, flight conditions, and effects of aircraft critical zones on the problem. Several test procedures were examined. Transl. by E.H.W.

N73-29915 Southampton Univ. (England). Inst. of Sound and Vibration Research.

ESTIMATES OF THE RESPONSE OF BOX TYPE STRUCTURES TO ACOUSTIC LOADING

Brian L. Clarkson *In* AGARD Symp. on Acoustic Fatigue May 1973 16 p refs

A multicell box structure representing typical aircraft construction was tested in a high intensity noise facility. The vibration response of the internal ribs was studied. The test specimen was designed in such a way the ribs could be changed to produce variants in a typical tailplane design. A semi empirical method for analyzing the response is developed and compared with the experimental results. Author

N73-29916 Lockheed-California Co., Burbank.

CORRELATION OF SONIC FATIGUE FAILURES IN LARGE FAN ENGINE DUCTS WITH SIMPLIFIED THEORY

Jaak Soovere *In* AGARD Symp. on Acoustic Fatigue May 1973 14 p refs

The nature of the large fan jet engine intake duct noise and its effect on the duct structure are described. A simple semi-empirical method is developed to predict the stresses in intake duct structure induced by fan noise. The predicted stresses at the failure location, show good correlation with random fatigue data for bending across the rivet line. Author

N73-29920 Aeritalia, Turin (Italy).

ACOUSTIC FATIGUE TEST ON THE VFW-FOKKER VAK 191 B STRUCTURAL COMPONENTS

Pietro Selvaggi and Angelo Lorea (Fiat S.p.A., Turin) *In* AGARD Symp. on Acoustic Fatigue May 1973 16 p refs

Near field noise and temperature measurements on 1/4 scale model of the VFW-FOKKER VAK 191 B aircraft indicated that critical environments will be induced on aircraft structural components during the VTO and STO configurations. The results of the structural response and endurance test performed on a fuselage skin panel and on a wing trailing edge flap are reported. The noise and temperature simulation procedure and the experimental facilities arranged for testing purpose are described. Author

N73-29921 Royal Aircraft Establishment, Farnborough (England). Structures Dept.

SOME CONSIDERATIONS OF THE FATIGUE BEHAVIOUR OF ALUMINUM ALLOY STRUCTURES UNDER ACOUSTIC LOADING

W. T. Kirkby *In* AGARD Symp. on Acoustic Fatigue May 1973 14 p refs

Data on the fatigue performance of aluminum alloy structural elements which represent typical skin-stringer attachments, or integrally-milled skin-stiffener configurations, for use in design against acoustic fatigue are discussed. The fatigue data have generally been obtained from tests under narrow-band random loading with zero mean stress in the skin. Some guidance is given on the allowances which should be made for differences in bandwidth and for effects of mean stress, when using such acoustic fatigue data. The tentative advice given is based on general experience of the fatigue behaviour of other types of structural elements under a wider range of random loading conditions. Some consideration is also given to some aspects of crack propagation under acoustic fatigue loading. In particular the problem of crack propagation under combined fatigue loading actions is discussed. Predictions of crack growth under cabin pressurisation and acoustic loading are used to illustrate the significance of the problem with reference to aircraft structures which must satisfy fail-safe requirements. Author

N73-29922 Hawker Siddeley Aviation, Ltd., Brough (England). **ASSESSMENT OF SIREN TEST TECHNIQUES**

Eric James Phillips *In* AGARD Symp. on Acoustic Fatigue May 1973 18 p refs

The siren as a test technique for the determination of response and life of aircraft structures subject to engine noise field excitation is discussed. A flat panel specimen is to be placed in the near noise field of a typical jet engine and its stress response measured. The specimen is placed in a siren and the response which was measured in the engine noise field reproduced as closely as possible. The differences in response is assessed with regard to the extrapolation of measured siren fatigue life to service environments. Specimen responses in the engine noise field and in the siren are compared with the theoretically predicted response, using methods of varying complexity. Author

N73-29923 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

SONIC FATIGUE RESISTANCE OF LIGHTWEIGHT AIRCRAFT STRUCTURES

R. C. W. VanderHeyde and A. W. Kolb *In* AGARD Symp. on Acoustic Fatigue May 1973 17 p refs

An experimental program under which the response and sonic-fatigue resistance of lightweight aircraft structures were investigated is presented. The program involved a series of aluminum-alloy panels of bonded-beaded and skin-stringer design. A total of 60 bonded-beaded and 60 skin-stringer type test specimens was investigated. The panels were tested in groups of 5 or 10 at 4 different overall sound-pressure levels to obtain test results with a high level of confidence. The data reported include mode shapes, panel damping ratios, linearity of response, fatigue life, and failure location. For some panel configurations, data to above 10 to the 8th power cycles were obtained. The test facility, test fixture, noise source, testing technique, and instrumentation used, are described along with the test results. Fatigue failure detection techniques are discussed. The test results are compared with stress predictions from various available methods. Author

N73-29924# Advisory Group for Aerospace Research and Development, Paris (France).

FATIGUE LIFE PREDICTION FOR AIRCRAFT STRUCTURES AND MATERIALS

May 1973 223 p refs
(AGARD-LS-62) Avail: NTIS HC \$13.25

Procedures for predicting the fatigue life of aircraft structures are described. The subjects discussed are: (1) methods of stress measurement analysis for fatigue life evaluation, (2) application of fracture mechanics principles in design and analysis of aircraft structures, (3) effects of corrosion fatigue, (4) crack growth prediction techniques, and (5) development of analytic theory for fatigue.

N73-29925 National Aerospace Lab., Amsterdam (Netherlands).

ASPECTS OF AERONAUTICAL FATIGUE

J. Schijve *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 23 p refs
N73-29924 20-32)

The evaluation of the fatigue quality of an aircraft is discussed. Several steps, such as: (1) determination of the fatigue load environment, (2) response of the aircraft structure, (3) internal load distributions and (4) estimation of the fatigue properties are involved. The fatigue properties comprise fatigue life, crack propagation and residual strength. The latter two items together with inspection procedures are qualifying the fail-safety. The above aspects are analyzed with reference to the contributions of design efforts, calculations, testing, inspections and fatigue load monitoring. Author

N73-29926 Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).

METHODS OF STRESS-MEASUREMENT ANALYSIS FOR

FATIGUE LIFE EVALUATION

O. Buxbaum *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 19 p refs

The possibilities and limitations of a spectral presentation of measured stress-time histories are described. A concept is presented which distinguishes between stresses due to random vibrations and stresses due to manoeuvres, variations of payload, and which is suitable for any theoretical or experimental fatigue life evaluation. Reference is made also to fatigue testing under random loading and to the derivation of external loads. Author

N73-29927 Hawker Siddeley Aviation, Ltd., Hatfield (England).
THE USE OF COUNTING ACCELEROMETER DATA IN FATIGUE LIFE PREDICTIONS FOR AIRCRAFT FLYING IN COMPLEX ROLES

J. A. B. Lambert *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 18 p refs

The use of counting accelerometer data for predicting the fatigue life of aircraft flying in various load conditions is discussed. Methods for conducting a full scale fatigue test are explained. The application of load and acceleration relationships for fighter and transport aircraft is analyzed. The characteristics of fatigue meters for obtaining accurate load data are described. Author

N73-29928 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

THE USE OF FRACTURE MECHANICS PRINCIPLES IN THE DESIGN AND ANALYSIS OF DAMAGE TOLERANT AIRCRAFT STRUCTURES

Howard A. Wood *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 13 p refs

Current trends in the usage of high strength structural materials for aerospace applications are reviewed. The manner in which fracture control procedures may be implemented to achieve a higher degree of damage tolerance are discussed. The application of fracture requirements to two current designs is related. These experiences have contributed to the formulation of specifications for use across the board on all new systems. Important aspects of the proposed USAF damage tolerance criteria, including initial damage assumption and crack growth analyses, are discussed. Author

N73-29929 Battelle-Northwest, Richland, Wash.
CORROSION FATIGUE - OR - HOW TO REPLACE THE FULL SCALE FATIGUE TEST

W. E. Anderson *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 10 p refs

The effect of environment and stress-cycling in real-time on in-service structural failure is discussed. Comparative calculations of cracking from a fastener hole are used as the basis of the investigation. A method to overcome the limitations of full-scale fatigue test data is proposed. The method involves sacrificial examination of selected portions of airframes and testing of the structural materials under several environmental and stress histories. Application of the procedure for calculating scheduled repair times for individual airframes based on respective flight experiences is proposed. Author

N73-29930 Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
ON FATIGUE ANALYSIS AND TESTING FOR THE DESIGN OF THE AIRFRAME

Walter J. Crichlow *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 36 p refs

The experimental and analytical techniques for controlling time to fatigue crack initiation in design of aircraft structure are reviewed to define improvements that may be gained from available research knowledge. Discrepancies among simple theory, experiment, and service are being better explained by accountability for residual stress systems created by higher than

average loading peaks recurring randomly throughout the service load spectrum. Analytical accounting for the generation, decay, and recreation of residual stress spectra is an essential adjunct to the experimental approach, for not all parts can be critically tested, and not all load spectra variations can be accommodated in test. Recent advances in residual stress analyses are reviewed. Failure theory, interaction matrix, chemical (corrosion), and mechanical (fretting) environmental aspects are explored. Variability of results are discussed in terms of design life reduction factors. Author

N73-29931 Battelle-Northwest, Richland, Wash.
A RATIONAL ANALYTIC THEORY OF FATIGUE-REVISITED

W. E. Anderson *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 9 p refs

Fatigue of airframe structures is viewed from the standpoint of crack initiation and extension. By employing a rational analytic theory of fatigue, the aspect of crack extension is treated in terms of the maximum stress-field-parameter, and the minimum to maximum load excursion ratio. Initiation is treated as that period prior to development of a well-behaved crack. A number of airframe fatigue test data are thereby examined and compared with interpreted service experiences. The principal differences seem to stem from environmental influences in service that are not represented during laboratory experiments. Author

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A SUMMARY OF CRACK GROWTH PREDICTION TECHNIQUES

Howard A. Wood *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 31 p refs

The use of material growth rate data and analytical retardation models in predicting crack growth under variable amplitude loading is reviewed. Retardation models of current interest are discussed and compared. An effective stress model is described, including the mathematical formulation, applicability and usage limitations. Comparison of analyses and tests for typical spectra are shown. A primary factor in the accurate prediction of spectrum crack growth behavior is the proper representation of basic growth rate data including consideration of R factor shift and possible limit, threshold levels of stress intensity, closure effects and environment. The relative significance of each of these parameters on total crack growth life is discussed. Author

N73-29933 Hawker Siddeley Aviation, Ltd., Hatfield (England).
THE R.Ae.S. - ESDU CUMULATIVE DAMAGE HYPOTHESIS

J. A. B. Lambert *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 16 p refs

The limitations of a cumulative damage hypothesis for estimating the fatigue life of airframes are described. The major source of error is identified as being due to neglecting the redistribution of stresses that occurs when a part yields at a stress concentration. A method which takes the localized yielding effects into account is proposed. The procedure involves estimating the change in the actual mean stress of subsequent stress cycles after yielding has occurred. Author

N73-29934 Industrieranlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
FATIGUE LIFE PREDICTION: A SOMEWHAT OPTIMISTIC VIEW OF THE PROBLEM

Walter Schuetz *In* AGARD Fatigue Life Prediction for Aircraft Struct. and Mater. May 1973 32 p refs

Lack of correlation between the fatigue life predicted from calculations and tests and the service life actually obtained is discussed. This may be due to one or several of the following

causes: (1) incorrect load spectra were assumed in the calculations and applied in the tests including the full scale test (2) Miner's Rule was used in the life calculations. (3) unexpected failures occurred, starting from material flaws in non redundant structure built of high strength materials, and (4) the load sequence in the tests including the full scale test was too much simplified. It is suggested that major improvements in the accuracy of fatigue life prediction should be possible using modern methods and modern data. These are compared to hitherto existing methods for life calculations in the design stage, for component testing and for the full scale fatigue test. Author

polynomial expressions in dive angle complement which are multiplied, in turn, by the 1st, 2nd, and 3rd natural logarithms of release altitude. (Modified author abstract) GRA

N73-29944*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

RESULTS OF GROUND VIBRATION TESTS ON A YF-12 AIRPLANE

Ronald J. Wilson, Frank W. Cazier, Jr., and Richard R. Larson
Washington Aug. 1973 93 p
(NASA-TM-X-2880; H-736) Avail: NTIS HC \$3.00 CSCL 01C

Ground vibration tests were conducted on a YF-12 airplane. To approximate a structural free-free boundary condition during the tests, each of the landing gears was supported on a support system designed to have a low natural frequency. The test equipment and the procedures used for the ground vibration tests are described. The results are presented in the form of frequency response data, measured mode lines, and elastic mode shapes for the wing/body, rudder, and fuselage ventral fin. In the frequency range between 3.4 cps and 28.8 cps, nine symmetrical wing/body modes, six antisymmetrical wing/body modes, two rudder modes, and one ventral fin mode were measured. Author

N73-29967# National Academy of Sciences - National Research Council, Washington, D.C.

REPORT OF THE PLUME EMISSIONS PANEL Final Report

Brian OBrien Jun. 1973 29 p
(Contract F18600-73-C-0066; F18600-69-C-0032)
(AD-763123; AFSC-TR-73-002) Avail: NTIS CSCL 21/2

The Plume Emissions Panel of the NAS Advisory Committee to the Air Force Systems Command was formed initially to investigate techniques for simulating the infrared emission from turbojet aircraft exhaust plumes. These techniques were to be applied to drone target vehicles for seeker testing, and for pilot training with infrared seeking weapons. A symposium was arranged to bring together available information related to exhaust plumes. As a result of the symposium and other discussions, it became clear that an investigation of specific radiation simulation techniques would be premature. This results from the fact that there is far too little known about the detailed radiation characteristics of the real target plume to be able to produce a satisfactory simulation at this time. (Modified author abstract)

GRA

N73-29992# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Advanced Systems Analysis.

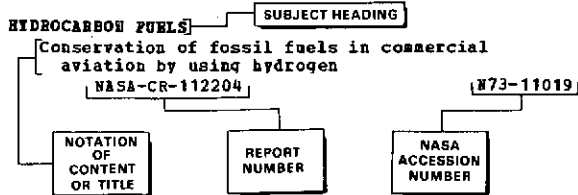
BOMB RANGE FORMULAE BASED UPON RELEASE ALTITUDE, DIVE ANGLE AND VELOCITY, M-117 BOMB, F-4 AND F-105 AIRCRAFT

C. Albert Broom Jan. 1973 62 p refs
(AD-762500; ASD/XRO-R-73-1) Avail: NTIS CSCL 19/5

The report provides a method for determining bomb range of low drag bombs as a function of altitude, velocity, and dive angle at weapon release. When dive angle and velocity are fixed, the author shows that bomb range is equal to the constant, e , raised to a power consisting of a constant term, plus a second constant multiplied by the natural logarithm of release altitude, plus a third constant multiplied by the second natural logarithm of release altitude plus a fourth constant multiplied by the third natural logarithm of altitude at release. For the constant velocity case, bomb range can be determined by raising the constant, e , to a power consisting of about 11 terms. These exponent terms include a constant term plus a set of 3

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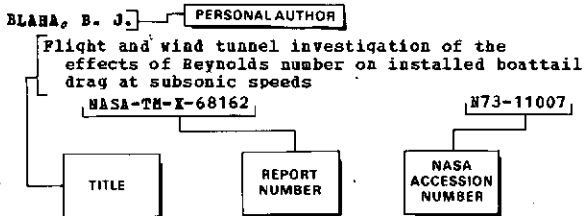
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