NASA SP-7037 (15)

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 15

FEBRUARY 1972

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (15)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 15

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1972 in

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

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 363 reports, journal articles, and other documents originally announced in January 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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

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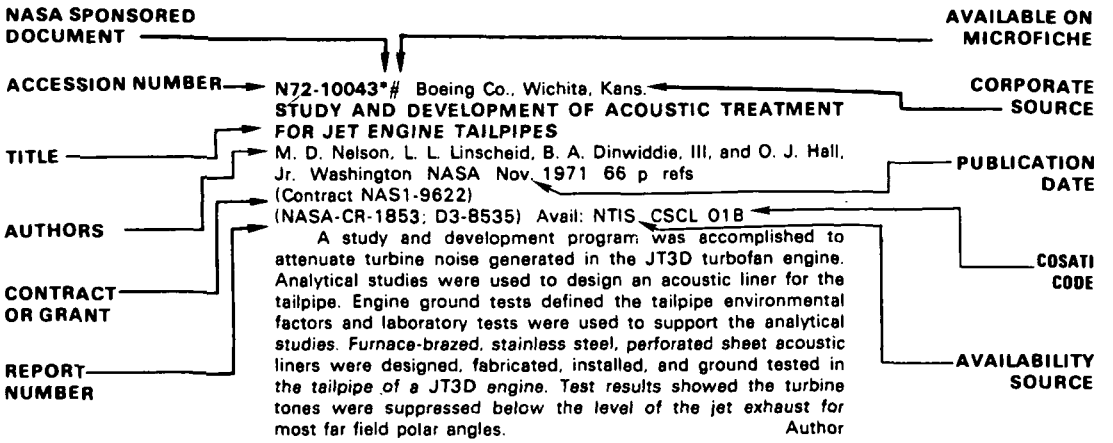

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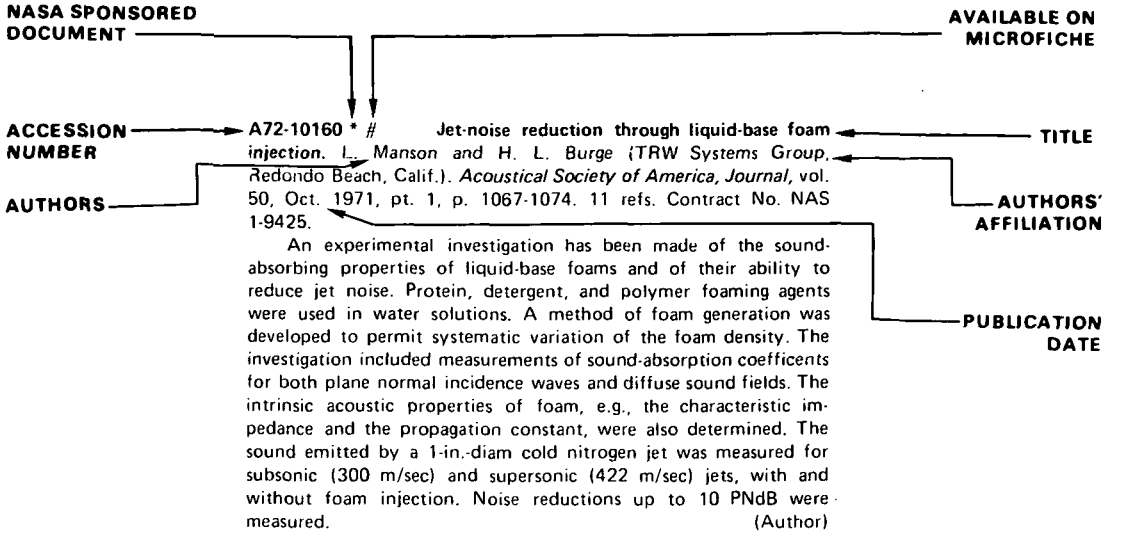

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 15) FEBRUARY 1972

IAA ENTRIES

A72-10070 # **Problems of the use of inertial navigation systems in aviation (Problemele utilizării sistemelor inerţiale de navigaţie în aviaţie).** I. Aron. *Transporturi Auto, Navale şi Aeriene,* vol. I (18), July 1971, p. 367-372, 390. 10 refs. In Rumanian.

Analysis of the limits of the classical navigation systems, the progress achieved in the field of automated inertial navigation devices, and the advantages and urgency of using the latter on board passenger aircraft. Attention is paid to accelerometer and gyroscope design and construction as major devices in inertial systems. By computing the aircraft's coordinates continuously and automatically, inertial systems lighten and simplify the crew's work. M.M.

A72-10149 **Recording antenna radiation patterns by semi-automation.** M. A. Ziller (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *VertiFlite,* vol. 17, Sept.-Oct. 1971, p. 6, 7, 10.

Use of models to permit three-dimensional recording of radiation patterns under relative free-space conditions, thus facilitating trial antenna relocations. The aircraft and antenna are scaled down, requiring an upward scaling of test frequencies to maintain aircraft size-to-wavelength ratio. A polar recorder, synchronized via a synchro-servo drive with the model rotator, plots the pattern semiautomatically. A saving of more than 90% in flight costs has been realized. In addition, resolution is improved with almost continuous data in contrast to 24 discrete data points. F.R.L.

A72-10150 **Elastomeric bearings for rotor system applications.** C. H. Fagan (Bell Helicopter Co., Fort Worth, Tex.). *VertiFlite,* vol. 17, Sept.-Oct. 1971, p. 12, 13, 16-19.

Discussion of all-elastomeric-bearing rotors developed by the U.S. Army and Bell Helicopter Co., which should virtually eliminate the need for replacing bearings and related parts, thus greatly reducing the down time and cost of unscheduled helicopter maintenance. Another advantage of elastomeric bearings is that the appearance of the elastomer can be used as an indicator of the severity of previous rotor oscillatory loads and motions. Endurance tests conducted on flapping bearings for both main and tail rotors have shown that their service life can be expected to be in excess of 2000 hr. F.R.L.

A72-10157 **Field measurement of infrasonic noise.** R. A. Hood and H. G. Leventhall (Chelsea College, London, England). *Acustica,* vol. 25, July 1971, p. 10-13. 10 refs. Research supported by the Medical Research Council.

Portable equipment for the detection and recording of noise in the frequency range from 2 to 500 Hz is described, together with typical results obtained in an automobile, blast furnace, railroad car, engine room, and helicopters. Factors responsible for peaks appearing at various frequencies are identified, and research on the subjective effects of infrasonic noise is indicated. T.M.

A72-10160 * # **Jet-noise reduction through liquid-base foam injection.** L. Manson and H. L. Burge (TRW Systems Group, Redondo Beach, Calif.). *Acoustical Society of America, Journal,* vol. 50, Oct. 1971, pt. 1, p. 1067-1074. 11 refs. Contract No. NAS 1-9425.

An experimental investigation has been made of the sound-absorbing properties of liquid-base foams and of their ability to reduce jet noise. Protein, detergent, and polymer foaming agents were used in water solutions. A method of foam generation was developed to permit systematic variation of the foam density. The investigation included measurements of sound-absorption coefficents for both plane normal incidence waves and diffuse sound fields. The intrinsic acoustic properties of foam, e.g., the characteristic impedance and the propagation constant, were also determined. The sound emitted by a 1-in.-diam cold nitrogen jet was measured for subsonic (300 m/sec) and supersonic (422 m/sec) jets, with and without foam injection. Noise reductions up to 10 PNdB were measured. (Author)

A72-10177 # **Air traffic control separation minima and navigational capability.** A. White (National Air Traffic Control Services, London, England). *Institute of Navigation, Journal,* vol. 24, Oct. 1971, p. 443-456.

Examination of the manner in which navigation capability, ATC systems and the general ATC environment have been interlinked in the development of adequate separation values. Only safe separation standards are considered, and not spacing criteria, although inevitably the two are interrelated. Errors in navigation in a typical long-range oceanic environment are discussed, together with errors in navigation during flight on airways and other continental controlled airspace, and ATC intervention capability as related to the development of separation minima. Positive measures that are being taken to explore the means by which separation values can be derived from the direct measurement of navigational and ATC performance during current operations are indicated. M.M.

A72-10178 **Mathematical studies on separation standards.** D. E. Lloyd (Royal Aircraft Establishment, Farnborough, Hants.,

England). *Institute of Navigation, Journal,* vol. 24, Oct. 1971, p. 456-458.

Brief description of the mathematical theory of navigational collision risk for parallel tracks. The results of calculations made in 1967 on the required spacing between the center lines of opposite-direction twin airways carrying, mainly, climbing and descending traffic leaving and entering a terminal area are tabulated. For the radar monitored cases, the spacing was assumed to be determined by controller workload, represented by the 'intervention rate' which was defined as the ratio between the number of interventions and the number of flights along the sector. M.M.

A72-10179 # **A preliminary analysis of navigational performance observed at Strumble 1969-70.** C. M. Britland (Royal Aircraft Establishment, Farnborough, Hants., England). *Institute of Navigation, Journal,* vol. 24, Oct. 1971, p. 458-462; Discussion, p. 462-468.

Discussion of some of the features of a statistical analysis of data on track-keeping recently collected along Green 1 Airway near the Strumble VOR. All values quoted are illustrative only and have no firm validity at this time but illustrate the numbers involved in determining acceptable separation standards for the lateral navigation case in a typical 'continental' environment. The statistical data suggest that a spacing of 6 nm would increase the risk about 30 times without surveillance; hence the surveillance system must prevent all but 1 in 30 of the potential collisions - namely, be 97% effective - for the same safety level. M.M.

A72-10180 **The potential of existing avionics technology.** S. Ratcliffe (Royal Radar Establishment, Malvern, Worcs., England). *Institute of Navigation, Journal,* vol. 24, Oct. 1971, p. 469-483. 21 refs.

Discussion of the areas in which improved avionics could, in the relatively near future, contribute to overcoming the limitations described by Reich (1966) and Dickie. The constraints under which the airspace planners must operate are considered, together with the contribution which good electronic design might make to breaking the decision-taking bottleneck. The important areas in which improved avionics techniques may be expected to ease the problems resulting from rising traffic are listed as: (1) navigational and control techniques which better exploit the potentialities of airborne computers; (2) the evolution of a compatible SSR (secondary surveillance radar) with discrete addressing; (3) correlation protected ILS; and (4) problem-solving computers for ATC. M.M.

A72-10181 # **Polar navigation - A new Transverse Mercator technique.** G. C. Dyer. *Institute of Navigation, Journal,* vol. 24, Oct. 1971, p. 484-495.

The secant-expansion of the grid overprint on the Global Navigation Chart GNC 1N Transverse Mercator allows a new look at polar navigation. A navigator can operate his latitude/longitude GPI (ground position indicator) up to 90 deg earth latitude and plot accurately on the GNC 1N. Operation in a FALSE LAT./LONG. mode with a FALSE equator established through the pole means that the gyro transport correction term is small. The 'meridian difference' angle (MERDIFF) involved in this technique is analogous to, and no more difficult to handle than, the convergence angle which applies to more traditional 'grid' techniques. Adoption of the method could mean that many aircraft will be able to conduct their polar flight on one chart; the need to change 'grids' can be avoided. The technique does as well as traditional grid methods in reducing the effect of longitude error being reflected as astro heading error. M.M.

A72-10183 # **Terrain clearance during descent and approach.** J. D. Proctor. *Institute of Navigation, Journal,* vol. 24, Oct. 1971, p. 565-568.

The effect of ATC is often to bring the aircraft below the optimum profile; the controller likes to get the aircraft down too early rather than too late because too late may entail descent in holding patterns which takes up extra airspace and disrupts sequencing. It is pointed out that information on areas and safe heights where aircraft descend under radar control should be provided to pilots and navigators. The areas should be defined by lines easily discerned by the aircrew, for instance VOR radials or DME distances. While following radar instructions they could then easily check terrain clearance. M.M.

A72-10192 # **Rigid pavement stresses under aircraft loading.** M. Sargious, G. A. Ross (Calgary, University, Calgary, Alberta, Canada), and G. A. LeMoal. *ASCE, Transportation Engineering Journal,* vol. 97, Nov. 1971, p. 579-590. 9 refs.

Surface strain measurements were made under field loading conditions on an airport apron rigid pavement. Theoretical calculations for the same loading conditions were carried out using finite element method and pavement structure properties as determined by laboratory tests on materials sampled from the test site. It was found that theoretical predictions considering static loads are in fair agreement with field pavement strain measurements under parking aircraft. Dynamic effects in field measurements due to aircraft vibration and load shifts were found to be insignificant in the cases studied. It was found that careful consideration must be given to gauge size and placement when using strain rosettes to predict stresses at a point near a wheel load. O.H.

A72-10193 # **Density altitude variations and runway lengths.** T. B. Davinroy (Pennsylvania State University, University Park, Pa.). *(American Society of Civil Engineers, National Transportation Engineering Meeting, Boston, Mass., July 13-17, 1970, Preprint 1242.) ASCE, Transportation Engineering Journal,* vol. 97, Nov. 1971, p. 591-607. 19 refs.

The effect of variations in density altitude - i.e., altitude in the standard atmosphere to which the actual density corresponds - on required airport runway lengths and takeoff weights is investigated. It is shown that the necessity of accurate knowledge of changing meteorological conditions, particularly air temperature and pressure altitude, at departure airports was recognized prior to the introduction of jumbo-jet aircraft into service. Previous studies on the effect of variations in these two variables were made and, because the effects of pressure altitude variations were smaller than those of temperature variations, pressure accountability was not made a part of the U.S. regulations. A different form of presentation of computed runway lengths, with and without pressure accountability utilizing a probability plot, results in a much broader picture of the effects and permits an analysis both from the point of view of the aircraft operator and the airport designer. The results of the study indicate that payloads can be effected from 1.5 to 13%, or the required runway length can vary from 1 to 4%, or both. O.H.

A72-10216 **Interior noise radiated by an airplane fuselage subjected to turbulent boundary layer excitation and evaluation of noise reduction treatments.** W. V. Bhat and J. F. Wilby (Boeing Co., Acoustic Research Group, Seattle, Wash.). *Journal of Sound and Vibration,* vol. 18, Oct. 22, 1971, p. 449-464. 11 refs.

Measurement of the acoustic power radiated by an aircraft fuselage structure exposed to a turbulent boundary layer pressure field at two flight Mach numbers. For a single fuselage panel the radiated power is approximately 90 and 70 dB relative to 10 the the minus 13th W at Mach 0.85 and 0.55, respectively. Damping tape and rubber wedge treatments applied to the structure reduce the acoustic radiation, but they are more effective at Mach 0.85 than at

Mach 0.55. The flight test data are in poor agreement with available wind tunnel measurements, indicating the need for improvements in scaling laws. (Author)

A72-10217 Turbulent boundary layers and surface pressure fluctuations on two-dimensional aerofoils. B. D. Mugridge (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 18, Oct. 22, 1971, p. 475-486. 11 refs.

The unsteady flow about two-dimensional aerofoils has been examined experimentally to determine the surface pressure fluctuations induced by turbulent boundary layers. The measured pressures are described in terms of the boundary layer steady state flow parameters and on this basis the magnitude of the fluctuations are approximately 15 dB greater than the pressures beneath an equivalent wall boundary layer. The difference is attributed to greater flow intermittency in the aerofoil boundary layers and cross-correlations between the surface pressures and the turbulent velocities are examined to test the validity of this conclusion. (Author)

A72-10219 * The vibration of a box-type structure. II - Response to a travelling pressure wave. N. Popplewell (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 18, Oct. 22, 1971, p. 521-531. 11 refs. Grant No. NGR-52-025-003.

A finite element method is formulated for determining the transient response of a box-type structure to a traveling, arbitrarily shaped pressure wave. The method is illustrated by considering an example of practical concern - the sonic boom. The acceleration-time histories of a closed box are compared with those obtained experimentally from a simulated boom. Satisfactory agreement is obtained with only four rectangular elements per individual face and a simplified loading of the box. (Author)

A72-10220 Tone radiation from axial flow fans running in turbulent flow. N. Chandrashekhara (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 18, Oct. 22, 1971, p. 533-543. 9 refs.

The theory of sound radiation from helicopter rotors is extended to axial flow fans running in turbulent flow. The inlet turbulence is treated as gusts superposed on the mean flow. The fluctuating lift on the rotor blades due to the incident gusts is evaluated from the two-dimensional analysis. Then the expression for the sound radiated is evaluated. The analysis is compared with the experimental results. (Author)

A72-10223 The reduction of aircraft engine fan-compressor noise using acoustic linings. R. A. Mangiarotty (Department of Trade and Industry /Civil Aviation/, London, England). *(British Acoustical Society, Spring Meeting, University of Birmingham, Birmingham, England, Apr. 5-7, 1971, Paper 71 SA6.) Journal of Sound and Vibration,* vol. 18, Oct. 22, 1971, p. 565-576. 19 refs.

The development of a method is described for reducing the approach-landing noise of commercial jet transports by means of acoustic linings for attenuating the noise generated by the fan-compressor in turbofan engines and radiated from the intake and fan-exit ducts. The method is applied in particular to the Pratt & Whitney JT3D engine powering the Boeing 707 and the Douglas DC-8 aircraft. A brief discussion is given on the general characteristics of aircraft subjective noise spectra, engine noise reduction techniques, results of research and development on acoustic linings, lining technology and full scale engine testing. Finally, a summary of areas of lining research and technology requiring further investigation is given. (Author)

A72-10245 Producibility considerations in production planning for new aircraft. S. J. Torget (Boeing Co., Commercial Airplane Group, Renton, Wash.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710746.* 9 p. Members, $1.00; nonmembers, $1.50.

This paper describes some aspects of aircraft producibility at The Boeing Company, and discusses the functions of Design Engineering and Manufacturing organizations in achieving a producible airplane. The makeup and function of the product team prior to Corporate go-ahead, as well as their objectives and timing, are defined. Producibility aspects in both preliminary design and production phases of the aircraft program are identified and described. Specifically, producibility considerations during the preliminary design phase in the provisioning of facilities, subcontracting, and scheduling, as well as production-phase design verification, production planning, subcontractor coordination, materials handling, and plant layout and equipment, are discussed. The effects of design changes on producibility are noted. A discussion of motivation as a factor in producibility is included. (Author)

A72-10247 Producibility in design. G. Petronio (Grumman Aerospace Corp., Bethpage, N.Y.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710748.* 8 p. Members, $1.00; nonmembers, $1.50.

Discussion of aspects of producibility, a concept defined as an input to aircraft design techniques which is aimed at the reduction of production cost and the enhancement of product profitability. Under this concept, a joint engineering and manufacturing team continuously analyzes fabrication methods and materials to minimize production cost and optimize product performance. This analysis is concurrent with all stages of design and can have strong influence on aircraft design. Applications of this concept to cast canopy frames, wing carry-through members, split cockpit sections, forgings, and castings are considered. V.Z.

A72-10248 Future trends in aircraft design. M. L. Olason and K. W. Hoefs (Boeing Co., Commercial Airplane Group, Renton, Wash.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710749.* 12 p. Members, $1.00; nonmembers, $1.50.

This paper identifies some future aircraft design trends by reviewing the projected traffic forecast, current transports and their potential derivatives, new technology, and some possible new programs. New airplanes examined include two versions (0.84M and 0.98M) for transcontinental and international use and a STOL version for short-haul operation. In addition, a special-purpose resource air carrier is discussed to indicate the degree to which an aircraft designer is able to accommodate unique requirements. For each new aircraft, the purpose of the design and the associated technology challenges are discussed. (Author)

A72-10249 The crystal ball focuses on the next generation of transport aircraft. R. E. Black, D. G. Murphy, and J. A. Stern (Douglas Aircraft Co., Long Beach, Calif.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufac-*

turing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710750. 20 p. Members, $1.00; nonmembers, $1.50.

Commercial aircraft market requirements are reviewed and all-cargo, STOL, SST and CTOL aircraft types currently being studied are discussed. It is concluded that after the derivative versions of the present generation of wide-body transports have been introduced into service, the next all-new commercial transport will probably be an advanced technology CTOL. This transport must be quieter than present aircraft. An assessment is made of what technological advances are most likely to be incorporated in this aircraft. Supercritical airfoil technology represents the most promising of the several expected technological advances. It can be applied to either economically increase cruise speeds or to significantly reduce operating costs. There are, in addition, a number of interesting possibilities in structures, propulsion and systems design. The characteristics of medium range aircraft, having cruise Mach numbers of 0.85, 0.92, 0.95, and 0.98, are presented. (Author)

A72-10250 Advanced technology for STOL transports. J. J. Cornish, III (Lockheed Georgia Co., Marietta, Ga.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710751.* 11 p. Members, $1.00; nonmembers, $1.50.

From an analysis of a typical large airport and its growth problems, it is concluded that STOL aircraft systems are needed now - with or without high-speed ground transportation systems. It is also shown that the needed first-generation STOL aircraft can be in operation in 1975. These contemporary STOL aircraft will, however, be only a step in the evolution to improved aircraft of the future. The needs for technological improvements are discussed, and some new prospects in STOL technology are described. (Author)

A72-10251 FAA certification and the growth model 747B airplane. E. Pfafman (Boeing Co., Seattle, Wash.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710753.* 6 p. Members, $1.00; nonmembers, $1.50.

Major differences in the 747-200B compared with the 747-100 include provisions for the higher thrust JT9D-7 engines, increased fuel capacity, increased maximum taxi weight and maximum flight weights, and a nacelle modification to meet the noise rule. Areas which could be improved by revised rules are considered together with certain problems encountered in connection with the overall 747 program. G.R.

A72-10252 Development status of the L-1011 TriStar. J. E. Hawkes (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710755.* 21 p. Members, $1.00; nonmembers, $1.50.

A new commercial jet transport capable of expanding the current limits of operating efficiency, reliability and safety was the goal of the TriStar program in its design phase. Now, all indications are that the flight test phase of the program will result in the timely certification of such a plane and a prompt start of deliveries to airline customers. Flight time in the test program is ahead of schedule, and test results to date indicate that the TriStar will meet or exceed guarantees to the airlines. The latter case holds true particularly in respect to performance of certain advanced systems, such as the Autoland. G.R.

A72-10253 The airworthiness certification of Concorde. N. Harpur (British Aircraft Corp., Ltd., London, England). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710756.* 10 p. Members, $1.00; nonmembers, $1.50.

The certification authorities organization is discussed together with airworthiness requirements, maintenance procedures, and the certification program. Problems were encountered in connection with airworthiness objectives, the airworthiness performance code, the flying qualities, and the fatigue evaluation of structures. With the ground and flight test programs for development and for certification well under way, the task of establishing conformance with the requirements is progressing well. With increasing confidence that the ground and flight tests yet to be completed will proceed without any major setback, it is considered that British, French and U.S. Type Certification of Concorde will be achieved during the first half of 1974. G.R.

A72-10254 * A progress report on the development of an augmentor wing jet STOL research aircraft. H. C. Quigley, S. R. M. Sinclair (NASA, Ames Research Center, Moffett Field, Calif.), T. C. Nark, Jr., and J. V. O'Keefe (Boeing Co., Seattle, Wash.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710757.* 13 p. 14 refs. Members, $1.00; nonmembers, $1.50.

The development of the aircraft has progressed to the point where the design of the modifications to the de Havilland C-8A Buffalo is complete and the engines are being tested. The predicted performance shows that the aircraft will be able to take off and land in less than 1500 ft. Simulation studies indicate that the handling qualities of the aircraft, with stability augmentation, will be acceptable for STOL research missions. Special techniques were required, however, for flight path control and transition from cruise to landing configuration. G.R.

A72-10255 Air Force STOL tactical transport technology program. R. B. Lowry and G. S. Oates, Jr. (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710758.* 8 p. Members, $1.00; nonmembers, $1.50.

An industry-assisted, state-of-the-art assessment of STOL tactical transport technology has been conducted by the Air Force. The assessment indicated that three turbofan concepts possessed the highest potential for satisfying the Air Force medium STOL transport mission. These concepts are the externally blown jet flap, internally blown jet flap, and mechanical flap with vectored cruise thrust. The Air Force has constructed a program to identify and fill the gaps in the technology, thereby reducing future system development risk. The program will also identify areas requiring future research. The program is in three phases, with the first phase primarily small-scale wind tunnel tests, analyses, and ground-based simulation. Phase II consists of larger-scale wind tunnel testing, critical component testing, and further simulation. Phase III is scheduled to be development of a technology demonstrator vehicle. Inasmuch as approval has only been granted for phase I, detailed task descriptions for only that phase are given in this paper. (Author)

A72-10256 Design comparison of quiet M = 0.80 STOL transports. R. Scherrer and R. Olson (Lockheed-California Co., Burbank, Calif.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710759.* 14 p. 27 refs. Members, $1.00; nonmembers, $1.50.

This paper deals with a comparison, on a common basis, between quiet, point-design, turbofan, prop-fan, and turboprop intercity STOL transports as a means of possibly accelerating convergence toward a preferred system. Results indicate the high

speed turboprop aircraft is superior in terms of minimum gross weight, and therefore superior in direct operating cost and ticket cost. It is probably also the safest of the three aircraft because of the greatest thrust margin and least thrust asymmetry during wave-off. (Author)

A72-10257 **Propulsion system optimization for the ATT.** G. L. Brines (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710760.* 6 p. Members, $1.00; nonmembers, $1.50.

Supercritical airfoil technology offers the potential of efficient commercial flight at or near the speed of sound. This paper reviews a recent internal study by Pratt and Whitney to define the optimum propulsion system characteristics for a commercial transport designed to fly at Mach 0.95. The impact on aircraft gross weight of propulsion cycle characteristics such as bypass ratio, overall pressure ratio, turbine temperature, nacelle weight and drag as well as the important criteria of noise is reviewed. In addition, the implications of flying at very high initial cruise altitudes above the majority of current traffic is discussed. (Author)

A72-10258 **Propulsion system requirements for advanced technology air transports.** M. B. Schwartz (United Air Lines, Inc., Chicago, Ill.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710761.* 6 p. 5 refs. Members, $1.00; nonmembers, $1.50.

This paper endeavors to identify some of the requirements for the propulsion system of the advanced technology transport. These requirements lie in the areas of design, material selections, accessibility and maintainability of the system, and noise and emission control. The design should provide for adequate stall margins for the compressor, maximum reliability, mechanical and operational simplicity whenever possible, and a modular type of assembly to facilitate on-line and on-wing maintenance. The airframe manufacturer must engineer the powerplant installation to provide maximum accessibility to the engine gas path hardware and the engine accessories. The engine designers must strive for noise levels within the state-of-the-art and preferably below the FAR 36 compliance requirements. The engine should be optimized to produce the minimum possible amount of noxious gases, particulates, and unburned hydrocarbons. (Author)

A72-10259 * **Installation and integration of transonic transport propulsion systems.** L. T. Goodmanson and W. H. Schultz (Boeing Co., Commercial Airplane Group, Renton, Wash.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710762.* 14 p. Members, $1.00; nonmembers, $1.50. Contract No. NAS 1-10703.

Initial work indicates that a viable aircraft family can be designed for higher subsonic cruise speeds. Studies to date suggest that the propulsion system/nacelle design and the incorporation of noise attenuation into this design will have more influence on the choice of an optimum engine than engine weight and fuel consumption. These studies also suggest the payoff resulting from the incorporation of new technology items such as the internal engine generator and new structural cowl concepts because of the greater sensitivity to drag. These factors, plus the greater interdependency of the transonic aircraft and its propulsion system, point up the importance of a total system approach to propulsion system optimization and design. G.R.

A72-10265 **Graphite fan blade development.** B. L. Koff (General Electric Co., Aircraft Engine Group, West Lynn, Mass.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710771.* 17 p. Members, $1.00; nonmembers, $1.50.

A status summary is given for the development at General Electric's engine test facility at Peebles, Ohio, of a graphite fiber composite fan blade design suitable for flight application. Used in subsonic turbofan engines, the fan blade design provides substantial potential reductions in weight for both the fan rotor and the containment structure as well as reduces sensitivity to fatigue failure from foreign object damage. A composite system containing 60% Modmor Type 2 fibers and 40% E293 epoxy resin was selected as the material for the blade design. The various phases of processing and testing the composite fans are described. At the present development stage the graphite composite fan can take the impact of twelve 1 and 2-in. iceballs fired at 400 knots without damage. V.Z.

A72-10266 * **The NASA Quiet Engine.** J. J. Kramer (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710774.* 8 p. 13 refs. Members, $1.00; nonmembers, $1.50. NASA-supported research.

The NASA Quiet Engine Program will incorporate all available noise-reduction technology into a propulsion system suitable for subsonic civil transport aircraft. Full-scale experimental hardware is being built and tested primarily for noise performance. The program is in process, and component tests to date indicate that it is possible to achieve or exceed noise reduction objectives of 15-20 PNdB below the levels of 707/DC-8 long-range transport aircraft. (Author)

A72-10267 **Olympus 593 powerplant in Concorde.** P. H. Calder (Rolls-Royce, Ltd., Bristol Engine Div., Bristol, England). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710775.* 18 p. Members, $1.00; nonmembers, $1.50.

Most of the important technical aspects of the two prototype Concordes and of their Olympus 593 powerplants have been explored and the aeroplanes are flying regularly at Mach 2.0 over long distances. The current status of the powerplant performance, further performance development, the engine and intake control systems, the reheat and exhaust systems, engine/intake compatibility, bench and flight engine development program, the environment and service experience, are reviewed. Convincing performance demonstrations have been made and active discussions with airlines are in hand regarding production versions of the aeroplane. (Author)

A72-10268 **Design features of the Garrett ATF3 turbofan engine.** R. R. Van Nimwegen (AiResearch Manufacturing Co., Los Angeles, Calif.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710776.* 14 p. Members, $1.00; nonmembers, $1.50.

A new approach in the design of small turbofan aircraft propulsion engines is directed toward providing executive type aircraft with coast-to-coast capability. The Garrett ATF3 turbofan engine employs a unique three-spool design concept using advanced component technology, provides an efficiency comparable to the largest turbofan engines, has low emissions, and is easily maintained. (Author)

A72-10269 **Influence of powerplant design on airplane operational effectiveness - The operator's point of view.** J. R. Wilcox (American Airlines, Inc., New York, N.Y.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710777.* 3 p. Members, $1.00; nonmembers, $1.50.

Discussion of a single-team approach to the development of the jumbo tri-jet and its power-plant installation. According to it, the manufacturers and operators of the airframe and the engine are organized into a single team to produce a power-plant installation with an operational efficiency in keeping with the jumbo tri-jet mission requirements. V.Z.

A72-10270 **Team approach to power plant design for maximum operational effectiveness.** L. A. Wright (Douglas Aircraft Co., Long Beach, Calif.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710778.* 8 p. Members, $1.00; nonmembers, $1.50.

A new concept of intimate customer participation evolved during the design, development, and test phases of the DC-10 propulsion system. This concept was resolved into the Airline Propulsion Team approach which took full advantage of the unique contributions to design available from the customer. The design of the DC-10 propulsion system incorporates customer contributions based on his experience and expertise in such areas as operation, maintenance, and overhaul. This paper discusses the methods and operation of the Airline Propulsion Team as well as the immediate and projected benefits resulting from customer participation. (Author)

A72-10271 **The CF6 engine - Designed to improve operational effectiveness.** R. W. Hevener (General Electric Co., New York, N.Y.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710779.* 15 p. Members, $1.00; nonmembers, $1.50.

Description of improved design concepts incorporated in the CF6 engine to meet new requirements in performance, operational characteristics, environmental considerations, dispatch reliability and utilization, and heavy maintenance. Improvements described involve fuel consumption, thrust-weight ratio, starter air requirements, noise levels, smoke emission, maintenance schedules, monitoring capabilities, and accessory replacement procedures. T.M.

A72-10280 **Control of warpage during machining.** C. L. Bennett (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Sept. 28-30, 1971, Paper 710801.* 7 p. Members, $1.00; nonmembers, $1.50.

The increased use of large aluminum-alloy forgings for structural components of the jumbo jet air transport brought attention to bear on the costly distortion problem associated with machining these forgings. This paper discusses one warpage problem - the floor beam - and its solution. Investigation showed that distortion is due primarily to the relief of residual quenching stresses by machining, and that the amount of distortion depends upon the magnitude, distribution, and locations of these stresses within the part. Control of this condition and improved packing and storage methods resulted in a greatly reduced distortion incidence. (Author)

A72-10301 **Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1971. 239 p.

Following a review of parachute applications and some associated research problems, the symposium deals with escape from aircraft, paratrooping, supply dropping, braking of aircraft, and the stabilization and retardation of weapons and other armament stores. Three-component measurements for rigid parachute models, parachute research and development, testing, observations on breathing and related phenomena, high and low speed parachute research, aerodynamic inflation of parachutes, supersonic and transonic deployment of ribbon parachutes, materials, and mechanics of failure are among the subjects treated. F.R.L.

A72-10302 **A review of parachute applications and some associated current research problems.** G. W. H. Stevens (Royal Aircraft Establishment, Farnborough, Hants., England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 19 p. 45 refs.

Review of the major designs of parachutes that have been used and why they are used in certain particular roles. Emphasis is on the basic scientific and technical aspects. The fields of application discussed are escape systems, weapons systems, paratrooping, supply dropping, upper atmosphere recovery systems, braking and energy absorption, aids to aircraft testing, and sport. An attempt is made to discuss problems rather than techniques. F.R.L.

A72-10303 # **Three component measurements for rigid parachute models.** K.-F. Doherr and D. Schmerwitz (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Braunschweig, West Germany). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 13 p. 5 refs.

The results of three component measurements for two sets of nonporous rigid models are presented. Both sets consisted in a hemispherical canopy with conical skirts of different length and with suspension lines made of thin wires. The second model set differed from the first one by a small ring of brass sheet which was placed at the position of the largest projected diameter of the hemisphere. This ring predetermined the region of flow separation. (Author)

A72-10304 # **Parachute R & D in industry.** D. Gladstone (Irvin Great Britain, Ltd., Letchworth, Herts., England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 8 p.

Examination of the industrial approach to parachute research and development in the U.K., with particular reference to the management aspects. The task of the research and development department is to generate production work; its activity is divided into the areas of materials and the parachutes themselves. Technical staff requirements are outlined, and the need for close liaison between government and industry is emphasized. F.R.L.

A72-10305 # **The testing of parachutes at supersonic speeds.** A. R. Turley and J. A. I. Reid (Hunting Engineering, Ltd.). In: Two-Day Symposium on Parachutes and Related Technologies,

London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 16 p.

Results of experience in obtaining information on the performance of small ribbon parachutes at speeds up to Mach 1.5. Trial work was carried out in a 9 x 8 ft transonic wind tunnel, a rocket sled track, and a water channel simulator. The rocket-propelled test vehicle overcomes the problems in wind tunnel trials of the small size of the specimen and the low density of the air. Initial water-channel simulator trials determined that the largest practical model size was a parachute with a flying diameter of 3 in. F.R.L.

A72-10306 The influence of axial cords on parachute performance. K. James (Royal Aircraft Establishment, Farnborough, Hants., England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 17 p.

The paper describes some trials that have recently been made in a wind tunnel at RAE to ascertain some of the characteristics of parachutes fitted with axial cords. The properties examined were the effect of the length of the axial cord on the drag of the parachute, on the diameter and projected area, shape, drag coefficient and stability. The drag was separated into its two components, carried respectively by the axial cord and by the main rigging lines. The opening characteristics of the parachutes were not investigated in these trials, but a number of parachutes of different shape were examined. These trials were supplemented by full-scale tests on 124 parachutes fitted with axial cords, by dropping block rubber dummies with them from a balloon at Cardington, and the time of opening was measured in these trials. The results of all these trials are given in the paper and discussed. (Author)

A72-10307 # Observations on breathing and related phenomena in some paratroop type parachutes when freely descending. R. G. Hume and G. W. H. Stevens (Royal Aircraft Establishment, Farnborough, Hants., England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 14 p. 6 refs.

Results of a series of parachute trials arranged to perform a dual function: to study the performance of several paratroop-type parachute assemblies under various store loadings, and to observe breathing oscillations, if any, in these parachutes. High speed motion picture cameras and kinetheodolites tracked the parachutes for about 15 sec during the steady part of each descent. It appears that breathing does not appear to be a priority consideration; rather, there seems to be a need to concentrate on canopy stability. F.R.L.

A72-10308 # High speed parachute research in the U.K. B. Tansley and D. Northey (Irvin Great Britain, Ltd., Letchworth, Herts., England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 12 p. 9 refs.

Review of the results obtained in the aerodynamic and structural sections of a program designed to investigate problems of supersonic parachutes for release at speeds up to Mach 1.5 at low altitude. The work dealt with flat, conical and hemisflo ribbon parachutes, and was carried out in a wind tunnel and on a rocket sled. In addition to aspects of aerodynamic drag, structure, and loads in individual elements, ribbon flutter and inflation time are discussed. F.R.L.

A72-10309 # The performance of parachutes at low speeds. J. R. Mitchell (RFD-GQ, Ltd., Woking, Surrey, England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 6 p.

Study of the flow characteristics of parachutes in free descent at low airspeed, which requires taking account of the variation in drag, glide angle, and oscillation angle. Wind tunnel tests showed that the effect of the gliding angle was to make the total drag of the parachute about twice what would be expected for the same parachute following a path parallel to its axis. Flow patterns were studied in a water channel, from which it appears reasonable to assume that the section of the parachute canopy can be represented by the arc of a circle. F.R.L.

A72-10310 Theory and experiment on parachute opening shock and filling time. H. G. Heinrich (Minnesota, University, Minneapolis, Minn.). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 14 p. 18 refs.

Outline of a method of parachute opening force and filling time calculation which is based on the time functions of aerodynamic drag, included air mass, apparent mass, and effective porosity. Using the momentum and continuity equations, an idealized canopy shape development, and a linear drag area-time relationship, expressions are obtained for the canopy volume and velocity. The calculated peak forces agree well with least mean square averages of field test results of 28-ft solid flat parachutes. It was found that forces and times change very little when figures were used which are within the presently accepted range of values. F.R.L.

A72-10311 # The aerodynamic inflation of shell type structures with particular reference to parachutes. B. W. Roberts (Sydney, University, Sydney, Australia). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 19 p. 15 refs.

Development of a new method for calculating the inflation loads and inflation times on a variety of subsonic parachute assemblies. The method is intended to serve as an alternative to the 'filling time' method proposed by Heinrich et al. The unsteady pressure distribution on a decelerating, inflating parabolic shell of revolution in the presence of an unsteady starting vortex flow is derived. If this resulting pressure distribution is used in conjunction with the structural constraints on the parachute system, then it is possible to find explicitly the opening loads and opening times. In essence, the method is a numerical solution to a nonlinear, second-order continuous system beginning with an appropriate set of initial conditions. A series of numerical examples is given to illustrate the versatility of the method. F.R.L.

A72-10312 # Supersonic and transonic deployment of ribbon parachutes at low altitudes. R. C. Maydew and D. W. Johnson (Sandia Laboratories, Albuquerque, N. Mex.). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 17 p. 8 refs. AEC-supported research.

Results are presented for twenty-five flight tests of a 22.2-ft (6.8-m) diameter ribbon parachute (reefed for 0.5 sec) with a nominal 2000-lb (907 kg) store. The design, fabrication, and packing of the parachute system are discussed. Low altitude drop tests were made with F-4 and A-4 aircraft at Mach numbers from 0.57 to 1.22, and rocket-boosted tests were made at Mach numbers from 1.62 to

1.70, the latter corresponding to a maximum dynamic pressure of 2720 psf (130 kN/sq m). The maximum measured snatch load, reefed stage opening shock, and second stage opening shock were approximately 65 klb (289 kN), 165 klb (734 kN) and 150 klb (667 kN), respectively. The measured load data and sequence of parachute function times are relatively consistent and repeatable. There is no discernible effect of Mach number on the steady state drag area of the reefed parachute at Mach numbers from 0.7 to 1.50. (Author)

A72-10314 # **Materials for use in parachutes.** S. A. Birch (Irvin Great Britain, Ltd., Letchworth, Herts., England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings.
London, Royal Aeronautical Society, 1971. 17 p.

Outline of the properties required for canopy fabrics and rigging line cordages, with review of materials in use and suggestions as to future trends. Nylon 66 is considered to be the most suitable material, and will continue to be used extensively. Nonwoven scrim-reinforced fabrics are likely to be used as canopy fabrics for 'once-off' use. Polypropylene fabrics and cordages have the advantage of cheapness. F.R.L.

A72-10315 # **The strain of stitched joins.** J. R. Mitchell (RFD-GQ, Ltd., Woking, Surrey, England). In: Two-Day Symposium on Parachutes and Related Technologies, London, England, September 15, 16, 1971, Proceedings. London, Royal Aeronautical Society, 1971. 4 p.

Consideration of one type of nylon webbing and two main types of thread, flax, and nylon. Flax extends about 3% at failure, which means that when a webbing join is stitched with flax, the first row of stitching is unable to stretch sufficiently to pass on much of the strain to the second row of stitching. The use of a nylon thread enables the strain to be transmitted differentially along the stitched join, but if the thread is more than twice as strong as the weft yarn it is possible for the weft yarn to be broken instead of the stitching so that the main webbing becomes shredded. A thicker webbing is more efficient to stitch than a thinner one because the extension of thread is greater in comparison with the actual extension of the warp yarns. F.R.L.

A72-10384 **Aerospace wire and cables methods of testing.** *SAE Aerospace Standard,* AS 1198, July 15, 1971. 43 p.

Recommended physical, electrical, and chemical methods of testing aerospace wires and cables for conformance to the requirements of their controlling detail specifications and other related documents. The intent of this instruction is to promote standardization and to eliminate unnecessary or undesirable variation in testing procedures. Conductor, insulation, wire, and cable test procedures are detailed for evaluating mechanical properties, coating thicknesses, continuity flaws, resistance, flammability, dimensions, dielectric properties; geometrical symmetry, abrasion characteristics, durability of identification, power factors, thermal effects, smoke characteristics, and other requirements. T.M.

A72-10385 **High pressure oxygen system filler valve.** *SAE Aerospace Standard,* AS 1225, July 30, 1971. 4 p.

Optimum standards of design, construction, and performance are defined for an oxygen filler valve used in aircraft to ensure safe servicing of high-pressure oxygen system cylinders. The intent is that the valve shall automatically control the rate of fill such that the temperature rise in the oxygen system caused by compression heating of the gas will be within acceptable limits. In addition, the valve is to have a pressure sensitive closing valve to automatically control the final pressure for a correct amount of oxygen in the system cylinder. The pressure closing level may be manually selected by means of adjustment dials on the valve. T.M.

A72-10386 **Pressure altimeter system minimum safe performance standard.** *SAE Aerospace Standard,* AS 942, June 15, 1971. 15 p.

Specification of the requirements for minimum safe performance of an altimeter system in its normal mode of operation on subsonic aircraft. Compliance is a means of assuring that the altimeter system will satisfactorily perform its intended function when exposed to conditions encountered in routine operations. The instrument system specified shall accept an input of static pressure, and in some equipment other inputs, that contribute altitude information to provide a visual indication of pressure altitude. Test procedures are described which apply specifically to analog type instruments. F.R.L.

A72-10388 **Hose assemblies - Aircraft and missiles, lightweight plastic hose, low pressure.** *SAE Aerospace Recommended Practice,* ARP 1180, July 15, 1971. 12 p.

Physical requirements and quality assurance provisions for lightweight plastic hose assemblies to be used in aircraft and missile petroleum-base-fuel and petroleum-base and synthetic lubricating oil systems operating in a temperature range of -65 to +275 F at pressures to 200 psi. Performance tests, oil resistance tests, fuel resistance tests, flexibility and vacuum tests, qualification testing, and preparation for delivery of the product are detailed. T.M.

A72-10389 **Flight test procedures for static pressure systems installed in subsonic transport aircraft.** *SAE Aerospace Recommended Practice,* ARP 921, July 15, 1971. 11 p. 24 refs.

Definition of the test procedures and equipment for performing flight testing on pitot-static systems installed in subsonic transport aircraft, the regulator documents being those of the FAA and the SAE. Prior to flight testing of any pitot-static system, the system should have been tested in accordance with the recommendations of ARP 975. In the interest of standardization only the trailing cone method of flight calibration is recommended; it exhibits very little or no static pressure errors. In principle, the idea is to suspend a static reference far enough behind an aircraft so that the ports are not affected by the aerodynamic disturbances of the airframe. F.R.L.

A72-10390 **Turbine nozzle area measurement by airflow method.** *SAE Aerospace Recommended Practice,* ARP 1195, July 15, 1971. 21 p.

Description of a recommended practice which provides a standard basis for airflow measurement of the relative aerodynamic throat area of gas turbine nozzles. Methods, conditions of measurement, and acceptable standards of accuracy are covered, and equipment known to meet the general requirements is described. Standard reference nozzles and mounting flanges are specified. F.R.L.

A72-10506 # **Compensation of cross-couplings in aircraft motion (Kompensatsiia perekrestnykh sviazei v dvizhenii samoleta).** V. S. Mechetnyi. In: Complex control systems.

Kiev, Naukova Dumka, 1971, p. 132-142. 11 refs. In Russian.

Investigation of the problem of aeroinertial interaction between the longitudinal and lateral motions (pitching and yawing) of a high-speed aircraft. The presence of cross-couplings between these motions leads to a deterioration of the dynamic properties of the aircraft and a complication of the control process. It is noted that known means of combating this phenomenon are frequently accompanied by undesirable consequences involving a disturbance of controllability, a reduction of maneuverability, and a limitation of the possibilities of a modern high-speed aircraft. A method of compensating aerodynamic cross-couplings is proposed. The laws of operation of a special cross-coupling compensation device performing this task are determined. It is shown that if the time constant of the compensation device is taken into account the aircraft/compensator system will be stable if the isolated pitching and yawing motions were stable. A.B.K.

A72-10723 # **Strength and stiffness of sandwich panels under transverse loading.** M. Langley. *Aircraft Engineering,* vol. 43, Oct. 1971, p. 11-15. 8 refs.

Description of work performed to translate Allen's (1969) theory of structural sandwich panel design into a form suitable for rapid estimation in a design office. The properties of end grain balsa were evaluated from the viewpoint of using it as the core material between metal and reinforced plastic facings. The consistency of balsa at any given density was examined as an essential property of the shear modulus; the latter quantity was evaluated and checked through a large number of beam tests. The results were used in panel testing for establishing a simple design office method of calculating the stresses and corresponding deflections in panels. T.M.

A72-10724 # **A300B European Airbus - Hydraulics and landing gear.** *Aircraft Engineering,* vol. 43, Oct. 1971, p. 16, 17.

Description of the hydraulics and landing gear of the European Airbus, demonstrating that generally known solutions are used. The landing gear was designed to have long fatigue life (32,000 flights); safety - e.g., free fall lowering and downlocking; reliability; easy maintenance - e.g., all parts of the main gear are identical and interchangeable between right and left hand; and simplicity. Maximum effort was made toward keeping weight to a minimum. Altogether the gear with its retraction jacks, but without wheels, brakes, and tires, weighs 7800 lb, or 2.7% of the takeoff weight of the aircraft. F.R.L.

A72-10725 # **Flap and slat systems and tailplane actuator.** *Aircraft Engineering,* vol. 43, Oct. 1971, p. 20-23.

Description of the flap and slat systems and the tailplane actuator of the A300B which were designed to the highest standard of reliability combined with minimum weight. Complexity is reduced to a minimum, and maximum use is made of proven principles in an attempt to reduce development costs. The slat operating system comprises a control unit, a transmission system, and twelve ball screw jacks, and it is required to operate three slat sections in each wing. The flap operating system is basically similar. The tailplane actuator, sited in the unpressurized rear section of the fuselage, forward of the tailplane pivot center, controls the longitudinal pitch trim by setting the position of the variable incidence tailplane according to commands initiated by the pilot or autopilot. F.R.L.

A72-10749 **Tensile behavior of high-strength alloys during rapid heating.** D. Hauser (Battelle Columbus Laboratories, Columbus, Ohio) and J. W. Wright, Jr. (U.S. Army, Research and Engineering Directorate, Redstone Arsenal, Ala.). In: Space shuttle materials; Proceedings of the National Technical Conference, Huntsville, Ala., October 5-7, 1971. Azusa, Calif., Society of Aerospace Material and Process Engineers, 1971, p. 287-295. 7 refs. Contract No. N 60921-68-C-0220.

Studies of tensile behavior were conducted on two grades of maraging steel, Ti-6Al-4V titanium alloy, and 7075-T6 aluminum alloy by applying a high tensile stress at room temperature that was maintained during subsequent rapid heating to failure. The results were compared to properties obtained from standard room- and elevated-temperature tensile tests. Significant differences in tensile behavior between these types of evaluations were found that demonstrate the need for developing design properties under conditions that closely simulate launch and reentry service conditions. (Author)

A72-10783 **Experimental evaluation of lightning protective coatings for boron/epoxy composites.** E. H. Schulte and D. W. Clifford (McDonnell Aircraft Co., St. Louis, Mo.). In: Space shuttle materials; Proceedings of the National Technical Conference, Huntsville, Ala., October 5-7, 1971. Azusa, Calif., Society of Aerospace Material and Process Engineers, 1971, p. 737-745. 12 refs.

A number of candidate lightning protective coatings for composite structural materials have been evaluated in the McDonnell Aircraft Company (MCAIR) Lightning Simulation Laboratory. Emphasis has been placed on coating parameter optimization and elucidation of damage mechanisms. Coated and uncoated aluminum foils, plasma sprayed aluminum, aluminum meshes, and bronze meshes, on dielectric substrates were tested by exposure to simulated high current lightning strikes. (Author)

A72-10813 # **Radioactive gas penetrant system - A report on initial product application.** W. C. Eddy, Jr. (Industrial Nucleonics Corp., Columbus, Ohio). In: Symposium on Nondestructive Evaluation in Aerospace, Weapons Systems, and Nuclear Applications, 8th, San Antonio, Tex., April 21-23, 1971, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1971, p. 265-271.

Review of the application of radioactive gas penetrants to jet engine manufacturing nondestructive evaluation problems and maintenance or service problems. The process is superior for the detection of porosity in complex investment castings and shows promise for measuring and evaluating low-cycle fatigue damage. Although the gas penetrant system would appear to serve only as a technique where defects are open to the surface, microstructure anomalies in most engineering materials have given a surprising degree of depth measurement capability. F.R.L.

A72-10814 # **Development of ultrasonic field inspection equipment for T53 gas turbine compressor discs.** B. E. Leonard (School of the Ozarks, Point Lookout, Mo.), S. R. McFarland (Southwest Research Institute, San Antonio, Tex.), and J. M. Thorp (U.S. Army, Aviation Systems Command, St. Louis, Mo.). In: Symposium on Nondestructive Evaluation in Aerospace, Weapons Systems, and Nuclear Applications, 8th, San Antonio, Tex., April 21-23, 1971, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1971, p. 272-277. Grant No. DA-AJ-01-68-C-1981(31).

Study of the cracking mechanism and development of a nondestructive means of early crack detection, undertaken because of the occurrence of service-induced cracking in the tenons of T53

gas turbine compressor disks. An ultrasonic device to locate cracks in affected components without removing the engine from the aircraft is described. The unit is completely portable and self-contained. F.R.L.

A72-10816 # **A metallurgical analysis of cracking in compressor discs of the T53-L13 gas turbine engine.** H. C. Burghard, Jr. (Southwest Research Institute, San Antonio, Tex.). In: Symposium on Nondestructive Evaluation in Aerospace, Weapons Systems, and Nuclear Applications, 8th, San Antonio, Tex., April 21-23, 1971, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1971, p. 299-310. 6 refs. Army-sponsored research.

Results of a comprehensive metallographic and fractographic examination of selected cracked tenons from second-stage compressor disks. The macroscopic features of the crack surfaces indicated crack initiation at points along the groove surface but did not provide any definite evidence of the fracture mechanism involved. Electron fractographic examination revealed that the crack surfaces were characterized by a predominance of a unique 'step-type' topography and only limited regions of well-defined fatigue striations. The combined observations of the metallographic and fractographic investigation established that the predominant fracture mechanism involved in the cracking of second-stage disks was *high-cycle fatigue crack propagation.* F.R.L.

A72-10864 **An assessment scheme for aerodrome forecasts.** P. B. Wright. *Meteorological Magazine,* vol. 100, Oct. 1971, p. 285-293.

A method is described which enables an assessment to be made, in a broad sense, of the usefulness of a set of terminal aerodrome forecasts. The test is confined to the elements of visibility, surface wind and low cloud, and the scoring system is such that an error in the neighborhood of values critical for the landing and takeoff of aircraft is marked more harshly than an error in another part of the range. The scheme also takes into account the use of PROB, TEMPO and INTER in a way which simulates the loss of value to the customer of a reduction in the preciseness of the forecast. (Author)

A72-10946 **MSDS - An experimental 24-channel multispectral scanner system.** E. M. Zaitzeff (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). In: Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings. Amsterdam, North-Holland Publishing Co., 1971, p. 702-711.

Description of the electromechanical scanner, encoding and recording electronics, ground processing operations, and aircraft mounting details of a multispectral scanning system to be flown in a NASA C-130 earth resources aircraft. Scanner operation covers 24 channels assigned to bands between 0.34 and 13 microns. The energy reflected or radiated from underlying terrain is reflected from a 45-deg rotating mirror and introduced into a spectrometer followed by appropriate detectors for the different channels. Calibration sources are explained, together with the electronics equipment. T.M.

A72-10960 **Automated air traffic control.** W. G. Laliberte, J. C. Nelson (Sperry Rand Corp., Univac Div., Washington, D.C.), R. J. Rolfe, J. C. Sater, J. D. Erickson, and G. L. Humfelt (Sperry Rand Corp., Univac Div., St. Paul, Minn.). *Sperry Rand Engineering Review,* vol. 24, no. 2, 1971, p. 2-23.

Description of the automated radar terminal system, ARTS III, whose installation is either planned or underway in 62 major U.S. air terminals. It is a modularly expandable, radar-controlled, beacon-tracking system which satisfies its essential design goal: it monitors - and has the potential capability of tracking - all aircraft flying within its radar range. In essence, ARTS 'sees' all aircraft within a 55-mile radius of the terminal, and displays the tracks of all beacon-equipped aircraft. The information displayed for the controller includes identification, altitude, and ground speed. By 1980, it is expected that 200 of the most advanced terminal automation systems will be in operation, thereby enabling the traffic controller to keep pace with the increase in global air traffic. M.V.E.

A72-10961 **Automated landing system.** M. J. Popik (Sperry Rand Corp., Sperry Flight Systems Div., Phoenix, Ariz.). *Sperry Rand Engineering Review,* vol. 24, no. 2, 1971, p. 24-31.

The role of automatic flight control in the over-all air traffic monitoring scheme is to provide precision, consistency, and automaticity, while giving flight crews more time for situation assessment and managerial duties. This role is especially crucial in the terminal area, where traffic density compounds crew workload and where the need for craft guidance during poor weather conditions presents the greatest challenge. Over the past five years, automatic flight control capability has been expanded to include not only landing, but also a variety of cruise modes of operation as required under specific, federally designated weather categories. The most recent automatic landing system to go into scheduled service is the 'fail-operational' system in the Boeing 747, which includes Sperry Rand's SPZ-1 autopilot-flight director system. This system has the capability of sustaining a failure while automatically guiding an aircraft to touchdown. As a result, it is the first autoland system for which a reduction in operational weather minimums has been allowed by either the United States or United Kingdom regulatory agencies. Early versions of the SPZ-1 and other automated Sperry Rand equipment have been controlling scheduled commercial aircraft to touchdown since February 1967, when one of Pan American's Boeing 727 jetliners made a fully automatic landing at JFK International Airport in New York. Since that time, other commercial aircraft have gained certification for automatic landing; in the future, all major aircraft are expected to be certified with autoland capability as a result of the safety it has added to poor-weather landings. (Author)

A72-10962 **Electronic scanning array for ATC.** J. J. Stangel and R. J. Timms (Sperry Rand Corp., Sperry Div., Great Neck, N.Y.). *Sperry Rand Engineering Review,* vol. 24, no. 2, 1971, p. 32-36.

Phased array systems overcome many of the critical restraints on air traffic control. They can be used for air traffic control radar beacon systems, airport or air route surveillance radars, and ground landing systems. A microwave data link between aircraft and ground control can be incorporated in the beacon system on a time share basis, significantly alleviating the burden on voice communications. The flexibility of electronic scanning will contribute to further automation of the air traffic control system. (Author)

A72-10963 **Aircraft power steering.** J. Camp and M. J. Campbell (Sperry Rand Corp., Vickers Div., Troy, Mich.). *Sperry Rand Engineering Review,* vol. 24, no. 2, 1971, p. 37-40.

The increasing demand for short-haul air travel, once in the exclusive service of big business but now compounded by a more general public need, has contributed to a rapid sales growth of intermediate-sized aircraft. The intermediate-sized plane must be able to utilize small fields (many of which do not have elaborate service

and maintenance facilities); at the same time, it must be capable of restarting with a self-contained energy source after standing unattended for long periods of time. All aircraft subsystems, designed with this same self-sufficiency potential, must be simple enough for easy maintenance and repair, yet sufficiently rugged for long life. An electromechanical nose wheel steering system developed by Sperry Rand's Vickers Division now supplies general aviation aircraft with the needed maneuverability and durability, and meets each aircraft's unique design parameters. (Author)

A72-10964 A simple three-dimensional missile trajectory model. G. B. Henton (Hughes Aircraft Co., Culver City, Calif.). *Simulation*, vol. 17, Aug. 1971, p. 83-87.

A three-dimensional trajectory model for missiles roll-controlled to an extent precluding any appreciable degree of roll is presented. It makes possible quite simple time-sharing digital or analog three-dimensional simulations. Motivation for the development of this missile trajectory model came from the need to overcome the limitations of single-plane simulation which restricts consideration to incoming and outgoing targets, even though crossing targets are of equal - if not greater - interest. In developing the presented trajectory model, advantage was taken of the existence of an easily computed direct transformation from wind-axis coordinates to inertial-axis coordinates for the case of a perfectly roll-controlled missile. M.V.E.

A72-10968 Manufacturing experiences with graphite filament reinforced composites. F. J. Fechek (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Philadelphia, Pa., Apr. 26-30, 1971, Paper EM 71-205.* 16 p.

Graphite filament reinforced composites possessing significant strength and modulus to density ratios have been developed to the point where feasibility and performance potential has been definitely established. The fiber/resin combinations available provide the designer with many alternatives to mechanical performance vs cost and manufacturing technique. This multiplicity of materials systems has tended to limit the obtaining of a large amount of statistical data on any single system to date, however. A description of the various constituent materials properties is presented along with a listing of components which have been designed, fabricated and tested using graphite fiber reinforced composites as the major structural material. Selected examples of structural hardware demonstration items are used to describe the fabrication processes and the tooling concepts which were employed. (Author)

A72-10969 Integrity control procedures for machining 300M steel and titanium aircraft components. C. M. Fleming and P. Arzt (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Philadelphia, Pa., Apr. 26-30, 1971, Paper IQ 71-238.* 18 p.

This paper describes engineering programs and methods used at McDonnell Aircraft Company (MCAIR) to develop surface integrity data for establishing process requirements for conventional machining, drilling, and grinding 300M steel and Ti-6Al-4V annealed titanium. Procedures, specimen types and test data obtained during drilling, reaming, and grinding of these materials are given. Also included is a discussion of the temper etch inspection method for steel surfaces and various methods used to improve the sensitivity of this nondestructive inspection method. Finally, methods used to control surface integrity during the fabrication of both commercial and fighter aircraft parts are described. (Author)

A72-11021 Ultrasonic inspection of helicopter rotor blades. I. Glover (Westland Aircraft, Ltd., Yeovil, Somerset, England). In: Ultrasonics 1971; Proceedings of a Conference, London, England, September 28, 29, 1971. Guildford, England, IPC Science and Technology Press, Ltd., 1971, p. 76-78.

Description of an automatic ultrasonic testing facility for use in inspecting a new type of blade construction on the Lynx helicopter. The basic NDT problems involved in inspecting the new type of blade are outlined, and the methods employed in solving them are described. Finally, the complete test installation is discussed, including the arrangements for ultrasonic inspection, complex scanning, and facsimile recording. A.B.K.

A72-11067 Influence of electric power quality on avionic design and weapon system effectiveness. J. S. Frichtel (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: PCSC '71; Power Conditioning Specialists Conference, California Institute of Technology, Pasadena, Calif., April 19, 20, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 152-161.

Design of all avionic systems on future aircraft is tied to the past by MIL-STD-704. Despite dramatic advances in performance and reliability of the avionic equipments, the power conditioning section of each subsystem must still tolerate wide frequency swings on a transient basis, long power interruptions, large voltage transients, and unbalanced phase voltages. During the past decade, General Electric has developed the variable speed constant frequency (VSCF) generation equipment under sponsorship by the U.S. Navy and Air Force. The power quality available through VSCF systems represents a significant improvement over that required by MIL-STD-704. The weapon system improvements achievable through the use of this improved power were reviewed and assessed on existing production avionic subsystems. Proposed next generation avionic systems were also assessed to determine relative benefits achievable for new designs. Parameters considered were power dissipation, weight, volume, reliability, performance and cost. Data from this study on specific equipments was extrapolated to the avionic systems of future aircraft and cost and weight projections were made for both avionics and airframes. (Author)

A72-11068 * A hybrid electrical power system for aircraft application. C. H. Lee and C. Y. Chin (AiResearch Manufacturing Co., Torrance, Calif.). In: PCSC '71; Power Conditioning Specialists Conference, California Institute of Technology, Pasadena, Calif., April 19, 20, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 162-174. Contract No. NAS 12-659.

Possible improvements to present aircraft electrical power systems for use in future advanced types of aircraft have been investigated. The conventional power system is examined, the characteristics of electric loads are reviewed, and various methods of power generation and distribution are appraised. It is shown that a hybrid system, with variable-frequency generation and high-voltage dc distribution, could overcome some of the limitations of the conventional system. O.H.

A72-11107 On the concept of air law (Zum Begriff des Luftrechts). W. Schwenk. *Zeitschrift für Luftrecht und Weltraumrechtsfragen*, vol. 20, Oct. 1, 1971, p. 260-263. 10 refs. In German.

Air law comprises the totality of legal regulations related to the use of the earth atmosphere by devices which maintain themselves in

the atmosphere through the utilization of the air properties. The relation of air law to concepts considered by Sand (1971) in connection with questions of international environmental protection and the use of the atmosphere is discussed. It is argued that an extension of the customary concept of air law as proposed by Sand would lead to an interlacing of various formerly strictly limited legal areas. Such an extension is objected to on the basis that it would be very difficult to define the boundaries of the new field. G.R.

A72-11109 Development of the DC-10 Nondestructive Testing Manual. D. J. Hagemaier and H. J. McFaul (Douglas Aircraft Co., Long Beach, Calif.). *Materials Evaluation,* vol. 29, Nov. 1971, p. 249-255.

The completion status and format of the NDT Manual being developed by a team of specialists are discussed. A detailed explanation of the section/subject format and a summary of NDT methods used are given. Planned accessibility to specific areas monitored by nondestructive test methods is the key to successful maintenance inspections based on the Manual. V.Z.

A72-11117 Aviation system design for safety and efficiency. N. Braverman (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.). *(Institute of Navigation, Annual Meeting, 27th, Pasadena, Calif., June 29-July 1, 1971.) Navigation,* vol. 18, Fall 1971, p. 308-319. 28 refs.

Acceptable levels of risks and methods for determining appropriate safety limits are discussed. The basic principles of proper and improper use of such design characteristics as accuracy, blunder rate, reliability, redundancy, Kalman filtering, independence, integration, and flexibility are reviewed with particular reference to their effects upon safety as distinguished from efficiency of air traffic control systems. Mutually consistent definitions of these various loosely used terms are presented. The nature and role of blunders and the basic principles usable for their prevention through employment of navigation facilities and independent surveillance systems are examined. M.V.E.

A72-11118 The role of inertial navigation in future air traffic control systems. D. Mackinnon and J. W. Hursh (MIT, Cambridge, Mass.). *(Institute of Navigation, Annual Meeting, 27th, Pasadena, Calif., June 29-July 1, 1971.) Navigation,* vol. 18, Fall 1971, p. 320-330. 8 refs.

Review of some of the trends in automatic flight control system development which will have a significant effect on the performance of the future air traffic control system. The higher path-control accuracies achievable with the aid of inertial measurement data will permit fully automatic flight operations under environmental conditions (wind, wind gust, and wind shear) which would be prohibitive with current technology. In addition, higher path accuracies and improved versatility will permit complex curved approach and departure paths leading to reductions in noise and air pollution while achieving maximum terminal capacity with a mix of CTOL, STOL, and VTOL aircraft. M.V.E.

A72-11132 # The configuration of a cable towed in a circular path. R. A. Skop (U.S. Navy, Naval Research Laboratory, Washington, D.C.) and Y.-I. Choo (Catholic University of America, Washington, D.C.). *Journal of Aircraft,* vol. 8, Nov. 1971, p. 856-862. 7 refs.

The problem of determining the equilibrium configuration of a cable towed in a circular path has both mathematical and practical interest. Mathematically, this interest is generated because of the multivalued nature of the boundary value problem. Practically, this interest arises because the towed drogue, for certain ranges of the governing parameters, obtains an equilibrium position very near the axis of rotation thus enabling pinpoint deliveries of payloads from fixed-wing aircraft. In this paper, the circular towing problem for a flexible, inextensible cable is examined. The equations of equilibrium and the boundary conditions which govern the cable configuration are derived and nondimensionalized to isolate the important parameters. The significance of these parameters for modeling the towing system is discussed. Finally, extensive numerical results are obtained for a particular airborne system. This example shows that an intimate relation exists between the mathematically interesting multivalued regions of solution and the practically interesting regions for which large towline verticality and small drogue radius are simultaneously present. (Author)

A72-11133 # An approximate true damping solution of the flutter equation by determinant iteration. H. J. Hassig (Lockheed-California Co., Burbank, Calif.). *Journal of Aircraft,* vol. 8, Nov. 1971, p. 885-889. 17 refs.

Description of the difference between a true damping, or rate-of-decay, solution of the flutter equation and the structural-damping-type of solution. True damping solutions are possible if unsteady aerodynamics can be expressed in terms of the complex variable p. If the aerodynamics are given at discrete values of the reduced frequency k, an approximate determination of the true damping is possible by assuming that the aerodynamic forces for harmonic motion are a good approximation for the cases of slowly increasing or decreasing amplitude. A determinant iteration method for obtaining the solution is presented. Results obtained by different methods of solving the flutter equation are compared. M.M.

A72-11134 * # Analysis of pilot warning indicator performance in terminal area traffic. J. R. Ruetenik, W. R. Lange, and J. H. Thompson (Kaman Sciences Corp., Burlington, Mass.). *Journal of Aircraft,* vol. 8, Nov. 1971, p. 905-911. 11 refs. Contract No. NAS 12-698.

Three pilot warning indicator concepts for collision hazard avoidance are analyzed using computer fast-time simulation. A hazard measure is defined based on a 1/2-g maximum horizontal acceleration, a maximum climb or dive angle of 10 deg for each aircraft, and a 20-sec warning time, through escape completion. The traffic model is based on flight tracks recorded in the Atlanta terminal area over an 11 hr period during August 1967. The basic PWI concept studied alarms on range to flashing beacons mounted on intruder aircraft as a function of relative azimuth and elevation. The alarm-hazard epoch ratio is about 17/1 to maintain the missed-alarm rate below 10%. Beacon vignetting or range-rate discrimination are shown to reduce the false-alarm rate by about 75%. (Author)

A72-11135 # Vortex velocity distributions at large downstream distances. A. H. Logan (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *Journal of Aircraft,* vol. 8, Nov. 1971, p. 930-932. 5 refs. Contract No. DA-31-124-ARO(D)-149.

Extension of the available data on the velocity structure within a trailing line vortex to large distances downstream of the generating wing. Data are presented to show the variation of both axial and tangential velocity with tunnel speed and trailing vortex strength. Specifically, data are presented at downstream distances of 10 and

26 chord lengths behind a semispan wing set at 4 and 12 deg angle of attack for tunnel speeds of 50 and 70 mph. It is pointed out that, for both speeds considered, the vortex generated at 4 deg angle of attack dissipated more rapidly than the vortex generated at 12 deg angle of attack. M.M.

A72-11136 # Determining aircraft stability coefficients from dynamic motions. S. M. Batill and C. W. Ingram (Notre Dame, University, Notre Dame, Ind.). *Journal of Aircraft,* vol. 8, Nov. 1971, p. 932-934. 5 refs.

Description of analytical and experimental work indicating that the aerodynamic stability coefficients can be extracted from the angular motion of aircraft configurations. Using a numerical integration fitting technique applied to the differential equations of motion, it is possible to determine values for the stability coefficients without imposing limiting assumptions on the configuration or its motion. The fitting technique demonstrated a high degree of accuracy as well as establishing the nonlinearity of the stability coefficients. This technique is currently being applied to the complete pitch, yaw and roll of an aircraft configuration with primary interest in extracting the cross-coupling stability coefficients. M.M.

A72-11137 # Acoustics - A new approach for monitoring the environment near airports. D. W. Beran (NOAA, Wave Propagation Laboratory, Boulder, Colo.). *Journal of Aircraft,* vol. 8, Nov. 1971, p. 934-936. 11 refs.

Description of a relatively new device, an acoustic echo sounder, which has the potential of not only indicating the presence or absence of wake vortices, but of acting as a continuous monitor of other important meteorological parameters of airport environments. The device consists of a fixed, vertically pointing antenna, in conjunction with two orthogonally positioned scanning antennas, which could provide a continual real time record of the inversion height, turbulent intensity, as well as an indication of the presence of wing tip vortices, and the vertical profile of the total wind vector. M.M.

A72-11150 Production applications of EDM and ECM. *Manufacturing Engineering and Management,* vol. 67, Nov. 1971, p. 19-22.

The applications of EDM and ECM machines in continuous and repetitive production of aircraft jet engine components at General Electric in Evendale are discussed. The machines are used for drilling and cutting when conventional machining of the thin-cross-section machine parts made of high temperature superalloys is costlier or difficult and impractical. Production of contoured slots, cutting of small holes, feeding of parts into electrodes, multiple-lead EDM, power supply units, and scalloped compressor retainers are covered as particular types of EDM and ECM tooling applications. The Shaped Tube Electrolytic Machining (STEM) method, an ECM variation for drilling small holes, is also described briefly. V.Z.

A72-11151 Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Annual Report 1970 (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Jahresbericht 1970). Porz-Wahn, Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, 1971. 422 p. In German.

A summary is presented of the organizational structure and areas of activity of the Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt (DFVLR) during the year 1970. The distribution of activity at the various facilities operated by the DFVLR is illustrated. Research being performed and findings obtained in the fields of flow mechanics, flight mechanics and piloting, strength of materials and structures, power plants and power conversion, and electronics are summarized, as well as research in the field of physics of the atmosphere, space simulation, and flight medicine. The operations of various computer centers maintained by the DFVLR are described, and the organization of the various institutions and working groups of the DFVLR which deal with problems of aircraft and spacecraft design and propulsion is discussed. The work of a study group dealing with extraterrestrial research is cited. A.B.K.

A72-11153 STOL aircraft in future transport systems. E. E. Marshall (British Aircraft Corp., Ltd., London, England). *Aeronautical Journal,* vol. 75, Oct. 1971, p. 695-704.

Travel characteristics and habits are examined in order to show how short takeoff and landing (STOL) aircraft can dramatically reduce the noise and land use problems. In particular, the following topics are discussed: airport congestion; community noise; airport location and layout; and traffic growth and airport capacity. An airport system for the United Kingdom and the London area is suggested together with a proposed STOL airliner design to meet these requirements. O.H.

A72-11154 A note on subsonic linearised theory for symmetrical cranked wings at zero incidence. R. C. Lock (Ministry of Technology, National Physical Laboratory, Teddington, Middx., England). *Aeronautical Journal,* vol. 75, Oct. 1971, p. 735-739.

Corrected formulas are presented for the basic streamwise and spanwise components of perturbation velocity due to the thickness, at and near the crank, in a simplified example consisting of two semiinfinite wing panels of different sweep angles joined together. Possible singularities in the flowfield in the neighborhood of the crank are examined. Finally, the implications of these formulas on the magnitude of the 'crank effect,' including the influence of freestream Mach number, are qualitatively discussed. O.H.

A72-11158 Time dependence of variances of sonic boom waveform. G. Kamali and A. D. Pierce (MIT, Cambridge, Mass.). *Nature,* vol. 234, Nov. 5, 1971, p. 30, 31.

Sonic boom pressure signatures during level overflights of F-104 aircraft (flight Mach number of 1.3 at 30,000 ft altitude) were recorded by forty-two ground-level microphones spaced equally in an 8,000-ft linear array. The variations in the signatures recorded by different microphones during the same overflight are believed to be caused primarily by atmospheric turbulence. The variations in these data were analyzed, and the results are used to partially substantiate Crow's (1969) theoretical model. T.M.

A72-11178 Numerical calculation of a sonic flow about an aircraft wing profile, by an inverse method (Calcul numérique d'un écoulement sonique autour d'un profil d'aile d'avion par une méthode inverse). D. Euvrard, J. Hubert, F. Rigaut, and G. Tournemine (Rennes, Université, Rennes, France). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques,* vol. 273, no. 16, Oct. 18, 1971, p. 739-742. 6 refs. In French. Research supported by the Direction des Recherches et Moyens d'Essais.

The first three terms are considered in the asymptotic development of a long-distance velocity field of an arbitrary plane symmetrical obstacle. The trail of this development on a large circle

is used in initiating the study. A mixed Cauchy problem is then solved by combining the pseudoviscosity-introducing Lax finite difference scheme with an extrapolation to the limit. The results obtained show qualitative agreement with experimental data. M.V.E.

A72-11258 # **From the propeller to the jet engine (Dall'elica al reattore).** G. Rotondi. *Alata Internazionale,* vol. 27, Oct. 1971, p. 17, 18, 21 (2 ff.). In Italian.

Discussion of problems connected with increasing the efficiency of modern air transport. It is pointed out that the large-capacity helicopter is best suited to operate from extremely small spaces and to reach adequate speeds over short hauls. The conventional aircraft is logically the most economical transportation over distances of 500-600 km, while STOL's supremacy from 150 to 500 km appears to be unchallenged. The VTOL aircraft also offers remarkable possibilities, particularly in the most radical solutions which are less penalized by the necessity of achieving a delicate compromise of a technical and operational nature. The features of various versions of STOL and VTOL aircraft are examined from the standpoint of performance and efficiency, together with various approaches to the problem of reducing landing and takeoff distances. M.M.

A72-11373 # **Thermal strength testing methods for aircraft gas turbine engine nozzle apparatuses (Metodika termoprochnostnykh ispytanii soplovykh apparatov turbin aviatsionnykh GTD).** P. F. Grigor'ev and M. P. Meshcheriakov. *Prochnost' i Dinamika Aviatsionnykh Dvigatelei,* no. 6, 1971, p. 182-185. In Russian.

A special gasdynamic test stand is used for thermal shock tests on aircraft gas turbine engine nozzles to determine the causes of damage produced in nozzle blades under thermal load cycles. It is found that cracks and edge wobbling, depending on blade material, can be produced by cycled thermal loads in nozzle blades. The damage is linked to stability loss due to creep under pressure. It is also shown that the thermal fatigue damage can be controlled by varying the thermal cycle parameters and temperature maxima. V.Z.

A72-11374 # **Determination of radial stresses in ring-to-drum transition areas of disks (K opredeleniiu napriazhenii v radiusakh perekhoda oboda diska v baraban).** A. A. Kovalev, A. A. Simakov, and I. I. Kurtseva. *Prochnost' i Dinamika Aviatsionnykh Dvigatelei,* no. 6, 1971, p. 185-190. In Russian.

Analysis of thermal stresses which develop in the disk-to-drum transition areas of the axial compressor of an operating AM-3 aircraft engine. The thermal stresses vary in magnitude and sign, produce tension during takeoff and compression during landing, and may lead to radial cracks in these areas. Experiments are carried out to measure the temperature and stress distributions in rigidly connected compressor disks and drums. The occurrence of alternating static loads in the rigid-junction areas is demonstrated by both calculations and experiments. V.Z.

A72-11395 **The three-dimensional turbulent boundary layer on an infinite yawed wing.** J. F. Nash and R. R. Tseng (Lockheed-Georgia Research Laboratory, Marietta, Ga.). *Aeronautical Quarterly,* vol. 22, Nov. 1971, p. 346-362. 10 refs.

Description of the results of calculations of the incompressible turbulent boundary layer on an infinite yawed wing. The effects of increasing lift coefficient, and increasing Reynolds number, on the displacement thickness, and on the magnitude and direction of the skin friction, are discussed. The effects of the state of the boundary layer along the attachment line are also considered. A study is made to determine whether the behavior of the boundary layer can adequately be predicted by a two-dimensional calculation. It is concluded that there is no simple way to accomplish this. However, with some modification, a two-dimensional calculation can be made to give an acceptable numerical representation of the chordwise components of the flow. M.M.

A72-11441 **Experimental manufacture of Inconel Alloy 718 compressor rotor blades from metal powder preforms.** B. Triffleman, F. C. Wagner, and K. K. Irani (Curtiss-Wright Corp., Buffalo, N.Y.). In: Modern developments in powder metallurgy, Volume 5; Proceedings of the International Powder Metallurgy Conference, New York, N.Y., July 12-16, 1970.
New York, Plenum Press, 1971, p. 37-46. 6 refs.

Development of methods for making aircraft quality parts from forged Inconel Alloy 718 metal powder preforms. Wherever possible, standard production type equipment was used for the consolidation of the metal powders, and metal powder preforms were designed which would fit into present shop forging practices. It was found possible to produce fully dense aircraft engine compressor blades meeting specification properties, including improved fatigue properties as compared with conventional wrought blades. F.R.L.

A72-11511 # **Buckling of an elastic column containing a fatigue crack.** A. Berkovits and A. Golod (Technion - Israel Institute of Technology, Haifa, Israel). *Society for Experimental Stress Analysis, Fall Meeting, Milwaukee, Wis., Oct. 19-22, 1971, Paper 1914A.* 17 p. 10 refs.

Results of an experimental program conducted in order to study the residual buckling strength of an elastic column containing a fatigue crack, are presented in this paper. Tests were performed on bars of rectangular cross-section, made from 2024-T351 aluminum-alloy plate and containing a fatigue crack at the midsection. Results obtained show a reduction of buckling strength of 8% under hinged-hinged end conditions, in apparent tentative accord with data obtained from columns containing machined notches. Although it is small, the reduction in buckling strength is thought to be significant for design and requires further investigation. (Author)

A72-11584 # **One-dimensional unsteady flow in a rotating vane cascade (Odnomernoe nestatsionarnoe techenie vo vrashchaiushcheisia reshetke).** V. T. Mitrokhin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Sept.-Oct. 1971, p. 77-83. 6 refs. In Russian.

Theoretical analysis of the dynamic behavior of one-dimensional fluid flows in the rotating and static vane cascades of turbine engines. The propagation of vibrations in a fluid flow having an unsteady average velocity during rotation is discussed. It is assumed that a cascade vane is a linear system with distributed parameters and that mechanical energy is fed into and removed from the system by vibrations. V.Z.

A72-11637 # **Experimental investigation of the strength of rotating disks in aircraft gas turbines operating under variable thermal conditions (Eksperimental'noe issledovanie prochnosti vrashchaiushchikhsia diskov aviatsionnykh gazovykh turbin, rabotaiushchikh v usloviiakh teplosmen).** V. I. Formichev, I. A. Kozlov, V. A. Sekistov, and V. M. Leshchenko. In: Strength and plasticity. Moscow, Izdatel'stvo Nauka, 1971, p. 380-382. In Russian.

Description of a test assembly for strength analysis of gas turbine disks at rotation rates up to 75,000 rpm with temperature

gradients between the periphery and center of the disk reaching 500 C in alternation. Thermal and mechanical loads close to real operational loads can be obtained when this assembly is used in testing gas turbine disks. V.Z.

A72-11654 * The handling qualities simulation program for the augmentor wing jet STOL research aircraft. W. B. Cleveland (NASA, Ames Research Center, Moffett Field, Calif.). In: *Fall Joint Computer Conference, Las Vegas, Nev., November 16-18, 1971, Proceedings.* Montvale, N.J., AFIPS Press, 1971, p. 213-223.

Description of a program in which a complete STOL research aircraft (modified de Havilland C8-A Buffalo) was simulated to determine final design values for control systems and devices which augment aircraft control. Program objectives, computer requirements, and the simulation software and hardware are outlined together with the organization of the digital operations. The simulation program in combination with simulator hardware provided test pilots a realistic representation of the aircraft, with the result that various control and stability augmentation systems were evaluated using pilot handling qualities ratings. Final design parameters were then found for the aircraft which is scheduled for flight test in early 1972. T.M.

A72-11669 # A note of the configuration of jet sheet on a thin, jet-flapped airfoil. T. Kida and Y. Miyai (Osaka Prefecture, University, Sakai, Japan). *Osaka Prefecture, University, Bulletin, Series A - Engineering and Natural Sciences,* vol. 19, no. 2, 1970, p. 187-196. 5 refs.

Derivation of a solution to an integrodifferential equation describing the aerodynamic behavior of this airfoil within the framework of the linear theory. Convergence of the solution is examined and the solution is extended in the form of a power series to be applicable to the airfoil configuration at the trailing edge, at infinity and at an intermediate point. Calculations are made to compare this solution with the one given by Spence (1956), showing that the latter is less effective. V.Z.

A72-11699 # The development of small gas turbine engines at UACL /Lecture/. J. P. Beauregard (United Aircraft of Canada, Ltd., Longueil, Quebec, Canada). *(Canadian Aeronautics and Space Institute, Annual General Meeting, Montreal, Canada, May 6, 7, 1971.) Canadian Aeronautics and Space Journal,* vol. 17, Oct. 1971, p. 308-322. 10 refs.

Two types of successful small gas turbine aircraft engines - i.e., PT6 and JT15D - are discussed in detail. A review is presented of the PT6 and JT15D stories covering the factors which led to their overall configuration, some representative development problems, and the experience with the engines in service. O.H.

A72-11700 # On the possibility of roll control for the externally-blown jet flap. R. H. Wickens (National Research Council, Low Speed Aerodynamics Section, Ottawa, Canada). *Canadian Aeronautics and Space Journal,* vol. 17, Oct. 1971, p. 329, 330.

Correction of rolling moments, induced by an asymmetric loss of lift due to an engine failure, has been investigated for the case of the externally blown flap. A relatively simple technique is proposed which may be used to aid conventional controls and which yields encouraging results. The results indicate a significant measure of roll control in the event of an engine failure, provided sufficient lateral adjustment of the additional lift distribution is available. O.H.

A72-11716 Air transportation in our changing society. J. P. Loomis and J. K. Wetherbee (Battelle Columbus Laboratories, Columbus, Ohio). *Battelle Research Outlook,* vol. 3, no. 2, 1971, p. 2-6.

Description of the present situation in the air transport industry, with discussion of what is needed and of what might be done to achieve the kinds of service that air transport can furnish. Attention is given to general and commercial aviation, and the roles of the FAA and CAB. Various possible policies are considered, leading to the conclusion that the Federal government must provide the leadership in making them work. F.R.L.

A72-11717 Improving the efficiency of airports. R. H. Byers, C. B. Shields, and R. E. Thompson. *Battelle Research Outlook,* vol. 3, no. 2, 1971, p. 7-12.

Outline of the steps being taken to develop more efficient airports in order to shorten total trip time. Airports must be enlarged, boarding gates must be spread out, and the parking space must be expanded. These changes involve longer travel distances within the terminal area. Basic transport systems considered are the continuous type (private cars or taxis), and the batching type (buses and guided systems). Baggage handling, fire protection, security, monitoring of dispersed equipment, and central control are discussed. F.R.L.

A72-11718 Air traffic control - A problem in decision-making. A. C. Robinson and J. D. Hill (Battelle Columbus Laboratories, Columbus, Ohio). *Battelle Research Outlook,* vol. 3, no. 2, 1971, p. 13-17.

Exposition of the tasks of air traffic control, which must keep thousands of crisscrossing flights untangled. Some 16,000 air traffic controllers man the system, and are distributed between the Air Traffic Control Centers, which control traffic en route, and the terminal areas which control takeoffs, approaches, landings, and terminal-area holding patterns. The way the system works is outlined, various problems are discussed, and future improvements are described. Technological and administrative delays in correcting deficiencies are reviewed. F.R.L.

A72-11719 For a better, short-haul flight. J. W. Chadwick, R. F. Porter, and E. F. Hitt (Battelle Columbus Laboratories, Columbus, Ohio). *Battelle Research Outlook,* vol. 3, no. 2, 1971, p. 18-21.

Characterization of the needs of the short-haul air transport system, with suggestions of how future short takeoff and landing aircraft will help satisfy them. To achieve the goal aircraft, airways, and airports must be developed jointly, within the constraints of economic reality. A cruising speed of about 400 kt is desirable, as well as the ability to fly safely at low airspeed. Aircraft should be able to operate from runways less than 2000 ft long, and to climb steeply. Attention is given to navigation and landing aids, as well as to the interrelationship between short-haul airports and the community. F.R.L.

A72-11720 Smoother travel in rough air. J. H. Brown, Jr. (Battelle Columbus Laboratories, Columbus, Ohio) and L. J. Reynolds. *Battelle Research Outlook,* vol. 3, no. 2, 1971, p. 22-25.

Discussion of aircraft ride comfort, a subject of considerable importance, since about 85% of all flights take place at moderate or low altitudes, where turbulence is greatest. The main problem is due to unscheduled rising or sinking; rotational oscillation and structural

vibration are of relatively minor importance. One route to comfort criteria is to correlate personal discomfort stemming from the severity of in-flight turbulence with measured aircraft responses. Free-wing and fixed-wing aircraft are compared, and it is considered that the former are of considerable promise. Such wings are free, either partially or completely, to rotate about a lateral axis that extends through the fuselage. F.R.L.

A72-11721 Air transportation in the American economy. N. Simons, Jr. and R. L. Craig (Battelle Columbus Laboratories, Columbus, Ohio). *Battelle Research Outlook,* vol. 3, no. 2, 1971, p. 26-29.

Attempt, beginning with 1960, to find reliable figures for dissecting civil aviation into its major contributing factors to the American economy, and estimating their worth. The overall contribution is the sum of the sales of aviation services by air carriers, plus the costs of operating business and personal aircraft. In the 1970's, civil aviation can expect benefits from population changes, particularly in age distribution. Three factors in future growth are real disposable income, airline fares, and the time-trend variable. It is suggested that the demand for air transportation will be able to support an annual increase in growth of about 15%. It is pointed out that almost as many people now travel by general aviation as by scheduled airlines. F.R.L.

A72-11756 Electronic displays for attack aircraft (Elektronische Displays für Kampfflugzeuge). R. Beyer (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). *Wehrtechnik,* no. 6, 1971, p. 235-239. 5 refs. In German. (DFVLR-SONDDR-140)

The characteristics of modern attack aircraft, their subsystems, and the role of the pilot are described. Features of electronic displays employed in these aircraft are reviewed, and the development of suitable displays using a mission model for testing individual flight maneuvers is discussed. Basic principles of the simulation technique are outlined, and display design criteria are examined. Recent advances in the display techniques, such as head-up and head-down displays, multisensor displays (MSD), and eyeglass displays, are reviewed. Future prospects in this field are outlined. O.H.

A72-11968 # Ways of improving the antiwear properties of fuels for jet engines (Puti uluchsheniia protivoiznosnykh svoistv topliv dlia reaktivnykh dvigatelei). I. E. Bespolov, B. F. Korobov, M. D. Khaikin, V. V. Sashevskii, and M. V. Khokhlacheva (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologiia Topliv i Masel,* vol. 16, no. 10, 1971, p. 56-58. 9 refs. In Russian.

Study of the effect of fuel viscosity on the antiwear properties of a number of fuels differing in their naphthene hydrocarbon and sulfur contents. It is found that the antiwear properties of jet fuels noticeably improve with an increase in fuel viscosity only if the samples being compared do not differ in chemical composition and are obtained by similar processes. An increase in the naphthene hydrocarbon content in the fuel leads to an improvement in its antiwear properties. With an increase in the mercaptan sulfur content the antiwear properties of the fuel deteriorate. The use of an additive effectively improves antiwear properties. A.B.K.

A72-11972 Real-gas effects in very weak shock waves in the atmosphere and the structure of sonic bangs. J. P. Hodgson and N. H. Johannesen (Manchester, Victoria University, Manchester, England). *Journal of Fluid Mechanics,* vol. 50, Nov. 15, 1971, p. 17-20. 8 refs.

An approximate expression is given for the thickness of weak fully dispersed shock waves. Using available data on the thermodynamic properties of air, it is shown that shocks of the strength expected in sonic bangs are fully dispersed. Estimated relaxation times for dry and humid air lead to wide variations in possible thickness, varying from millimeters to meters. (Author)

A72-11973 On the noise sources of the unsuppressed high-speed jet. K. A. Bishop, W. Smith (Rolls-Royce, Ltd., Bristol, England), and J. E. Ffowcs Williams (Rolls-Royce, Ltd., Bristol; Imperial College of Science and Technology, London, England). *Journal of Fluid Mechanics,* vol. 50, Nov. 15, 1971, p. 21-31. 16 refs.

The paper describes an interpretation of jet-noise theory and scale-model experiments to highlight physical properties of jet-noise sources at very high speed. The study is prompted by current efforts to suppress the noise of supersonic transport aircraft. The principal noise sources are shown to be very large-scale wave-like undulations of the jet flow that travel downstream at supersonic speed for a distance of several jet diameters. These motions are relatively well ordered and are probably more akin to recognizable instabilities of a laminar flow than the confused small-scale turbulence. Because of this we postulate a model of the noise generating motions as the instability products of a jet flow of low equivalent Reynolds number. This Reynolds number is based on an eddy viscosity and can be further reduced by artificially increasing the small-scale turbulence level. This step would tend to stabilize the flow and inhibit the formation of large-scale noise producing eddies. (Author)

A72-12002 # Vibration - A review of interesting cases. J. P. Den Hartog (MIT, Cambridge, Mass.). In: CANCAM 71; Proceedings of the Third Canadian Congress of Applied Mechanics, University of Calgary, Calgary, Alberta, Canada, May 17-21, 1971. Calgary, Canada, University of Calgary, 1971, p. 17-27. 5 refs.

Review of a number of cases of vibration which was not predicted during the design stage or even during the experimental development stage. The cases discussed are those of the Comet and Electra aircraft and the Graf Zeppelin dirigible, Pogo vibration in large rockets, solar flutter of missile antennas, and density wave oscillations in a boiling water atomic power reactor. Factors complicating the construction of an alternating velocity precipitator designed to remove extremely small solid particles (flyash) from smokestack gas are considered. A.B.K.

A72-12022 Future aircraft noise in the vicinity of airports. G. Zimmermann (Max-Planck-Institut für Strömungsforschung, Göttingen, West Germany). *Airport Forum,* no. 3, 1971, p. 38, 39, 42-46. In English and German.

Consideration of the effects of aircraft engine noise on the environs of airports and of the possibility of reducing the level of this noise. Noise measurement scales currently in use are reviewed, and the sources of engine noise are investigated, tracing a large portion of this noise to the use of turbofan engines with a low bypass ratio. It is foreseen that the problem of fan noise will be greatly mitigated by the trend toward turbofan engines with high bypass ratios which are used in jumbo jets. An estimate is made of future air traffic and of the noise level to be expected in the vicinity of some typical airports by 1975. The provisions of an Aircraft Noise Act recently enacted by the Federal Republic of Germany are reviewed. A.B.K.

A72-12023 **New paving concept for New York airports.** N. C. Yang (Port of New York Authority, New York, N.Y.). *Airport Forum*, no. 3, 1971, p. 53-57, 59-65. In English and German.

Description of the design and testing of a new type of airport pavement (called pozzolanic) consisting of lime, cement, and fly ash that combine with sand (and stone where needed) to form a semirigid base. The material is distinguished by the fact that it spreads like dirt, hardens like concrete, but has many of the advantages of asphalt. Also, the new material is considerably cheaper than conventional pavement materials. The new material is not as rigid as concrete and will therefore conform more readily to long-term settling of the subgrade with a minimum of stress induced in the pavement structure. At the same time, it is able to withstand more loadings without cracking or rutting than a conventional asphaltic base. Its strength increases significantly for at least five years, automatically compensating for the almost certain increase in aircraft size and weight. A.B.K.

A72-12030 # **Supersonic and hypersonic flow with attached shock waves over delta wings.** W. H. Hui (Southampton, University, Southampton, England). *Royal Society (London), Proceedings, Series A*, vol. 325, no. 1561, Nov. 9, 1971, p. 251-268. 17 refs.

A unified theory is developed for supersonic and hypersonic flow with attached shock waves over the lower surface of a delta wing at an angle of attack. The flow field on the lower surface of a delta wing consists of uniform flow regions near the leading edges, where the crossflow is supersonic and a nonuniform flow region near the central part, where the crossflow is subsonic. In the nonuniform flow region, the theory is based on the assumption that the flow differs slightly from the corresponding two-dimensional flow over a flat plate. Thus a linearized perturbation on a nonlinear flow field is first calculated and then strained and corrected so that the flow is matched continuously to the uniform flow which is obtained exactly. When compared with available exact numerical solutions the theory gives, in all cases, almost identical results, except near the crossflow sonic line where existing numerical methods fail to produce a discontinuous slope in the pressure curve, whereas the present theory predicts such a discontinuity and shows that the slope has a square root singularity at the crossflow sonic line similar to that in the supersonic linear theory. (Author)

A72-12033 **Conflict detection at Knoxville.** H. Wachsman (FAA, Systems Research and Development Service, Washington, D.C.). *Journal of Air Traffic Control*, vol. 14, Nov. 1971, p. 8-11.

Discussion of the STARAN (Stellar Attitude Reference and Navigation) Associative Processor which has been installed in the Knoxville TRACON (Terminal Radar Approach Control). An associative processor attains magnitudes of computational speed through the use of arithmetic and logic associated with each word in its memory array. Its strength lies in its ability to perform great numbers of calculations in parallel. STARAN performs a conflict detection function which will relieve the air traffic controllers of the responsibility for any conflict, near-miss, or collision of aircraft in flight. F.R.L.

A72-12042 **AVOID - A short-range high-definition radar.** K. L. Fuller (Mullard, Ltd., Redhill, Surrey, England). *Philips Technical Review*, vol. 32, no. 1, 1971, p. 13-19.

A system is described in which established principles of radar technology are combined in an original way to produce a radar with a range from 3 to 160 m, a 2 m resolution, and a 50 Hz picture-frequency display. Range measurements are made with a CW FM signal. Electronic angular scan is obtained with the aid of an antenna consisting of a length of waveguide with about 80 radiating holes. Undesirable side lobes in the radiation pattern are avoided by filling the waveguide with a dielectric. Mounted on a vehicle, the system allows the latter to be driven on an airfield under very poor visibility conditions. V.P.

A72-12050 # **Two examples of application of Kalman filters to integrated navigation systems (Due esempi di applicazioni del filtro di Kalman ad equipaggiamenti integrati di navigazione).** A. Ferraro and A. Lucifredi (Genova, Università, Genoa, Italy). *Tecnica Italiana*, vol. 36, May 1971, p. 163-168. 11 refs. In Italian.

Discussion of the application of optimal stochastic filters to navigation systems by means of two examples. The first example considers an air navigation system consisting of an inertial device (INS) and a LORAN (plus an altimeter); the measurement errors are modeled as colored noises. The second example shows the application to a system of submarine navigation; the instruments are an inertial device (SINS) and an OMEGA (plus a depth sensor). The measurement errors are modeled as the sum of a bias and a colored noise. M.M.

A72-12077 **Preliminary results of measurements of heavy primaries in the region of supersonic transport using plastic stacks.** O. C. Allkofer, W. Enge, W. Heinrich, and H. Röhrs (Institut für reine und angewandte Kernphysik, Kiel, West Germany). In: International Congress on Protection Against Accelerator and Space Radiation, Geneva, Switzerland, April 26-30, 1971, Proceedings. Volume 1. Geneva, Organisation Européenne pour la Recherche Nucléaire, 1971, p. 512-521; Discussion, p. 522, 523. Discussion in English and French.

Study of so-called thin-down hits, i.e., stopping heavy primaries, which can deposit a radiation dose of some thousand rads near the end of their trajectory, using balloon-borne stacks of cellulose nitrate, cellulose acetate, and a polycarbonate as detectors. The aim of the experiment is to determine the intensities of thin-down hits with charges Z equal to or greater than 6 for different deep layers in the plastic stack. The thin-down intensities which are measured in the deeper layers of the plastic stack can be directly compared with the intensities in the interior of the body of an SST traveler, since the fragmentation probabilities and the interaction mean free paths for heavy ions can be assumed to be equal in plastic and in human tissue. F.R.L.

A72-12078 **Radiological protection in SST aircraft.** E. W. Fuller and B. Day (Atomic Weapons Research Establishment, Aldermaston, Berks., England). In: International Congress on Protection Against Accelerator and Space Radiation, Geneva, Switzerland, April 26-30, 1971, Proceedings. Volume 1. Geneva, Organisation Européenne pour la Recherche Nucléaire, 1971, p. 524-554; Discussion, p. 555, 556. 34 refs. Research supported by the Ministry of Aviation Supply.

The work done so far in the United Kingdom in the field of radiological environment studies of supersonic transport aircraft (SSTs), such as the Franco-British Concorde, and the development of such instrumentation as might be required for monitoring it, is reviewed. It is shown that, as the first step, the extent was considered to which the stratospheric situation is covered by recommendations initially proposed to control exposure to ground based sources of radiation. Then a study was made of the dose and dose equivalent rates produced in the altitude band of interest by the galactic and solar cosmic radiation. To measure the dose equivalent rate from solar cosmic radiation at the Concorde cruising altitude, an instrument, referred to as the In-Flight Radiation Warning Meter (IFRWM), was developed and evaluated using the galactic cosmic radiation at altitudes up to 30 km (balloon flights) and the radiation from GeV accelerators. O.H.

A72-12106 **Pictorial navigation systems.** B. H. L. Blake (Marconi-Elliott Avionic Systems, Ltd., Basildon, Essex, England). *Shell Aviation News*, no. 400, 1971, p. 18-20.

General evaluation of visual position display, used in addition to the more usual digital readout for navigation. Such a display enables the latter to be monitored at a glance, and prevents gross blunders in insertion or readout of alphanumeric position information. A display system normally consists of a computer which accepts the sensor information and converts it into values to drive the map display; a control unit; and the display head itself. The system should be able to work with any type of airborne navigation sensor and with combinations of these sensors. A typical pictorial navigation system, the Marconi AD670, is described, with details of the map display unit, the electronics unit, and the controller. F.R.L.

A72-12226 **B-1 design keyed to future growth.** R. R. Ropelewski. *Aviation Week and Space Technology*, vol. 95, Nov. 29, 1971, p. 34-37.

Consideration of the B-1 strategic bomber design, which is expected to exert some influence on future aircraft. The B-1 is intended to serve for the remainder of this century as the primary manned strategic bomber of the U.S. The variable-sweep wing and its pivot is the single most complex structural aspect of the B-1. Projected operating speeds up to Mach 2.2 have dictated the requirement for variable-geometry inlets on the engine nacelles to maintain high inlet efficiency at all speeds. Attention is given to the landing gear, control system, and instrumentation. F.R.L.

A72-12228 # **Boundary-layer development on a wing-body combination.** Z. Jaňour. *Zpráva VZLÚ*, Sept. 1971, p. 1-13. 5 refs.

Results of measurements of aerodynamic forces and pressure distribution on a model simulating a wing-body combination. The effect of the fuselage on the flow past the wing is analyzed. The boundary layer on the upper surface of the wing, as developed under the conditions given by the outer flow, is investigated by means of a hot-wire technique and flow visualization. The results show the changes of the outer potential flow and of the boundary layer (mainly its transition to turbulence) which occur in the neighborhood of the fuselage. A.B.K.

A72-12270 # **A new area rule for hypersonic wing-bodies.** N. Malmuth (North American Rockwell Science Center, Thousand Oaks, Calif.). *AIAA Journal*, vol. 9, Dec. 1971, p. 2460-2462. 6 refs. Contract No. F44620-71-C-0021.

An area rule is obtained for the change in the lift-drag ratio of a hypersonic delta wing due to the addition on its compressive side of a conical body of arbitrary cross section. The area rule states that the change in aerodynamic efficiency of such a wing is directly proportional to the body volume and independent of its cross-sectional shape. O.H.

A72-12275 # **Skin-friction measurement in flow with pressure gradient.** R. G. Bradley and A. R. Mann (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA Journal*, vol. 9, Dec. 1971, p. 2470, 2471. 5 refs. Research supported by the General Dynamics Independent Research and Development Funds.

Description of data comparing two different surface-impact-probe measurements for nonisobaric flow over an airfoil section in high subsonic flow. The two impact-probe devices were a Preston tube (a surface-mounted circular tube) and a Stanton tube (a segment of razor blade mounted over a static pressure orifice). The performances of these two devices are compared with each other and with theoretical calculations of the skin-friction coefficient. M.M.

A72-12295 # **High-altitude equipment of civil aircraft (Vysotnoe oborudovanie samoletov grazhdanskoi aviatsii).** N. G. Grishanov. Moscow, Izdatel'stvo Transport, 1971. 264 p. 16 refs. In Russian.

The principles of design and operation of the air-conditioning systems in pressurized cabins of transport aircraft and the oxygen equipment of such aircraft are outlined. Air-pressure, air-temperature, and air-moisture control systems are described, as well as aircraft oxygen supply systems and equipment for monitoring aircraft life-support systems. The maintenance of pressurized cabins and their high-altitude equipment is discussed, as well as the maintenance and operation of the oxygen equipment. A.B.K.

A72-12298 # **Course-indicating systems and automatic navigation aids for civil aviation aircraft (Kursovye sistemy i navigatsionnye avtomaty samoletov grazhdanskoi aviatsii).** N. M. Bogdanchenko, G. Iu. Voloshin, and V. S. Belykh. Moscow, Izdatel'stvo Transport, 1971. 268 p. 13 refs. In Russian.

The general design and operational principles of course-indicating systems, astronomical compasses, and navigation aids are outlined. Errors and their causes are examined along with means of improving the precision of these systems. Particular attention is given to the design and elements of the GIK-1 gyro flux gate telecompass, and the KS-6 and GMK-1 course-indicating systems. Technical servicing, maintenance, and maintenance schedules are discussed. A general method of determining the basic reliability features of aids and systems is proposed, and general principles of error analysis are studied. The book is equally well suited as a textbook and as a reference for engineers and technicians. V.P.

A72-12323 **C-SCAN - Pilot's window to the deck.** H. Hechtman (Cutler-Hammer Co., Airborne Instruments Laboratory Div., Deer Park, N.Y.). *Signal*, vol. 26, Dec. 1971, p. 32-34, 36.

Discussion of the Carrier System for Controlled Approach of Naval aircraft (C-SCAN) which provides a clear guidance for a poor-visibility landing of tactical jets on the flight deck of an aircraft carrier. The system transmits, receives, and decodes landing information with the aid of microwave scanning beams which give the pilot of an approaching jet a window to the carrier deck. The C-SCAN equipment, the shore-based installations and the reliability of the system are discussed. The fail-safe features of C-SCAN, such as SPN-41, TRN-28 monitors, ARA-63 fault detectors, and BIT circuits, are noted. V.Z.

A72-12345 **A comparison of the lift of flat delta wings and waveriders at high angles of incidence and high Mach number.** L. C. Squire (Cambridge University, Cambridge, England). *Ingenieur-Archiv*, vol. 40, no. 5, 1971, p. 339-352. 16 refs.

It has been suggested that in the conditions of lifting reentry caret wings are likely to have higher lift coefficients than flat-bottomed wings with the same ratio of lift to drag. Thus, for given speed and wing loading, they can reenter at higher altitudes with a consequent reduction in stagnation point heating rate. In this paper thin-shock-layer theory is used to study the lifting properties of caret and flat-bottomed wings and of wings with concave lower surfaces. It is found that significant gains in lift coefficient can be achieved with moderately recessed lower surfaces. These results hold for both perfect and real gas flows. (Author)

A72-12376 **EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record.** Convention sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc. (IEEE Publication 71 C 34 - AES), 1971. 272 p. Members,

$12.50; nonmembers, $14.50.

Digital matched filters using fast Fourier transforms, splash-detection radar digital signal processing, detection of targets in non-Rayleigh sea clutter, and radar measurement accuracy in log-normal clutter are among the topics covered in contributions concerned with results in radar signal processing. Other contributions include industrial and biomedical transducers, air traffic control, oceanographic and atmospheric technology, technical requirements and resource allocation in aerospace-borne earth resources exploration, and current problems in radar technology.

M.V.E.

A72-12377 The microwave landing system development program. J. W. Edwards (FAA, Washington, D.C.). In: EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 17-21.

A summary is presented of the activities required over a five year time period for the development of a microwave landing system. The broad range of user operational requirements this system must satisfy has been tentatively established by Special Committee 117 of the Radio Technical Commission for Aeronautics. M.V.E.

A72-12378 A discrete address ATC beacon system. M. T. Pozesky (FAA, Washington, D.C.). In: EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 22-26.

A discussion of the concept, operation, and various design options for the development of an upgraded Air Traffic Control surveillance and data acquisition/communication system is presented in this paper. A review of the development, evolution, and functions of the present Air Traffic Control Radar Beacon System is presented together with a discussion of the need and concept for an upgraded Discrete Address Beacon System. The operation, functions, and critical design issues of the proposed Discrete Address Beacon System are presented and various design considerations and alternatives are developed and identified. (Author)

A72-12379 FAA CAS/PWI program - Past, present, future. J. L. Brennan (FAA, Washington, D.C.). In: EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 27-32.

This paper traces the history of Federal Aviation Administration (FAA) activity in the Collision Avoidance System (CAS) and Pilot Warning Instrument (PWI) areas, examines the results of these efforts to the extent they have influenced our present program, discusses some remaining problem areas, and presents FAA's plans to solve these problems. (Author)

A72-12380 The FAA air traffic control automation program. J. W. Rabb (FAA, National Airspace System Program Office, Washington, D.C.). In: EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 33-40.

Review of the air traffic control automation program currently implemented in order to meet the challenge of rapid growth of air transportation. When completed in 1974, each of the 20 domestic air route traffic control centers and the busiest terminal facilities will be interconnected to form the world's largest real time computer command and control network. M.V.E.

A72-12383 FAA plans for AEROSAT. G. E. Lundquist (FAA, Washington, D.C.). In: EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 108-112.

Review of the present program requirements, technical features, and implementation plans for the UHF preoperational and operational Aeronautical Satellite Systems (AEROSAT) over the Pacific and Atlantic airspaces. Following a brief glimpse at the history, present state, and future trends of oceanic air traffic and air traffic control (ATC), the international aspects and special problems of ATC are discussed. ATC problems reviewed include: limited flight levels available, long-haul track conflicts, air speed differences in aircraft operations, differences in estimated and actual fix times, adverse weather conditions, and communication delays. Satellite national policy and present aeronautical satellite programs are considered. M.V.E.

A72-12393 A limited scan antenna. L. Melancon (Raytheon Co., Equipment Div., Waltham, Mass.). In: EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 190-192.

An antenna system is described that is capable of electronically scanning a pencil beam more than ten beamwidths from boresight with a comparatively small number of active elements. This is accomplished by using a large inexpensive reflector to obtain aperture gain and a small phased array to provide electronic scanning. The antenna is part of a tactical aircraft landing system which must be transportable by aircraft, helicopter and ground vehicles. One of the most challenging aspects of the design was to achieve the proper balance between antenna characteristics, as they affect system performance, and tight weight and volume constraints. (Author)

A72-12403 * Telemetry and the integrated avionics approach. W. O. Frost (NASA, Marshall Space Flight Center, Instrumentation and Communications Div., Huntsville, Ala.) and D. H. Ellis (SCI Electronics, Inc., Huntsville, Ala.). In: Telemetry applications in the aerospace industry; Proceedings of the Seventeenth International Aerospace Instrumentation Symposium, Las Vegas, Nev., May 10-12, 1971. Pittsburgh, Instrument Society of America, 1971, p. 1-7.

The unique problems encountered in the integrated approach to aircraft and spacecraft avionics system designs are discussed with the emphasis on recent advances in telemetry as a factor facilitating the integration. A listing of subsystems planned for integration on the Space Shuttle vehicle is given, covering auxiliary pumping and propellant, crew controls and displays, computation, communications and radar, electric power, guidance, navigation and control, air-bearing engines, main engines, reaction control, and structural/mechanical elements. Considerations are given for the multiplexed data bus design applicable to integrated avionics. V.Z.

A72-12408 Data analysis system for Army flight testing. A. L. Kelley and R. J. Haase (EMR-Telemetry, Sarasota, Fla.). In: Telemetry applications in the aerospace industry; Proceedings of the Seventeenth International Aerospace Instrumentation Symposium, Las Vegas, Nev., May 10-12, 1971. Pittsburgh, Instrument Society of America, 1971, p. 40-47.

Discussion of the EMR-designed system used presently by the Army Aviation Systems Activity (ASTA) for improvement of fixed and rotary wing aircraft tests. Covered are components of the Advanced Instrumentation and Data Analysis System (AIDAS), including the Airborne System, the computer-controlled Central

Ground Station, and two computer-controlled mobile Remote Ground Stations (RGS). Details are given on the PCM and FM data acquisition packages of the Airborne System, RGS subsystems, computer subsystems, and software. The improvement of data reduction achieved with the AIDAS system is noted. V.Z.

A72-12420 Interactive graphic displays for air traffic control. J. T. McNamara, Jr. (Raytheon Digital Systems and Displays Laboratory, Sudbury, Mass.). *Electronic Progress,* vol. 13, Fall 1971, p. 11-18.

Review of the current computer-aided air traffic control displays, covering the Computer Display Channel (CDC), the Computer Update Equipment (CUE) subsystem, the Central Computer Complex (CCC), Plan View Displays (PVD), and the Digital Control and Vector Generator (DCVG). The operational capabilities of these systems are discussed and block diagrams of CUE/CDC display subsystems, CDC data processing flow and PVD are given. Also described are the vector and character generation process and depletion systems. V.Z.

A72-12421 Tactical displays. G. B. Levine (Raytheon Digital Systems and Displays Laboratory, Sudbury, Mass.). *Electronic Progress,* vol. 13, Fall 1971, p. 19-24.

Discussion of a new tactical air traffic control system, the AN/TPN-19 Landing Control Central, being developed by Raytheon Company for the Air Force. The system provides airport surveillance, precision approach and landing, and operator/aircraft/machine operations by using a terminal Area Surveillance Radar (ASR), a Precision Approach Radar (PAR) and an Operations Center (OPS). Besides the basic radar information, the display provides the following operator aids to ease the operator work load: Range Marks giving the operator a range reference, Runway Cursor, which is an extension of the runway centerline to facilitate aircraft vectoring, Azimuth Cursor, which is a line which can be suitably positioned, and a display capable of being off-centered one radius to provide sector coverage. V.Z.

A72-12422 # Nonequilibrium boundary layer flow on highly-swept hypersonic wings. G. R. Inger (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper.* 26 p. 10 refs. (VPI-E-71-23)

Analysis of the nonequilibrium effects in a laminar three-dimensional flow at the leading edge of a swept hypersonic infinite span wing with an intensively cooled surface. A significant effect of a sweep-induced crossflow on the nonequilibrium behavior of the three-dimensional flow is demonstrated. This effect is caused by a change in the flow inviscid characteristics changing the boundary layer pattern, by an alteration of the Dahmköhler parameters which control the nonequilibrium level in the gas phase and in the catalytic surface reactions, and by the development of dissipative viscous heating which can change the nonequilibrium boundary flow condition from one with prevailing recombination to one with prevailing dissociation. Two approximate closed solutions are given for estimating the nonequilibrium characteristics of the boundary layer in terms of gasdynamics. V.Z.

A72-12440 # Matrix method of calculating the strength of hinged main-rotor blades for a helicopter in steady forward flight (Macierzowa metoda obliczeń wytrzymałościowych przegubowych łopat wirników nośnych śmigłowców w ustalonym locie skośnym). L. Żerek. *Instytut Lotnictwa, Prace,* no. 46, 1971, p. 69-103. 5 refs. In Polish.

Description of a matrix method of calculating the aerodynamic loads (lift), transverse forces, bending moments, torques, flexural deflections, and the twist of hinged main-rotor blades in a helicopter during steady forward flight. The proposed method accounts for the influence of flexural and torsional deflections on the distribution of aerodynamic loads along the blade span as a function of time. The actual blade, representing a continuous system with a given distribution of mass and torsional and flexural rigidity, is replaced by an elastic axis with piecewise constant rigidity and a discrete distribution of mass and moments of inertia. The displacement of the centers of mass of individual blade segments along the chord is taken into account together with both internal blade damping and aerodynamic damping. T.M.

A72-12498 Fatigue damage detection. J. R. Barton and F. N. Kusenberger (Southwest Research Institute, San Antonio, Tex.). In: Metal fatigue damage - Mechanism, detection, avoidance, and repair. Philadelphia, American Society for Testing and Materials, 1971, p. 123-227. 89 refs.

Relationships between the characterization and the nondestructive detection of fatigue damage are discussed and illustrated. Inspection methods presently used at overhaul facilities are reviewed, and examples of the equipment used and the results obtained are given. The advantages and limitations of currently used nondestructive methods are summarized. A perspective review of recent research efforts in nondestructive fatigue damage detection including descriptions of methods and typical experimental results is presented. Finally, nondestructive evaluation technology is appraised critically in relation to the desired results and practices, and this appraisal is used as a basis for a look into the future. (Author)

A72-12499 Field practices in the repair of fatigue damaged jet engine components. H. G. Popp, L. G. Wilbers (GE Material and Process Technology Laboratories, Evendale, Ohio), and V. J. Erdeman (Eastern Air Lines, Inc., Miami, Fla.). In: Metal fatigue damage - Mechanism, detection, avoidance, and repair. Philadelphia, American Society for Testing and Materials, 1971, p. 228-253. 5 refs.

Review of jet engine overhaul procedures for hardware fatigue damage repair. Details are given on techniques for removal of distressed metal, replacement of distressed area, and repair welding for restoring components to original condition. Lack of knowledge on fatigue damage buildup and lack of confidence to restoration processing are noted as major obstacles for progress in this field. V.Z.

A72-12501 # A synopsis on Q/STOL engines. *Aircraft Engineering,* vol. 43, Nov. 1971, p. 12, 13.

Discussion of powerplants for Q/STOL aircraft, which must be capable of landing and taking off from a runway not more than 2000 ft in length, with a noise level not greater than 95 PNdB at a distance of 500 ft from the runway. A Q/STOL aircraft has more installed thrust at takeoff than a CTOL aircraft, and it can therefore have engines with a higher bypass ratio for the same cruise speed. A rapidly increasing number of turbine stages are required. Some details of the Rolls-Royce/SNECMA M45S(RB 410) engine project are given. F.R.L.

A72-12502 # Externally blown flaps, aerodynamic feasibility study of a STOL-transporter. P. Kuehl and D. Welte (Dornier

AG, Friedrichshafen, West Germany). *Aircraft Engineering*, vol. 43, Nov. 1971, p. 16-18.

Use of externally blown flaps to achieve typical STOL characteristics for medium and heavy jet transport aircraft. As part of a project study conducted by Dornier AG concerning a 40-ton transport aircraft, the aerodynamic and flight mechanical feasibility is demonstrated. The basic data were supplied by wind tunnel tests on a model of the aircraft. With a view to V/STOL capability, the engine jet deflection was optimized by means of a novel slot flap design on a simple rectangular wing. Short takeoff and short landing distances are calculated, and aspects of tailplane design are discussed. F.R.L.

A72-12503 # **V/STOL R & D in France.** *Aircraft Engineering*, vol. 43, Nov. 1971, p. 20-23.

Discussion of various configurations for the Aladin II noiseless STOL aircraft project. The solution envisaged consists in combining a wing equipped with adapted flaps with a convenient number of noiseless propelling units of a design similar to those imagined for the Bertin Aerotrain. Rudders relatively larger than those provided for a conventional aircraft should be used. The proposed turbojet unit is described, as well as two versions of the aircraft, one of 90 to 100 passenger capacity, the other of 45 to 50 passengers. Economical aspects and commercial activities and tasks of STOL aircraft are considered. F.R.L.

A72-12504 # **The load on the brake parachute of a jet aeroplane under the influence of the engine wake.** R. Sandstrom. *Aircraft Engineering*, vol. 43, Nov. 1971, p. 26, 27, 30. 9 refs.

Consideration of the effect of jet engine efflux which, in certain cases, can give a considerable contribution to the load caused by the aircraft velocity on a deployed brake parachute. When engine disturbances appear incidentally during landing it can happen that the engine speed is considerably higher than the speed corresponding to ground idle power when the brake parachute is released. The load on the parachute can thus in certain cases hazard the strength of the installation. To evaluate the load contribution from the engine efflux implies information about certain engine characteristics, aircraft velocity, and the drag coefficient of the brake parachute. F.R.L.

A72-12542 # **In-flight studies of aircraft stability and controllability (Issledovaniia v polete ustoichivosti i upravliaemosti samoleta).** Iu. I. Sneshko. Moscow, Izdatel'stvo Mashinostroenie, 1971. 328 p. 41 refs. In Russian.

The theoretical principles and current methods of in-flight study of the stability and controllability of aircraft in both steady and unsteady regimes are outlined. Aircraft tests in limiting regimes (limiting speed, acceleration, and angle of attack) and in special flight situations (engine failure, failure of the automatic stabilization system, and failure of the control system hydraulic amplifiers) are considered. The equations of motion and the characteristics of an aircraft as a dynamic system are presented, as well as criteria for estimating and characterizing stability and controllability. Methods and techniques for in-flight determination of aircraft stability and controllability are described, together with methods of determining balancing curves from acceleration and speed, methods of determining aerodynamic force moments and their derivatives, methods of determining frequency characteristics and impulse and transition functions, and methods of evaluating the behavior of aircraft in limiting regimes and in special flight situations. A.B.K.

A72-12561 # **Ductility improvements in superalloys.** R. G. Dunn and D. I. Sponseller (Climax Molybdenum Company of Europe, Ltd., London, England). In: *Toward improved ductility and* toughness; Proceedings of the Symposium, Kyoto, Japan, October 25, 26, 1971. Tokyo, Climax Molybdenum Development Co. (Japan), Ltd., 1971, p. 321-343. 22 refs.

Some recent developments concerning ductility improvements in superalloys are discussed. Particular emphasis is placed upon ductility or workability improvements that are achieved without sacrificing elevated-temperature strength properties. Because of the economic and technological impact that the aircraft gas turbine exerts on the superalloy industry, the ductility improvements are specifically directed toward aircraft engine applications. Two of the developments involve hafnium alloying and directional-solidification effects on cast-superalloy ductility properties. The two remaining developments relate to ductility and workability improvements in wrought superalloys and involve a discussion of thermomechanically processed and powder-metallurgy components. (Author)

A72-12621 # **Air traffic regulations (Luftverkehrs-Verordnungen).** M. Hofmann and E. Grabherr (Bayerische Staatsministerium für Wirtschaft und Verkehr, Munich, West Germany). Munich, C. H. Beck'sche Verlagsbuchhandlung, 1971. 554 p. 56 refs. In German. $28.40.

The regulations considered are valid in the territory of the Federal German Republic. The obligations of the participants in the air traffic are covered together with general rules, rules for the flight with and without instruments, and fines to be imposed in case of violations of the regulations. Other regulations discussed are concerned with questions of granting licenses. Also covered are rules for the examination of personnel and equipment, the operation of aircraft, flight security, and administrative costs. G.R.

A72-12622 # **Air traffic law (Luftverkehrsgesetz).** M. Hofmann and E. Grabherr (Bayerische Staatsministerium für Wirtschaft und Verkehr, Munich, West Germany). Munich, C. H. Beck'sche Verlagsbuchhandlung, 1971. 622 p. 53 refs. In German. $28.40.

The air traffic law discussed covers according to German law the totality of special legal norms concerned with air traffic, the vehicles used in air traffic, and the air space with regard to its properties as an element of air traffic. The subjects covered include German air law, the organization of air traffic administration, international air law, and other important legal regulations concerning the air traffic. Private organizations related to air traffic are also considered, giving attentions to international and national organizations. G.R.

A72-12640 Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings (Simposio su Radioaiuti alla Navigazione Marittima e Aerea, Trieste, Italy, June 24-26, 1971, Proceedings). Symposium sponsored by the Associazione Elettrotecnica ed Elettronica Italiana. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 124 p. In Italian.

Papers on radio aids to navigation covering radar cross section of real targets, problems and technical aspects connected with the use of the L band in an aerial navigation aid system via satellite, use of sequential analysis in communications and radar systems, improvement of visibility in scattering media, aircraft radio navigation systems by means of polar coordinates and their development, and contribution to the radar resolution problem. M.M.

A72-12642 # **Problems and technical aspects connected with the use of the L band in an aerial navigation aid system via satellite**

(Problemi ed aspetti tecnici connessi con l'uso della banda L in un sistema via satellite per l'assistenza alla navigazione aerea). G. Quaglione and E. Vitali. In: Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 24 p. 9 refs. In Italian.

Description of the advantages of using the L band (1540 to 1660 MHz) in a satellite system employed in solving the various problems connected with assistance to aerial navigation. The accuracy of determination of a vehicle's position made possible by the L band is discussed, together with the use of data transmission at a rate of 600 to 1200 bit/sec to provide the ground station with information on vehicle status and position. Voice communications and modulation methods are examined, including the factors which determine the margin to be assigned to the L band system. A technical and financial evaluation of the system is made. M.M.

A72-12645 # **ILS system for landing aircraft and its future developments (Sistema ILS per l'atterraggio dei velivoli e suoi sviluppi futuri).** D. Graziani. In: Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 4 p. In Italian.

Description of the currently used ILS aircraft landing system, following a brief historical outline. The refinements recently undergone by this system in order to make landing possible under particularly adverse weather conditions are discussed. New future systems destined to replace the ILS system are briefly mentioned. M.M.

A72-12646 # **Aircraft radio navigation systems by means of polar coordinates and their development (Sistemi di radionavigazione a coordinate polari per velivoli e loro sviluppo).** D. Graziani. In: Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 10 p. In Italian.

Following a brief historical outline, the principles of operation of radio navigation systems by means of polar coordinates (VOR, TACAN, DME) currently in use are discussed. Recently introduced improvements are briefly mentioned, together with further developments and conversions that such systems will undergo in the future in order to ensure ever greater flight safety and accuracy. M.M.

A72-12647 # **Investigation of an associative memory for use in digital computers employed as aids to air and naval traffic (Studio di una memoria associativa per l'utilizzazione in calcolatori digitali impiegati in aiuto al traffico aereo/navale).** G. De Stasio and C. Maggi (Selenia S.p.A., Rome, Italy). In: Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 7 p. In Italian.

Analysis of problems connected with the real time processing of data on air and naval traffic by means of conventional computers. A new system of associative memory for carrying out the most interesting logic functions for such problems is proposed. The times that can be obtained by means of the new memory are compared with those of the conventional systems. A computer architecture for the optimum use of such a memory and suitable treatment of the related problems is proposed. M.M.

A72-12649 # **Automation of air traffic - The ATCAS system (Automazione del traffico aereo - Sistema ATCAS).** A. Venditti and F. La Rovere (Selenia S.p.A., Rome, Italy). In: Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 7 p. In Italian.

Brief but complete description of the ATCAS system. An overview of the principal problems presented by air traffic control is given, with emphasis on the Italian situation, and a description of the solutions adopted in ATCAS. M.M.

A72-12650 # **Techniques for the extraction of radar data (Tecniche di estrazione dei dati radar).** G. Grasso (Selenia S.p.A., Rome, Italy). In: Symposium on Radio Aids to Maritime and Aerial Navigation, Trieste, Italy, June 24-26, 1971, Proceedings. Trieste, Associazione Elettrotecnica ed Elettronica Italiana, 1971. 10 p. 5 refs. In Italian.

Discussion of the requirements and characteristics of methods used in the automatic extraction of data detected by radar. The setup and functions of a data extractor are treated, together with methods for quantifying the azimuth, moving window detection, and coordinate measurement. The ATCAS data extractor is described and analyzed, and the results obtained are examined. M.M.

A72-12705 # **Angle of attack and thrust control for steeply approaching aircraft (Anstellwinkel- und Schubregelung für steilanfliegende Flugzeuge).** G. Schänzer (Bodenseewerk Gerätetechnik GmbH, Überlingen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-063.* 32 p. In German.

Description of an integrated STOL flight control system which refers the angle of attack, the altitude deviation, and all other essential state variables in a highly coupled form to the altitude controller and the gas throttle. With the aid of quadratic integral criteria the proposed system was optimized in such a way that it completely satisfies all requirements with reference to piloting accuracy, gust suppression, and passenger comfort. The results of a test of this system in a twin-engine propeller-driven tailwheel aircraft are cited. A.B.K.

A72-12707 # **Force and pressure distribution measurements on a wing-body combination with wing of low aspect ratio in compressible flow (Kraft- und Druckverteilungsmessungen an einer Flügel-Rumpf-Kombination mit Flügel kleiner Streckung in kompressibler Strömung).** W. Stahl, K. Hartmann, and W. Schneider (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-118.* 39 p. 9 refs. In German.

The combination investigated consisted of a delta wing and a body in the form of a circular cylinder with an ogival nose. Mach numbers were in the range from 0.5 to 2.2. Normal forces and pitching moments were measured as well as spanwise pressure distributions in several sections on the pressure and suction sides. Oil-flow and smoke pictures provided some insight into the flow field. The influence of the Reynolds number was investigated at Mach numbers 0.5, 1.0, and 1.8. Angles of incidence varied from 0 deg to 30 deg. G.R.

A72-12709 # **Investigation of unsteady interference effects on a harmonically oscillating wing-tailplane model with a variable sweep wing in the low subsonic region (Untersuchung instationärer Interferenzeffekte an einem harmonisch schwingenden Flügel-Höhenleitwerks-Modell mit variabler Flügelpfeilung im niedrigen Unterschallbereich).** H. Triebstein (Aerodynamische Versuchsanstalt, Göttingen, West Germany) and J. Becker (Messerschmitt-Bölkow-

Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-081.* 48 p. 17 refs. In German.

Special emphasis in the investigation is given to the unsteady aerodynamic interfering effects at various wing-tailplane configurations. In particular, the effects of the wing sweep-back, the wing angle of attack and the V-position of the tailplane stabilizer are investigated in detail for several reduced frequencies and longitudinal positions of the wing and tailplane. G.R.

A72-12712 # **Experimental investigation of the drag and lift of wings with a blunt trailing edge in compressible flow (Experimentelle Untersuchung des Widerstandes und Auftriebes von Flügeln mit stumpfer Hinterkante bei kompressibler Strömung).** M. Tanner (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-114.* 33 p. 12 refs. In German.

Drag and lift measurements were performed on two rectangular wings with an aspect ratio equal to 2 and with various trailing edges, in the freestream Mach number range from 0.5 to 2.2. In addition to straight trailing edges - i.e., sharp and blunt - various serrated blunt trailing edges were also examined. Some of these were found to reduce the drag remarkably. By splitting up the total drag in its components, it was possible to predict the relative magnitude of the components and the optimum trailing edge thickness. O.H.

A72-12714 # **Adaptation of the nonlinear characteristic of an attitude control system developed for a V/STOL aircraft to a helicopter (Anpassung eines Lagereglers nichtlinearer Charakteristik, entwickelt für ein VSTOL-Flugzeug, an einen Hubschrauber).** H. Schmidtlein (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-060.* 72 p. In German.

Free-flight simulation tests are described whose aim was to determine the adaptability of a nonlinear attitude control system developed by VFW-Fokker for the VAK 191 B aircraft to the roll and pitch control of a helicopter. The modifications which arise from this adaptation and some associated problems are examined. The Bell 47-G free-flight simulator was employed in the tests. V.P.

A72-12718 **Spin control by means of the 'superstall' characteristic (Trudelbeeinflussung durch die 'Superstall'-Charakteristik).** H. Neppert (Hamburger Fluzeugbau GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-057.* 24 p. 10 refs. In German.

Three cases of spinning have been investigated and compared. These include conventional steep and flat spins which depend on damping in yaw, and flat spins with a 'superstall' characteristic. This latter is not determined by damping in yaw, and is mostly distinguished from conventional flat spins by a lower rate of rotation. These relationships are explained by some examples. O.H.

A72-12722 **Methods of construction of aeroelastic models for a rational flutter analysis of modern aircraft designs (Bauweisen aeroelastischer Modelle für eine rationelle Flatteruntersuchung moderner Flugzeugkonzeptionen).** H. Hönlinger (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-082.* 27 p. 8 refs. In German.

Description of a combined computational-experimental method of flutter analysis involving the study of specially constructed aeroelastic models. The proposed method is characterized by a considerable reduction of the risk of error and also by a reduction of the labor involved. In the proposed method appropriately constructed flutter models are investigated in a wind tunnel concurrently with the calculations in an early stage of the design process. These models are not intended to simulate the real state of the aircraft by accurate imitation of the original structure so as to make the computation superfluous, but to constitute a complementary concurrent analysis in analog form in contrast to the digitally performed calculation. A.B.K.

A72-12723 # **Experimental studies of aerodynamic coefficients of a wing-fuselage combination and comparison with the results of linear and nonlinear theories at subsonic speeds (Experimentelle Untersuchungen aerodynamischer Beiwerte einer Flügel-Rumpf-Kombination und Vergleich mit den Resultaten linearer und nichtlinearer Theorien bei Unterschallgeschwindigkeiten).** E. Herpfer and J. T. Heynatz (Dornier System GmbH, Friedrichshafen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-115.* 66 p. 25 refs. In German.

Comparison of various methods of calculating the most important aerodynamic coefficients of the longitudinal, lateral, and roll motion of a wing-fuselage combination in the range of large angles of attack and small sideslip angles. The ranges of applicability and the reliabilities of the various methods are established on the basis of comparisons with the results of experimental studies of a wing-fuselage configuration in incompressible and compressible flow regions. It is found that while linear theories are useful only for angles of attack up to 5 deg, the nonlinear methods considered yield good or satisfactory results for angles of attack up to 12 deg. At larger angles of attack all the theories discussed become increasingly inapplicable. A.B.K.

A72-12725 **Methods of flight vibration testing of modern high-performance aircraft (Methoden des Flugschwingungsversuches an modernen Hochleistungsflugzeugen).** G. Haidl and F.-J. Rudolph (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-083.* 25 p. 8 refs. In German.

Review of the existing methods of ascertaining the flutter stability of high-speed aircraft. Methods of producing in-flight vibrations of aircraft are discussed, including pulsed excitation by solid-fuel rockets, pulsed excitation by electrically controlled rudder impacts, harmonic excitation, and sliding frequency excitation. Methods of evaluating the responses to these various types of excitation are considered, including filtering, the root-locus method, spectral decomposition, and methods based on the use of correlation functions. A.B.K.

A72-12730 # **Calculation of the unsteady pressure distribution on harmonically oscillating slender wing-fuselage configurations (Berechnung der instationären Druckverteilungen an harmonisch schwingenden schlanken Flügel-Rumpf-Konfigurationen).** K. Chao (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-080.* 34 p. 13 refs. In German.

Based upon the slender body theory the pressure distribution is calculated numerically. The configurations investigated consist of a circular cylindrical fuselage body with a conical nose and a delta

wing with straight, cubic or sinusoidal leading edges. In particular, the influence of the fuselage and the effects of wing geometry and reduced frequency are investigated in detail. For three delta wings with straight leading edges the results were compared with the corresponding data obtained on the basis of three-dimensional lifting surface theory. G.R.

A72-12733 # **Application of interactive computer graphics in wing unit designs (Die Anwendung von interaktiver Computer-Graphik bei der Berechnung von Tragwerken).** J. H. Argyris and I. Grieger (Stuttgart, Universität, Stuttgart, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-107.* 36 p. 20 refs. In German.

Discussion of a man-machine dialog technique which uses graph screen displays to facilitate the input of human decisions into a computer in response to information provided by the computer. Some aspects of the application of this technique to aircraft wing unit designs are analyzed. Graph transformation, interactive computer data graph analysis and system structure representation by this technique are considered. Details are given on the application of this computer data input and display technique to a two-cell fuselage, an aircraft tail unit and truss. V.Z.

A72-12745 # **Unsolved problems of airplane aerodynamics (Offene Probleme der Flugzeug-Aerodynamik).** J. Barche (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971, Paper 71-105.* 32 p. 32 refs. In German.

Problems inherent in current and future aircraft design which still lack a solution as a result of gaps in the theoretical and experimental description of flow patterns are discussed. Both civil and military aircraft in the subsonic and transonic range are considered. Problems arising in different phases of aerodynamic design are examined first. Next, special flow problems encountered during different flight phases, such as takeoff and landing, during transonic flight, and during flight maneuvers, are characterized and explained. O.H.

A72-12748 # **Current situation of radio aids for aerial navigation in Italy and prospects for the near future (Situazione attuale dei radioaiuti alla navigazione aerea in Italia e prospettive per il prossimo futuro).** A. Pepe (Aeronautica Militare, Ispettorato Telecomunicazioni ed Assistenza al Volo, Rome, Italy). *Associazione Elettrotecnica ed Elettronica Italiana, Simposio su Radioaiuti alla Navigazione Marittima e Aerea, Trieste, Italy, June 24-26, 1971, Paper.* 11 p. In Italian.

Emphasis is placed on problems connected with the efficiency, updating and technical development of facilities as well as their quantitative and qualitative suitability to the growing requirements of air traffic. The contribution that automation of ATC will make to air navigation is briefly discussed. M.M.

A72-12749 # **Doppler - A modern aid for air navigation (Doppler - Moderno ausilio per la navigazione aerea).** G. Puddu and J. Glagg (Marconi Italiana S.p.A., Genoa, Italy). *Associazione Elettrotecnica ed Elettronica Italiana, Simposio su Radioaiuti alla Navigazione Marittima e Aerea, Trieste, Italy, June 24-26, 1971, Paper.* 4 p. In Italian.

Description of a typical Doppler system consisting of a sensor (navigation radar device), a computer unit, and a data transmitter. The navigation radar operates on the basis of the Doppler effect and provides a precise value of the aircraft's horizontal speed, obtained through the course data and velocity relative to the ground. Such data are sent continuously to the navigation computer unit. This equipment, completely transistorized, arranges for the continuous recording of the aircraft's position. The device can operate by means of a storage system, thus ensuring continuous performance during periods when the Doppler data may not be temporarily available. M.M.

A72-12800 # **Influence of the hydrocarbon composition of jet fuels on their thermal stability (Vliianie uglevodorodnogo sostava reaktivnykh topliv na ikh termicheskuiu stabil'nost').** E. M. Bushueva and I. E. Bespolov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologiia Topliv i Masel,* vol. 16, no. 9, 1971, p. 46-49. 6 refs. In Russian.

It is shown that aromatic hydrocarbons, particularly naphthalene derivatives and polycyclic naphtheno-aromatic hydrocarbons, comprise another (in addition to heteroorganic compounds) source of deposit formation during oxidation of jet fuels. The structure of the nonaromatic component exerts a strong influence on the degree of coagulation of the oxidation products of aromatic hydrocarbons. The maximum amount of the solid phase is observed during oxidation of a mixture of aromatic hydrocarbons with isoparaffin hydrocarbons. The minimum quantity of the solid phase is produced during oxidation of aromatic hydrocarbons mixed with bicyclic naphthenic hydrocarbons. T.M.

A72-12825 # **On the characteristics of wing with tip clearance. III - The force acting on a rectangular wing of low aspect ratio.** Y. Sugiyama (Nagoya University, Nagoya, Japan). *JSME, Bulletin,* vol. 14, Oct. 1971, p. 1077-1087. 13 refs.

Theoretical study of the effect of tip clearance on the aerodynamic force of an inviscid incompressible uniform flow about a wing. It is assumed that the vortex strength is constant across the wing span and that the downwash along the wing span is equal to its level at the center of the wing span. Expressions are derived to determine the force acting on a low aspect ratio wing with a tip clearance under the conditions studied. The expressions are based on an extension of Bollay's results. V.Z.

A72-12882 **The rostrum.** R. Prouty (Lockheed-California Co., Burbank, Calif.). *American Helicopter Society, Journal,* vol. 16, Oct. 1971, p. 61, 62.

Simple exploration of tip relief, with suggestion of an empirical means of predicting its magnitude. A blade tip may be thought of as a combination of a two-dimensional airfoil and a three-dimensional body. Because of the geometric relationships, tips with thick airfoil sections have more tip relief than do tips with thin airfoil sections. For quick estimates of the tip relief, the apparent drag divergence Mach number can be computed from the two-dimensional drag divergence, Mach number, the airfoil parameters, and flight conditions. F.R.L.

A72-12898 **Measuring, data-acquisition, and data-processing systems for the large wind tunnels of the Aerodynamische Versuchsanstalt Göttingen (Messtechnik, Datenerfassung und Datenverarbeitung an den grossen Windkanälen der Aerodynamischen Versuchsanstalt Göttingen).** H. Fütterer, D. Mehmel, and F. W.

Riegels (Aerodynamische Versuchsanstalt, Göttingen, West Germany). In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1970. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1971, p. 166-185. 14 refs. In German.

The measuring equipment and procedures, and the electronics of the data acquisition and processing systems employed at the 3-m wind tunnel and the transonic wind tunnel at Göttingen are examined. Improvements in the measuring equipment made during the last decade, and an improved compressor system suitable for engine simulation are discussed. A computerized real-time data processing system is described. V.P.

A72-12900 Conception and flight behavior of a jet-powered recoverable lift engine (Zur Konzeption und zum Flugverhalten eines strahlgetragenen Abwurftriebwerks). D. Rist (München, Technische Universität, Munich, West Germany). In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1970. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1971, p. 196-249. 13 refs. In German.

The concept of a disk-shaped lift engine intended to provide additional thrust during the takeoff and transition phases of V/STOL aircraft. After fulfilling this task, the engine returns to the ground, using its jet for a soft landing. The design of the engine, characterized by an unconventional arrangement of compressor, turbine, and combustion chamber is described. The recovery process is controlled solely by the strong gyroscopic properties of the engine rotor. V.P.

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STAR ENTRIES

N72-10003# Naval Weapons Lab., Dahlgren, Va. Warfare Analysis Dept.
EFFECT OF FIN SLOTS ON THE STATIC AND DYNAMIC STABILITY CHARACTERISTICS OF FINNED BODIES
Thomas A. Clare and Peter Daniels Jun. 1971 31 p refs
(AD-728016; NWL-TR-2582) Avail: NTIS CSCL 19/1

Static and dynamic stability characteristics of a cruciform, slotted fin configuration are presented. Aerodynamic coefficients are extracted from single degree of freedom, free oscillation wind tunnel tests employing nonlinear least squares procedures. The linear and nonlinear variations with angle of attack of the restoring and damping moment coefficients are presented for various fin slot sizes at subsonic speeds. Results indicate that, as slot size increases, the nonlinear contributions decrease in magnitude to a greater extent than the linear terms. Based on the signs of the various moment contributions, it was found that, while stability is reduced at small angles of attack due to increased slot size, greater stability is affected at moderate angles of attack. Author (GRA)

N72-10004# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Porz (West Germany).
AERODYNAMIC INTERFERENCE BETWEEN AIRCRAFT AND ENGINE JET [AERODYNAMISCHE INTERFERENZ ZWISCHEN FLUGZEUG UND TRIEBWERKSSTRAHL]
Apr. 1971 312 p refs Partly in ENGLISH and partly in GERMAN Proc. of the DGLR Symp., Duesseldorf, 3 Dec. 1970
(DLR-MITT-70-28) Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

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2. INTERFERENCE EFFECTS FROM JETS ON AIRCRAFT STATIC STABILITY. WIND TUNNEL METHODS USED IN SWEDEN G. Bennich (SAAB Aircraft Co.) 16 p

3. TECHNIQUE OF PROPULSION SYSTEM SIMULATION WITH HIGH PRESSURE EJECTORS FOR SUBSONIC WIND TUNNEL MEASUREMENTS ON A FIGHTER AIRCRAFT MODEL WITH VERTICAL TAKEOFF CHARACTERISTICS W. Heinzerling (Messerschmitt-Boelkow-Blohm, Munich) 22 p

4. TURBULENT AND LAMINAR JET PROPAGATION IN ROTATING SYSTEMS AND ITS APPLICATION TO JET MIXING IN THE WAKE OF REACTION DRIVEN ROTORS R. Schmidt and J. T. Heynatz (Dornier-Werke, Friedrichshafen, West Ger.) 37 p refs

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8. FORCE AND DOWNWASH MEASUREMENTS WITH JET SIMULATION ON MODELS OF THE EUROPEAN AIRBUS IN A LOW SPEED WIND TUNNEL W. Geissler (DFVLR, Goettingen, West Ger.) 22 p refs

9. INVESTIGATIONS OF EXHAUST JETS OF TL-ENGINE MODELS E. Schwantes (DFVLR, Brunswick) 33 p refs

10. CALCULATION OF THE PRESSURE DISTRIBUTION ON AN AIRCRAFT FUSELAGE WITH EMERGING LIFTING JETS USING SINGULARITIES G. Schulz (DFVLR, Porz, West Ger.) 36 p refs

11. AERODYNAMIC CALCULATIONS FOR THE INTERFERENCE OF SEVERAL PROPELLER-JETS WITH AN AEROFOIL G. Loebert (Ver. Flugtech. Werke Fokker, Munich) 43 p refs

N72-10005# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Aerodynamik.
POSSIBILITIES FOR JET SIMULATION IN THE 3m-WIND TUNNEL OF THE DFVLR-AVA GOETTINGEN [MOEGLICHKEITEN ZUR STRAHLSIMULATION IM 3M-WINDKANAL DER DFVLR-AVA GOETTINGEN]
E. Melzer and R. Wulf *In* DGLR Aerodyn. Interference Between Aircraft and Engine Jet Apr. 1971 28 p refs In GERMAN; ENGLISH summary
Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

Experiments were carried out in a low speed wind tunnel to determine jet aircraft/engine interference with several aircraft models. After a discussion of the similarity parameters of engine intake and exhaust models, some possibilities of jet generation are explained, including compressed air, motor-driven fans or propellers, and the use of compressed air for ejectors of turbines. The power plants involved are described, and their possibilities and limitations are discussed. ESRO

N72-10006# Saab Aircraft Co., Linkoping (Sweden).
INTERFERENCE EFFECTS FROM JETS ON AIRCRAFT STATIC STABILITY. WIND TUNNEL METHODS USED IN SWEDEN
G. Bennich *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 16 p
Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

The development of equipment for measuring jet interference in aircraft models is described. The main object of these tests was the determination of jet interference effects on the static stability of the twin engined SAAB 105 aircraft and the single engined SAAB-37 Viggen which has an ejector type of afterbody. Special supports enabled the measurement of yaw stability for the twin-engined aircraft; the single engined model support permitted variation in angle of attack and yaw. The supply of compressed air was regulated to simulate all engine settings. ESRO

N72-10007# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge-Entwicklung.
TECHNIQUE OF PROPULSION SYSTEM SIMULATION

WITH HIGH PRESSURE EJECTORS FOR SUBSONIC WIND TUNNEL MEASUREMENTS ON A FIGHTER AIRCRAFT MODEL WITH VERTICAL TAKEOFF CHARACTERISTICS [TECHNIK DER TRIEBWERKSSIMULATION MIT HOCHDRUCKEJEKTOREN BEI UNTERSCHALLWINDKANALMESSUNGEN AM MODELL EINES SENKRECHTSTARTFAEHIGEN KAMPFFLUGZEUGES]

W. Heinzerling *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 22 p In GERMAN (See

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

A wind tunnel model of a vertical takeoff fighter aircraft was designed to cater for the normal 6 component measurements in addition to jet interference measurements. The model's engines were high pressure ejectors, driven by compressed air. A survey is given of the measurements performed to determine aerodynamic characteristics with and without interference drag. ESRO

N72-10008# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

TURBULENT AND LAMINAR JET PROPAGATION IN ROTATING SYSTEMS AND ITS APPLICATION TO JET MIXING IN THE WAKE OF REACTION DRIVEN ROTORS [TURBULENTE UND LAMINARE STRAHLAUSBREITUNG IN ROTIERENDEN SYSTEMEN UND IHRE ANWENDUNG AUF DIE STRAHLMISCHUNG IM ABWINDFELD VON ROTOREN MIT REAKTIONSANTRIEBEN]

R. Schmidt and J. T. Heynatz *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 37 p refs In GERMAN

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

The kinematics and dynamic laws governing the propagation of a jet emerging from a rotating arm tip are derived for a fixed coordinate system. Using typical mixing laws for rectilinear jet propagation as an approximation, the cases of plane and round laminar and turbulent jets are compared. The spatial deviation of a jet in a rotor wake results from a further approximation. The transferability of the theoretical statements on jet propagation from one reference system to another is discussed. The principles of jet propagation in rotating systems are treated in a system of corrolated coordinates. The theoretical derivations are clarified with examples of jets with temperature equal to or higher than their environment. In addition, the characteristic properties of jet propagation are experimentally investigated using smoke photographs. ESRO

N72-10009# Royal Aircraft Establishment, Farnborough (England).

SOME EXPERIMENTS ON AN ENGINE INSTALLATION ABOVE THE WING OF A SWEPT-WINGED AIRCRAFT

J. A. Bagley *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 20 p refs

(RAE-TM-AERO-1271) Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

Experiments are described for a possible large diameter turbofan engine nacelle installation above the wing of a transport aircraft. The current generation of turbofan engines for transport aircraft have nacelle diameters of about 3m, and as engine bypass ratio increases, the nacelles will become even larger. To fit such engines in the conventional position below the wings will be increasingly difficult. Tests were first made on a partial model of the wing and nacelle with the jet represented by blowing from an external supply. Interference between the jet and wing was investigated by measuring pressures on the wing, by surveys of the total-head distribution in the jet, and by schlieren and oil-flow photography. These tests were followed by force measurements in a low-speed wind tunnel on a model of a swept wing and fuselage, fitted with a pair of free-flow nacelles. The results suggest that the lift-dependent drag of such an installation may be significantly larger than that of a conventional installation below the wing. Author (ESRO)

N72-10010# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Aerodynamik.

INFLUENCE OF A JET ON THE AERODYNAMIC PROPERTIES OF WINGS POSITIONED ABOVE THE JET NOZZLE [EINFLUSS EINES DUESENSTRAHLS AUF DIE AERODYNAMISCHEN BEIWERTE VON UEBER DER STRAHLDUESE ANGEORDNETEN FLUEGELN]

W. Baumert and L. Harms *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 20 p refs In GERMAN; ENGLISH summary

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

Rectangular and swept wings were investigated; position, inclination and velocity of the jet were varied. Wing and nacelle were mounted separately so that the wind tunnel balance did not measure jet thrust. A simple determination of jet interference was possible with this arrangement. The jet decreased wing lift, for the ratio of jet velocity and free stream velocity from 2 to 17 the lift loss increased linearly with the velocity ratio. The lift loss also increased with jet angle. The induced pitching moment is dependent on velocity ratio and varies with position of the jet. ESRO

N72-10011# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. Aerodynamik.

THE INFLUENCE OF AN INCLINED JET ON THE AERODYNAMIC CHARACTERISTICS OF A CONTROL SURFACE [DER EINFLUSS EINES GENEIGTEN STRAHLS AUF DIE AERODYNAMISCHEN EIGENSCHAFTEN EINES LEITWERKS]

M. Seidel *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 28 p refs In GERMAN

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

The variations in lift of a freestanding control surface due to a round, cold, engine jet were investigated. The most important parameter in VTOL longitudinal stability is the inclination of the jet engine to the flow direction. The measurements show that inclined incident jets result in lift losses of the control surface and thus are generally unfavorable to longitudinal stability. An empirical formula is derived for the estimation of lift loss due to jet impingement. ESRO

N72-10012# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Aerodynamik.

FORCE AND DOWNWASH MEASUREMENTS WITH JET SIMULATION ON MODELS OF THE EUROPEAN AIRBUS IN A LOW SPEED WIND TUNNEL [KRAFT- UND ABWINDMESSUNGEN MIT TRIEBWERKSSIMULATION AN MODELLEN DES EUROPAEISCHEN AIRBUS IM NIEDERGESCHWINDIGKEITSBEREICH] c02

W. Geissler *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 22 p refs In GERMAN; ENGLISH summary

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

Extensive wind tunnel measurements of the European airbus, including jet simulation, are reported. The jet interference influence on longitudinal stability led to repositioning of the nacelles. Simulation with the improved engine position did not indicate any reduction in jet interference, whilst bypass jet simulation showed further stability deterioration. Near ground, on the other hand, a clear improvement of longitudinal stability was observed. Further investigation at higher Reynolds numbers is necessary. ESRO

N72-10013# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.

INVESTIGATIONS OF EXHAUST JETS OF TL-ENGINE MODELS [UNTERSUCHUNGEN AN ABGASSTRAHLEN VON TL-TRIEBWERKSMODELLEN] c28

E. Schwantes *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 33 p refs In GERMAN

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

A systematic investigation of hot gas free jets, with an excess temperature of 550C, with critical nozzle pressure, and five differently shaped convergent nozzles is described. Large differences were noted with free jet measurements at lower nozzle Mach number. The exhaust jet emerged from the convergent nozzle with very high static overpressure, and accelerated to hypersonic speed within a core of approximately five nozzle diameters. The jet disintegration and the spatial jet propagation were less for the high speed jet than for a free jet with lower nozzle exhaust velocity due to weather turbulence. The jet propagation angle is almost the same for hot and cold jets, but thermal lifting forces resulted in a deformation of the circular cross section for horizontal hot gas jets. ESRO

N72-10014# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

CALCULATION OF THE PRESSURE DISTRIBUTION ON AN AIRCRAFT FUSELAGE WITH EMERGING LIFTING JETS USING SINGULARITIES [BERECHNUNG DER DRUCKVERTEILUNG AUF EINEM FLUGZEUGRUMPF MIT AUSTRETENDEN HUBSTRAHLEN MITTELS SINGULARITAETEN]

G. Schulz *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 36 p refs In GERMAN

Avail: NTIS HC $3.00/MF $0.96; ZLDI Munich: 54 DM

The influence of a lifting jet perpendicular to a cylindrical aircraft fuselage is theoretically calculated. The secondary action of the jet is twofold: ambient air is drawn in as an injector, whilst the external airflow around the jet is considered as that around a solid body. The injector action is determined by a half empirical relation. The injector is represented as a line sink in potential theory. The displacing action of the jet is represented by dipole distribution on the jet axis. Both sink and dipoles cause undue disturbances near the fuselage surface by velocity components normal to the contour. These disturbances can be corrected by additional singularities. The determination of these singularities is the essential problem of the investigation. ESRO

N72-10015# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Munich (West Germany).

AERODYNAMIC CALCULATIONS FOR THE INTERFERENCE OF SEVERAL PROPELLER-JETS WITH AN AEROFOIL [BERECHNUNG DER AERODYNAMIK DES VON MEHREREN STRAHLEN BEAUFSCHLAGTEN TRAGFLUEGELS]

G. Loebert *In* DGLR Aerodyn. Interference between Aircraft and Engine Jet Apr. 1971 43 p refs In GERMAN; ENGLISH summary

Avail: NTIS HC $6.00/MF $0.95; ZLDI Munich: 54 DM

The suitability of the lifting surface theory for V/STOL aircraft for the calculation of the aerodynamics of a wing immersed in one or more propeller slipstreams was investigated by comparison with experimental results. The comparison was conducted on the basis of lift, drag, pitching moment, normal-force distribution, and wake characteristics. The impact pressure distribution and field of direction in the airfoil wake are discussed. The influence of the main propeller-wing interference characteristics on the descent capability of propeller driven V/STOL aircraft is investigated. ESRO

N72-10018# National Physical Lab., Teddington (England). Aerodynamics Div.

A PROGRAMME OF RESEARCH INTO VISCOUS ASPECTS OF FLOW ON SWEPT WINGS

B. G. Thompson, G. A. Carr-Hill, and B. J. Powell (Kingston Polytech.) Sep. 1970 69 p refs

(NPL-AERO-NOTE-1100; ARC-32402; FM-4175; PERF-2947) Avail: NTIS

Current research to produce forward and inverse design programs for swept wings is described briefly. Calculations of linearized velocities, boundary layer development, and of external streamlines from surface pressures are presented. Problems affecting airfoil design and testing in viscous, nominally two-dimensional flow are also considered. Author (ESRO)

N72-10021# National Physical Lab., Teddington (England). Aerodynamics Div.

A NOTE ON SUBSONIC LINEARISED THEORY FOR SYMMETRICAL CRANKED WINGS AT ZERO-INCIDENCE

R. C. Lock Jul. 1970 17 p refs

(NPL-AERO-NOTE-1090; ARC-32225; FM-4157; PERF-2921) Avail: NTIS

Formulae are given for the streamwise and spanwise components of perturbation velocity due to thickness, as predicted by subsonic linearized theory, in the neighborhood of the crank formed by the junction of two semi-infinite swept wings of different sweep angles. The implications of these formulae for the magnitude of the crank effect are discussed qualitatively, including the influence of free stream Mach number.

Author (ESRO)

N72-10022# National Physical Lab., Teddington (England). Aerodynamics Div.

SEPARATION MEASUREMENTS ON A DELTA WING IN A SHOCK TUNNEL AT M=8.6 USING MONOCHROME AND COLOUR-SCHLIEREN PHOTOGRAPHY

R. F. Cash and A. M. Catley Sep. 1970 14 p refs Original contains color illustrations

(NPL-AERO-NOTE-1097; ARC-32399) Avail: NTIS

The measurements were made on a 76 deg swept delta wing in a 400 mm (16 in) shock tunnel and the free stream Reynolds number was 49,000 cm (125,000 in) for stagnation conditions of 150 atmospheres and 2000 K. A series of schlieren photographs of the established separated flow, induced by spanwise steps and wedges fixed at the rear of the model, were taken in monochrome and color. The technique, equipment, and the relative merits of the two systems are discussed in detail. Author (ESRO)

N72-10023# National Physical Lab., Teddington (England). Aerodynamics Div.
THE MECHANICAL DESIGN OF AN ADJUSTABLE NOZZLE FOR THE NPL 25 in BY 20 in (635 mm BY 508 mm) TRANSONIC WIND TUNNEL
N. G. Marcus Sep. 1970 28 p refs
(NPL-AERO-NOTE-1098; ARC-32400) Avail: NTIS

A description is given of the mechanical engineering design of a pair of steel flexible liners. These are positioned by simple motorized jack systems which easily adjust the flexible nozzle to control the tunnel Mach number. The aerodynamic loading, calculations, and design features are discussed. Author (ESRO)

N72-10025*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF CASING TREATMENT ON OVERALL AND BLADE ELEMENT PERFORMANCE OF A COMPRESSOR ROTOR
Royce D. Moore, George Kovich, and Robert J. Blade Washington Nov. 1971 65 p refs
(NASA-TN-D-6538; E-6119) Avail: NTIS CSCL 20D

An axial flow compressor rotor was tested at design speed with six different casing treatments across the rotor tip. Radial surveys of pressure, temperature, and flow angle were taken at the rotor inlet and outlet. Surveys were taken at several weight flows for each treatment. All the casings treatments decreased the weight flow at stall over that for the solid casing. Radial surveys indicate that the performance over the entire radial span of the blade is affected by the treatment across the rotor tip.
Author

N72-10031*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FULL-SCALE WIND-TUNNEL TESTS OF A SMALL UNPOWERED JET AIRCRAFT WITH A T-TAIL
Paul T. Soderman and Thomas N. Aiken Washington Nov. 1971 99 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab.
(NASA-TN-D-6573; A-3135) Avail: NTIS CSCL 01A

The aerodynamic characteristics of a full scale executive type jet transport aircraft with a T-tail were investigated in a 40 x 80 ft (12.2 by 24.4 meter) wind tunnel (subsonic). Static, longitudinal, and lateral stability, and control characteristics were determined at angles of attack from -2 deg to +42 deg. The aircraft wing had 13 deg of sweep and an aspect ratio of 5.02. The aircraft was tested power off with various wing leading- and trailing-edge high lift devices. The basic configuration was tested with and without such components as engine nacelles, wing tip tanks, and empannage. Hinge-moment data were obtained and downwash angles in the horizontal-tail plane location were calculated. The data were obtained at Reynolds numbers of 4.1 million and 8.7 million based on mean aerodynamic chord. The model had static longitudinal stability through initial stall. Severe tail buffett occurred near the angle of attack for maximum lift. Above initial stall the aircraft had pronounced pitch-up, characteristic of T-tail configurations. A stable trim point was possible at angles of attack between 30 deg and 40 deg (depending on c.g. location and flap setting). Hinge-moment data showed no regions with adverse effects on stick force. Comparisons of wind-tunnel data and flight-test are presented.
Author

N72-10033*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTIPLE FAN INTEGRATED PROPULSION WING SYSTEM Patent Application
Roger W. Luidens, inventor (to NASA) Filed 21 Jun. 1971 14 p
(NASA-Case-LEW-11224-1; US-Patent-Appl-SN-154934) Avail: NTIS CSCL 01B

A system for directing air against the wing flaps of STOL aircraft to produce both lift and forward thrust is described. Airpumps provide high pressure air to small tip turbine fans disposed spanwise under the wings and forward of the flaps; the fans then direct the air against the flaps to produce the lift and thrust. J.G.M.

N72-10034# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Flugzeuge.
PRELIMINARY TESTS AND PERFORMANCE OF ROLLING VERTICAL TAKEOFF AND LANDING OF THE VJ 101 C-X2 WITH IGNITED AFTERBURNERS [VORUNTERSUCHUNGEN UND DURCHFUEHRUNG VON ROLLENDEN SENKRECHTSTARTS UND -LANDUNGEN MIT DER VJ 101 C-X2 MIT GEZUENDETEN NACHBRENNERN]
O. Richarz, H. Heidrich, and V. Zeidler Bonn Bundeswehramt 1971 38 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(BMVg-FBWT-71-13) Avail: NTIS; Bundeswehramt, Bonn: 25 DM

A special takeoff and landing procedure, termed RVTOL (rolling vertical takeoff and landing), was developed for the VTOL aircraft VJ 101 C-X2. The RVTOL technique is believed to be an answer with this type of aircraft to the problems of recirculation, ground erosion, airframe thermal stress, and controllability. Almost complete independence from conventional ground equipment is claimed, due to the reliable operation of the three-channel flight control system. ESRO

N72-10035# National Physical Lab., Teddington (England). Environmental Unit.
A NEW BASIS FOR AIRCRAFT NOISE RATING
D. W. Robinson Mar. 1971 23 p refs
(NPL-Aero-Ac-49) Avail: NTIS

Starting with the definition of noise pollution level, it is shown that the incremental value of this quantity due to the occurrence of an aircraft noise provides a logical basis for rating the noise. This measure has simple additive properties which permit the same definition to be extended to an arbitary series of events, including the background noise and its fluctuations. By specifying reference values of certain parameters, a formula is evolved which is suitable for aircraft noise certification purposes; the relation of this measure to effective perceived noise level is discussed. Author (ESRO)

N72-10036# Defense Documentation Center, Alexandria, Va.
NOISE POLLUTION - AIRPLANE NOISE, VOLUME 1 Bibliography, Aug. 1947 - Dec. 1970
Jun. 1971 147 p refs 2 Vol.
(AD-724850; DDC-TAS-71-26-1) Avail: NTIS CSCL 20/1

The annotated bibliography is an unclassified compilation of references on airplane noise pollution in a series of bibliographies on environmental pollution. References deal primarily with effects of noise exposure on hearing, speech, communications and community/airport noise. Computer-generated indexes for corporate author-monitoring agency, subject, and title are included. requesting AD-722 910. Author (GRA)

N72-10037# Naval Ship Research and Development Center, Washington, D.C. Aviation and Surface Effects Ratios.
THEORETICAL PERFORMANCE OF A PURE JET FLAP ROTOR AT HIGH ADVANCE RATIOS
Robert M. Williams and Charles L. Bernitt Dec. 1970 49 p refs

(Proj. WF32.421.202)
(AD-726706; TN-AL-189) Avail: NTIS CSCL 01/3

The theoretical performance of a jet flap rotor at advance ratios greater than 1.0 is examined. The rotor is four bladed with purely elliptical airfoils of fifteen percent thickness ratio. Each airfoil has two plenum chambers which supply air to slots located beneath the leading and trailing edges, respectively. The rotor operates in cruise at advance ratios greater than unity so that the retreating blade is immersed in reverse flow. The lift and moments are controlled by ejecting a jet sheet out of the trailing edge on the advancing side of the azimuth and both the leading and trailing edge on the retreating side of the azimuth. Standard blade element theory is used to calculate jet flap rotor performance thrust coefficients representative of actual full-scale rotor operation. It is shown that good performance can be obtained using the jet flap and that substantially better performance can be achieved using a circulation control airfoil. Author (GRA)

N72-10038# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
BRIEFS OF ACCIDENTS INVOLVING AMATEUR/HOME BUILT AIRCRAFT: US GENERAL AVIATION
Jun. 1971 44 p
(PB-201438; NTSB-AMM-71-2) Avail: NTIS CSCL 01B

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

N72-10039# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
BRIEFS OF ACCIDENTS INVOLVING WEATHER AS A CAUSE RELATED FACTOR: US GENERAL AVIATION, 1968
Jun. 1971 196 p
(PB-201437; NTSB-AMM-71-1) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving weather. Author (GRA)

N72-10040# Quality Assurance Directorate (Materials), London (England).
THE INFRA-RED ANALYSIS OF AIRCRAFT CABIN-GAS ATMOSPHERES
D. J. Bishop and J. K. Corbett Oct. 1970 31 p refs
(QAD-MATS-174) Avail: NTIS

The analysis of the air-bleed cabin gas produced by Olympus and Pegasus engines has been carried out by infra-red spectrometry. The method utilizes a conventional double beam recording infra-red spectrophotometer equipped with a pair of multireflection long path cells. The lower limits of detection of the various contaminants listed in the specification have been determined both individually and in conjunction with large amounts of other impurities. This method has also been extended to cover air-bleed cabin gas samples which have been taken from development engines in which malfunctions of the engine components have been simulated. Author (ESRO)

N72-10041# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING MISSING AIRCRAFT: US GENERAL AVIATION, 1968
Jun. 1971 92 p
(NTSB-AMM-71-4; PB-201440) Avail: NTIS CSCL 01B

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

N72-10042# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
OPTIMIZATION STUDIES OF AIRCRAFT CONTROL VARIABLES
Mario Caluda, G. D. Wahitehouse, and A. J. McPhate May 1971 144 p refs
(Contract F44620-68-C-0021; AF Proj. 7921; Proj. THEMIS)
(AD-725069; THEMIS-LSU-T-TR-45; AFOSR-71-1798TR) Avail: NTIS CSCL 01/3

The feasibility of using an adaptive linear mathematical model to represent a human operator subjected to the task of controlling an attacking fighter aircraft was investigated. The ability of the model to perform pursuit tracking tasks subject to random evader tactics was analyzed by the implementation of the model into a six-degree-of-freedom digital fire control simulation. For the model to approach reality in every flight regime, an adaptive procedure was incorporated into the simulation in every flight regime, and an adaptive procedure was incorporated into the simulation to adjust the variable gain and lead time parameters of the human model. The adaptive procedure which uses a six parameter optimization scheme similar to that developed by M. J. D. Powell achieves the desired pursuit tracking results in the most direct way. As a means of evaluating the simulated performance of the human operator when performing this task, the performance data of the attacking aircraft was subjected to a number of spectral analysis operations. These spectral operations compared the frequency content of the data obtained from the simulation to actual data obtained from combat flight maneuvers. For both sets of data the evaders performed the same identical tactics. Author (GRA)

N72-10043*# Boeing Co., Wichita, Kans.
STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9622)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B

A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

N72-10044# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
INVESTIGATION OF DISPLAY REQUIREMENTS FOR HELICOPTER IFR MANUAL FORMATION FLIGHT UNDER VARIOUS OPERATIONAL AND ENVIRONMENTAL CONDITIONS Final Report, Aug. 1969 - Jun. 1970
Myrna L. Toivanen, Paul A. Anderson, and S. R. Hollingsworth Apr. 1971 199 p refs
(Contract N00014-66-C-0362; NR Proj. 213-054)
(AD-725209; JANAIR-700911; Rept-12543-FR6) Avail: NTIS CSCL 01/4

Systematic man-in-the-loop simulations were conducted to evaluate pilot/system performance in the manually controlled IFR SK/FF task for the UH-1 helicopter under various operational and environmental conditions. Interpreted within the constraints imposed upon and by the simulations, the empirical results indicated that leader heading, even when perturbed by lateral gusts, was an adequate system reference; 250-2000 feet were acceptable separation distances for fixed-formation maneuvers; there were no significant performance differences between the leader or follower frame of reference; the pursuit guidance technique was applicable to the rendezvous phase; display augmentation was not required during the rendezvous, but it reduced the difficulty of the control task and improved performance; the formation grouping concept was feasible from the standpoint of display/control considerations; and the trajectory-following and pursuit guidance control techniques were both suitable for providing control commands to the pilot for

formation grouping, although trajectory-following yielded better performance and pursuit guidance was easier to mechanize.
Author (GRA)

N72-10045*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF AN ALL-BODY HYPERSONIC AIRCRAFT CONFIGURATION AT MACH NUMBERS FROM 0.65 TO 10.6
Walter P. Nelms, Jr. and Charles L. Thomas Washington Nov. 1971 100 p refs
(NASA-TN-D-6577; A-4017) Avail: NTIS CSCL 01B

Aerodynamic characteristics of a model designed to represent an all body, hypersonic cruise aircraft are presented for Mach numbers from 0.65 to 10.6. The configuration had a delta planform with an elliptic cone forebody and an afterbody of elliptic cross section. Detailed effects of varying angle of attack (-2 to +15 deg), angle of sideslip (-2 to +8 deg), Mach number, and configuration buildup were considered. In addition, the effectiveness of horizontal tail, vertical tail, and canard stabilizing and control surfaces was investigated. The results indicate that all configurations were longitudinally stable near maximum lift drag ratio. The configurations with vertical tails were directionally stable at all angles of attack. Trim penalties were small at hypersonic speeds for a center of gravity location representative of the airplane, but because of the large rearward travel of the aerodynamic center, trim penalties were severe at transonic Mach numbers. Author

N72-10046# Army Foreign Science and Technology Center, Charlottesville, Va.
HELICOPTER AERODYNAMICS
D. I. Bazov 14 May 1971 224 p refs Transl. into ENGLISH of the book "Aerodinamika Vertoletov" Moscow, Transport Publishing House, 1969 p 1-196
(Proj. T702301-2301)
(AD-726841; FSTC-HT-23-549-71; ACSI-J-9360) Avail: NTIS CSCL 01/1

The principles of helicopter flight, special characteristics of the main rotor and its function in autorotation axial and oblique flow, regimes of vertical and horizontal flight, climb and descent, takeoff and landing, balance, stability and control of the helicopter and their acting aerodynamic forces are presented.
Author (GRA)

N72-10047# Grumman Aerospace Corp., Bethpage, N.Y.
AN AUTOMATED PROCEDURE FOR THE OPTIMIZATION OF PRACTICAL AEROSPACE STRUCTURES. VOLUME 2: TECHNICAL PROGRAMMER'S MANUAL Final Report, 15 Jan. 1969 - 15 Aug. 1970
Walter J. Dwyer, Robert K. Emerton, and Irving V. Ojalvo Wright-Patterson AFB, Ohio AFFDL Apr. 1971 107 p
(Contract F33615-69-C-1278)
(AD-725744; ADR-02-01-71-Vol-2; AFFDL-TR-70-118-vol-2) Avail: NTIS CSCL 01/3

The report documents the computer programs described in Volume I of this report entitled 'An Automated Procedure for the Optimization of Practical Aerospace Structures' (AD-726112). Both the main structural optimization program and the shell dynamics program are written in Fortran 4 language. This manual contains a description of the overlay structure, data set arrangement, and subroutines of both programs. Author (GRA)

N72-10048# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE GENERATION OF A MILITARY SPECIFICATION FOR FLYING QUALITIES OF PILOTED V/STOL AIRCRAFT MIL-F-83300 Final Report, Apr. 1966 - Mar. 1971
David L. Key Wright-Patterson AFB, Ohio AFFDL Apr. 1971 41 p refs
(Contracts AF 33(615)-3736; F33615-70-C-1322; AF Proj. 698DC)
(AD-725746; CAL-BB-2926-F-1; AFFDL-TR-21-23) Avail: NTIS CSCL 01/3

The document describes a four year effort which led to the adoption of a new military specification MIL-F-83300, 'Flying Qualities of Piloted V/STOL Aircraft', and the publication of a supporting document, 'Background Information and User Guide for MIL-F-83300, Military Specification - Flying Qualities of Piloted V/STOL Aircraft' (AFFDL-TR-70-88). Included in the report is an assessment of the status of V/STOL flying qualities research and recommendations for future work. Author (GRA)

N72-10049# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: SOUTHERN AIRWAYS, INCORPORATED, DOUGLAS DC-9-15, N92A, GULFPORT, MISSISSIPPI, 17 FEBRUARY 1971
1 Sep. 1971 22 p
(NTSB-AAR-71-14) Avail: NTIS

On February 17, 1971, DC-9-15 aircraft struck an electric transmission line static cable during a VOR approach to Runway 31 at the Gulfport, Mississippi, Municipal Airport. A successful missed approach was accomplished, and the aircraft landed at Gulfport. Of the seven passengers and four crew aboard the aircraft, the only reported injury was a passenger's scratched hand. The aircraft received substaintial damage to the left main landing gear, left wing, left fuselage, and the left engine. There was no fire. The weather was a partial obscuration with visibility 3/4 mile in fog. The probable cause of this accident was inadequate monitoring of the approach. The captain was preoccupied with the prelanding checklist during the final approach, and the first officer, who was flying the aircraft, was devoting his attention to an attempt to establish visual contact with the runway in low visibility. These activities resulted in an improperly executed VOR/DME approach during which the aircraft descended below the minimum descent altitude before the crew acquired visual contact with the runway environment.
Author

N72-10050# East Central Florida Regional Planning Council, Winter Park.
METROPOLITAN AIRCRAFT NOISE ABATEMENT POLICY STUDY: CAPE KENNEDY REGIONAL AIRPORT, MELBOURNE, FLORIDA
Jun. 1971 134 p refs
(PB-201195; ECFRPC-71-2) Avail: NTIS CSCL 13B

The report is an analysis of the relationship between noise generated by aircraft operations and the use of affected land surrounding the airport in Melbourne, Florida. It includes a presentation of current land use information and the prospects for change. Proposals were developed to encourage and enable the local governments involved to achieve compatible development through cooperative intergovernmental measures: comprehensive planning, capital improvement programming, mapping, zoning, annexation, land acquisition. The ecological impact is considered in a separate section. Author (GRA)

N72-10122# Army Aeromedical Research Lab., Fort Rucker, Ala. Aviation Center Team Study Group.
ENVIRONMENTAL EFFECTS ON ATTACK HELICOPTER CREW TASK PERFORMANCE IN THE NATO THEATER
Stanley C. Knapp, ed. May 1971 43 p ref
(AD-726949; USAARL-71-21) Avail: NTIS CSCL 06/19

The unique tasks, requirements and demands upon attack helicopter crews, and the effects of the environment upon the performance of these tasks are analyzed. Night operations under low ceilings, reduced visibility, high or low speeds, nap-of-the-earth flight profiles and a threat of sophisticated antiaircraft weaponry is defined as the 'worst-credible-environment' for the NATO theater. In this environment, the attack helicopter and its crew will be expected to fly a large percentage of its missions and deliver its ordnance with a high degree of accuracy. Task performance is outlined in a detailed matrix. Collective tasks are grouped into functional task clusters. The effects of climatic conditions, the hostile threat, social and civil factors upon performance of these task clusters are discussed. The effects of

the machine/mission created environment are presented and include hypoxia, toxic products, temperature extremes, visual and optical problems, acoustics, vibration, and human factors.
Author (GRA)

N72-10127# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
CREW COMPARTMENT VIBRATION ENVIRONMENT IN THE B-52 AIRCRAFT DURING LOW-ALTITUDE, HIGH-SPEED FLIGHT Final Report, Aug. 1966 - Dec. 1970
Jerry D. Speakman and Justis F. Rose, Jr. Mar. 1971 206 p refs
(AF PROJ. 7231)
(AD-727023; AMRL-TR-71-12) Avail: NTIS CSCL 06/19

Measurements were made of the pilot station vibration environment experienced in the B-52 aircraft during low-altitude, high-speed flight. Data were obtained of the longitudinal, lateral and vertical linear accelerations and the roll axis angular velocities and accelerations. The terrain contour following flights at 500-900 feet above the flat to semi-mountainous regions of Louisiana and Arkansas were made at 350 knots true airspeed. Data analyses included probability density and distribution and the auto-power spectral density functions in addition to tests for stationarity, randomness and normality. The individual degree-of-freedom results are presented in graphical and tabular form and in general indicate that the pilot station vibration environment produced by the combination of gust response and maneuvering: (1) is stationary for up to 590 seconds; (2) is a random phenomena that does not satisfy the chi-square goodness-of-fit test for Gaussian distribution; (3) cannot be adequately simulated in the laboratory for human biomedical tolerance and/or psycho-physiological performance studies using only vertical axis motion; (4) is remarkably in agreement with those PSD's calculated for the lateral and vertical axes using an aircraft transfer function experimentally derived on another program and the Dryden gust input spectrum. Author (GRA)

N72-10171# Federal Aviation Administration, Washington, D.C.
AERONAUTICAL TELECOMMUNICATIONS IN SOUTHEAST ASIA: INDONESIA, LAOS, MALAYSIA AND THAILAND
1970 262 p
Avail: NTIS

Descriptions of existing airway operations systems, conclusions and recommendations, equipment requirements, proposed courses of action, and economic and financial factors in aeronautical telecommunications are presented and discussed for Indonesia, Laos, Malaysia, and Thailand. The background and regional aspects of the study including objectives, scope, and methodology are summarized. J.M.

N72-10173# National Aviation Facilities Experimental Center, Atlantic City, N.J.
INVESTIGATION OF AIRBORNE MARKER BEACON Final Report, Jun. 1970 - Sep. 1971
Louis A. Dvorsky Nov. 1971 98 p
(Proj. 341-004-03X)
(FAA-NA-71-29) Avail: NTIS

Ground and air tests of a flight inspection marker beacon receiving system were made to identify and correct variations in marker pattern measurement from time to time and from aircraft to aircraft. The tests were made with both the T-29 Convair and DC-3 aircraft. Based on the flight test results, new receiver calibration and antenna system ramp calibration procedures were devised. Author

N72-10184# National Physical Lab., Teddington (England). Aerodynamics Div.
POSSIBLE DEVELOPMENTS OF A WIND TUNNEL COMPUTER SYSTEM
R. J. Young Sep. 1970 9 p
(NPL-AERO-1326; ARC-32396; Comp-FM-218) Avail: NTIS

Ways for developing the computer system with a view to providing multiple on-line facilities are explored. The function and applicability of available operating systems and hardware are discussed. The possibilities of a system using a sophisticated real-time executive program are compared with those of a system using a second computer. Author (ESRO)

N72-10232# Metropolitan Washington Council of Governments, D.C.
MARKETING ACCESS SERVICES: BALTIMORE-WASHINGTON REPORT NO. 1: IMMEDIATE AIRPORT ACCESS STUDY ACTION IMPROVEMENTS
1970 25 p Sponsored by Metropol. Washington Council of Govt.
(PB-200686; P-010) Avail: NTIS CSCL 05E

Short term airport access improvements in the Baltimore-Washington area, are studied with the design and implementation of a suitable access services brochure. Current access services at the region's airports and at nonregion airports; functional requirements for information dissemination; brochure contents; distribution possibilities; and financial and management aspects of brochure development, maintenance, and dissemination are considered. GRA

N72-10233# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TEST AND EVALUATION OF A DAYTIME COCKPIT FOG SIMULATOR Final Report, Apr. 1969 - May 1971
Morris Ritter Nov. 1971 35 p refs
(Proj. 073-323-04X)
(FAA-NA-71-44; FAA-RD-71-82) Avail: NTIS

An evaluation was conducted to determine the suitability of a daytime cockpit fog simulator to accurately and realistically simulate Category II and Category III weather conditions to the pilot during flight approaches. Thirteen pilots, using a DC-7 aircraft, participated in the program. The fog simulator was evaluated during atmospheric meteorological visibilities ranging from 1.5 to over 12 miles. Technical data, as well as completed pilot questionnaires, comprised the data analyzed. Although the simulator shows merit insofar as projecting realism, a redesign of the unit is necessary to correct deficiencies in various optical, electronic, and mechanical areas. Author

N72-10245# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
TURBULENT JET FLOWS
1971 343 p refs
(VKI-LS-36) Avail: NTIS HC $6.00/MF $0.95

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N72-10252# Imperial Coll. of Science and Technology, London (England).

TRANSMISSION OF LOW FREQUENCY JET PIPE SOUND THROUGH A NOZZLE FLOW

J. E. FfowcsWilliams *In* von Karman Inst. for Fluid Dyn. Turbulent Jet Flows 1971 8 p

(jefw/69) Avail: NTIS HC $6.00/MF $0.95

The basic flow model is subsonic jet of velocity V sub 2 formed by expanding a hot jet pipe flow of mean velocity V sub 1 and static pressure p sub 1 in a jet pipe of cross sectional area A sub 1 through a nozzle down to the ambient pressure p sub o. The jet flows in the direction + x. Superimposed on this basic flow is a low frequency sound wave of pressure p(+) incident from x less than o. The meaning of the low frequency in this context is that the nozzle scale is much smaller than the wavelength in both the jet stream and the environment. The problem is to determine the unsteady conditions at the nozzle exit and the sound field radiated to the static homogeneous environment exterior to the jet. It is shown that the influence of the nozzle transmission properties on the velocity depends on the velocity of the aerodynamic sound; aerodynamic sources contained within the jet but positioned many wavelengths upstream of the nozzle generate sound depending on jet velocity in precisely the same way as if the sources were in direct communication with the nozzle exterior. G.G.

N72-10253# Imperial Coll. of Science and Technology, London (England).

JET NOISE AT VERY LOW AND VERY HIGH SPEED

J. E. FfowcsWilliams *In* von Karman Inst. for Fluid Dyn. Turbulent Jet Flows 1971 9 p refs

Avail: NTIS HC $6.00/MF $0.95

A description of the possible sources of sound that can be met in low Mach number jet flows, and their strength is given in terms of flow parameters. Considered is jet noise at very low speed where nozzle exit turbulence may be a major contributor. Lighthill's theory is briefly summarized and used to estimate the sound of jets at moderate speeds. It is shown that very reasonable estimates of the field can be achieved from a crude description of the turbulent flow without recourse to the more involved aspects of the quadrupole theory. Then the question of noise produced by combustion of excess fuel in the exhaust is examined according to Lighthill's theory. The theory is applied to high Mach number situations where it is argued that the role of both Mach waves and shock waves needs further study. Finally, estimates of the sources to be expected in a moderate speed jet issuing from a multitube suppressor are made and applied to the noise from a fully developed jet flow. Author

N72-10254# Rolls-Royce, Ltd., Bristol (England). Bristol Engine Div.

ON THE NOISE SOURCES OF THE UNSUPPRESSED HIGH SPEED JET

K. A. Bishop, J. E. FfowcsWilliams (Imperial Coll. of Sci. and Technol.), and W. Smith *In* von Karman Inst. for Fluid Dyn. Turbulent Jet Flows 1971 17 p refs

(ARC-32723; F.M.4211; N.730) Avail: NTIS HC $6.00/MF $0.95

An interpretation of jet noise theory and scale model experiments to highlight physical properties of jet noise sources at very high speed are presented. The principal noise sources are shown to be very large scale wave-like undulations of the jet flow that travels downstream at supersonic speed for a distance of several jet diameters. These motions are relatively well ordered and are probably more akin to recognizable instabilities of a laminar flow than the confused small scale turbulence. A model of the noise generating motions as the instability products of a jet flow of low equivalent Reynolds number is formulated. This Reynolds number is based on an eddy viscosity and can be futher reduced by artificially increasing the small scale turbulence level. This step stabilizes the flow and inhibits the formation of large scale noise producing eddies. Author

N72-10332# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE KFA (DEPARTMENT OF THE ATMOSPHERIC PHYSICS) AERIAL EXPEDITIONS 1 AND 2 FOR STUDY OF THE PECULIARITIES OF CONDITIONS OF THE BOUNDARY LAYER OF THE ATMOSPHERE OVER AN OASIS AND A SEMIARID REGION

Yu. V. Petrov 19 Mar. 1971 6 p Transl. into ENGLISH from Tr. Tashkent Univ. Nauch. (USSR) no. 348, 1969 p 119-120

(Project AF PROJ. 682(E))

(AD-727535; FTD-HT-23-84-71; UR-0000-69-000-349) Avail: NTIS CSCL 04/1

An expedition was conducted during the periods 25 June through 23 July 1966 and 16-31 May 1967 by the Department of Physics of the Atmosphere of Tashkent University. The flights were made by a YaK-12M aircraft equipped with a meteorograph and other instruments from the Sergeli airport in the neighborhood of Chardara village at an altitude of 0.9-1.0 km in the standard atmosphere. Flights were made over the semiarid region at altitudes up to 2.5-3.0 km. The spatial distribution of zones of increased aircraft turbulence was determined; the maximum was at altitudes of 0.5-1.0 km. In this layer the accelerations attained 0.45 G in spring and 0.7 G in summer. Author (GRA)

N72-10361# Bay Area Air Pollution Control District, San Francisco, Calif.

REGIONAL AIRPORT SYSTEMS STUDY. ENVIRONMENTAL STUDIES: AVIATION EFFECT ON AIR QUALITY IN THE BAY REGION

Feb. 1971 169 p refs Sponsored in part by Dept. of Housing and Urban Develop.

Avail: NTIS

The results of a study of air contaminants associated with aircraft operations in the San Francisco Bay area are presented. Oxidant, carbon monoxide, sulfur dioxide, particulate matter, and nitrogen dioxide contaminants from aircraft engine emissions at public and military airports are covered as well as fuel handling, jet fuel dumping, and ground vehicle emissions. Region-wide and local climatological features are discussed including inversion climatology, airflow regimes, and temperature and precipitation distributions. The impact of aviation activities on air quality at four airports (San Francisco, Oakland, Oakland-North, and San Jose) is discussed utilizing a hybrid diffusion model. J.M.

N72-10396# Intermountain Forest and Range Experiment Station, Missoula, Mont. Northern Forest Fire Lab.

AIRBORNE INFRARED FOREST FIRE DETECTION SYSTEM Final Report, Apr. 1962 - Dec. 1967

Ralph A. Wilson, Stanley N. Hirsch, Forrest H. Madden, and John B. Losensky May 1971 114 p refs

(Contract OCD-OS-72-174; ARPA Order 636)

(AD-726953; FSRP-INT-93) Avail: NTIS CSCL 02/6

The report outlines the basic requirements for an airborne infrared forest fire detection system and discusses the capability of the system to detect hot fire targets in natural forest backgrounds. Author (GRA)

N72-10401*# Avco Corp., Wilmington, Mass. Systems Div.

FLIGHT INSTRUMENT AND TELEMETRY RESPONSE AND ITS INVERSION

M. R. Weinberger Washington NASA Sep. 1971 260 p refs (Contract NAS1-8541)
(NASA-CR-1768; AVSD-0283-70-CR) Avail: NTIS CSCL 01D

Mathematical models of rate gyros, servo accelerometers, pressure transducers, and telemetry systems were derived and their parameters were obtained from laboratory tests. Analog computer simulations were used extensively for verification of the validity for fast and large input signals. An optimal inversion method was derived to reconstruct input signals from noisy output signals and a computer program was prepared. Author

N72-10425# General Dynamics/Fort Worth, Tex.
DEVELOPMENT OF COMPOSITE TAPE LAYING PROCESS FOR ADVANCED FIBROUS REINFORCED COMPOSITE STRUCTURES Final Technical Report, Dec. 1966 - Jan. 1971
W. O. Sunafrank, W. H. Drebing, and H. L. Eaton Mar. 1971 421 p
(Contract F33615-67-C-1271; AF Proj. 872-7)
(AD-725765; AFML-TR-71-71; FTR-15) Avail: NTIS CSCL 13/9

The objective of the research was to develop and fabricate a numerically controlled prototype tape laying machine for performing layup operations required by airframe structural components of filament reinforced resin matrix composites. Mechanical functions of the machine as related to airframe component design requirements were investigated and defined. These included machine head variables of roller type, heat and pressure application, laying rates, tape feed mechanisms, shearing methods, disposal of cutoffs and tape specifications. In addition, compound contour requirements were considered. These included tilting vertical axis, pivot rollers, self-shaping rollers, and draping of flat layups to contour. It was determined that 75 percent of the airframe surfaces could be laid while using either the self-shaping roller or drape to shape approach, thereby eliminating the complexity factor of a 5-axis tilting head and the association of high production costs. A major problem has been tolerance control of fiber placement on the carrier. The contract has provided an improved manufacturing technology through development of an NC tape laying machine that will apply fiber reinforced tape up to 3 inches wide, to a part along a preprogrammed path. Author (GRA)

N72-10489# Naval Air Development Center, Johnsville, Pa. Aero Materials Div.
DEVELOPMENT OF A STRESS CRACK RESISTANT URETHANE SEALANT FOR HEATED AREAS OF AIRCRAFT SURFACES
A. Stander Jul. 1971 15 p refs
(Project WF51.543.202)
(AD-727592; NADC-MA-7139) Avail: NTIS CSCL 11/1

A sprayable urethane sealant, AMD-P-28A was developed for protection of exterior fastener areas. This sealant in laboratory testing does not crack around fastener heads during -60F cyclic fatigue loading (1,000-11,000 lbs.) even after a heating of 20 hours at 260F plus one hour at 325F, which simulates the frictional heating of F14A aircraft during a single PAR cycle. Author (GRA)

N72-10501# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
SPECTRAL ANALYSIS OF TRANSIENT DATA WITH APPLICATION TO AUTO-PILOT PARAMETER STUDIES
Raymond Speeg, G. D. Whitehouse, and A. J. McPhate May 1971 112 p refs
(Contract F44620-68-C-0021; AF Proj. 7921; Proj. Themis)
(AD-725068; THEMIS-LSU-T-TR-46; AFOSR-71-1797TR) Avail: NTIS CSCL 12/1

The objective of this work was to determine, through a frequency analysis approach, an appropriate range of values for the parameters which could be used to provide for an effective auto-pilot coupler transfer function. The power spectral density function for random data, describing the general frequency composition of the data in terms of the density of its mean square value was used in this analysis. Spectral plots of data generated by a digital simulation were compared to those of an actual flight test case used as a reference to determine when the appropriate range has been found. In the development a spectral analysis program was written that incorporates the Cookey-Tukey fast Fourier transfer, allowing the conversion of the data sets from the time domain to the frequency domain. This resulted in a range of values for the parameters of gain and lead in two channels of a model of the human pilot operator in an attacker-evader simulation. Author (GRA)

N72-10539*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TARGET CONTRAST CONSIDERATIONS IN MILLIMETER WAVE RADIOMETRY FOR AIRBORNE NAVIGATION
A. Mayer Aug. 1971 73 p refs
(NASA-TM-X-62082) Avail: NTIS CSCL 17G

Target signal requirements for aircraft navigation systems that use radiometric receivers which map thermally emitted power radiated by terrain or power radiated by ground-based beacons are discussed. For selected millimeter wavelength bands, microwaves suffer relatively little degradation by absorption or scattering on passage through the atmosphere, despite extreme weather variations. Interest centers on 8-millimeter waves because of component availability, portability (small size), high image resolution, and all-weather capability at this wavelength. The idea of radiometric airborne navigation is introduced. Elements of radiometry, terrain radiation, and atmospheric transmission characteristics are reviewed. Data pertaining to these elements at 8 mm wavelength are collected. Calculation of radiometric contrasts is discussed for some simple models of terrain targets. Author

N72-10543# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIR TRAFFIC CONTROL Quarterly Technical Summary Report, 1 Feb. - 30 Apr. 1971
Herbert G. Weiss 15 May 1971 15 p refs
(Contract F19628-70-C-0230; AF Proj. 649L)
(AD-725743; ESD-TR-71-146) Avail: NTIS CSCL 17/7

The report discusses the activities under way in Division 4 that are funded mainly by the Air Force. The progress on two other ATC tasks, namely, the preparation of a Technical Development Plan for the Discrete Address Beacon System for the FAA OSEM and studies relating to Fourth Generation ATC System Concepts for the DOT transportation Systems Center, are reported separately. A highlight of this quarter was the successful conclusion of the testing phase of a laser warning system for Logan Airport. Author (GRA)

N72-10589# National Physical Lab., Teddington (England). Acoustics Section.
INDEX OF NPL ACOUSTICS PUBLICATIONS, 1960 - 1970
D. W. Robinson, comp. Mar. 1971 39 p refs
(NPL-Aero-Ac-47) Avail: NTIS

This bibliography on acoustics comprises reports, separate publications, papers in scientific journals and contributions to published symposia. The works are listed in chronological order and are referred to in the subject index and author index by means of serial numbers. Author (ESRO)

N72-10824*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS TURBINE ENGINE FUEL CONTROL Patent Application
Harold C. Gold, inventor (to NASA) Filed 28 May 1971 29 p
(NASA-Case-LEW-11187-1; US-Patent-Appl-SN-147922) Avail: NTIS CSCL 21E

A variable-orifice system that is responsive to compressor inlet pressure and temperature, compressor discharge pressure,

and rotational speed of a gas turbine engine is incorporated into a hydraulic circuit. The circuit includes a zero gradient pump driven at a speed proportional to the speed of the engine. The resulting system provides control of fuel rate for starting, steady running, acceleration, and deceleration under varying altitudes and flight speeds. NASA

N72-10828# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmungsbereich Flugzeuge.
BASIC INVESTIGATIONS OF RECIRCULATION WITH CONFIGURATIONS CONSISTING OF 1 TO 6 JETS [GRUNDSATZUNTERSUCHUNGEN ZUR REZIRKULATION AN 1- BIS 6-STRAHLANORDNUNGEN]
F. Aulehla, W. Eder, and V. Zeidler Bonn Bundeswehramt 1971 60 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung
(BMVG-FBWT-71-12) Avail: NTIS; Bundeswehramt, Bonn: 25 DM

Analyses of the fundamental factors were performed and model tests were carried out to determine the mechanism of recirculation in jet powered V/STOL aircraft and to devise methods for preventing or reducing the occurrence of thrust loss, engine surge and flame-out for differing engine configurations. Preliminary studies of the correlation between model measurements and full-size operation, and flow effects from forward, aft and the sides on a lift thrust configuration, are separated. ESRO

N72-10830# Mitre Corp., McLean, Va.
A SURVEY OF PROPULSION SYSTEMS FOR LOW EMISSION URBAN VEHICLES
W. E. Fraize and R. K. Lay Sep. 1970 116 p refs Sponsored by DOT
(Contract F19628-68-C-0365)
(PB-200144; UMTA-TRD-52-70-2; M70-45) Avail: NTIS CSCL 13F

An overview is presented of low and negligible emission urban vehicle technology. Propulsion systems suitable for low emission urban vehicles are described. The state-of-the-art of low emission systems is surveyed by direct contact with active development efforts in industry; the more promising areas for future development are reviewed. Exhaust emissions for fossil-fueled heat engines are summarized. A computer program was developed to demonstrate the effect of the various route cycle and vehicle parameters on required power and vehicle speed; results are presented for a typical small urban bus.
Author (GRA)

N72-10957# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
AN APPLICATION OF FRACTURE CONCEPTS TO THE PREDICTION OF CRITICAL LENGTH OF FATIGUE CRACKS. PART 2: A REVIEW OF PERTINENT ASPECTS OF FRACTURE (THEORETICAL AND ANALYTICAL ASPECTS OF FATIGUE OF METALS) M. S. Thesis - Ohio State Univ., 1970 Technical Report, Jun. 1969 - Jun. 1970
Sidney O. Davis Apr. 1971 116 p refs
(AF Proj. 7351)
(AD-725028; AFML-TR-70-202-PT-2) Avail: NTIS CSCL 20/11

This part of the report (Volume 2) presents a technical documentary historical review of pertinent theoretical and analytical aspects of fatigue failure and its relationship to fracture mechanics. The review covers the period 1829 to 1970. Fatigue failure, i.e., fracture without gross plastic deformation under repeated application of stress below the proportional limit, has been recognized for at least 138 years. Despite numerous investigations on the subject, there is no available theory for correlating the many variables affecting fatigue failure and for successfully predicting failure. The application of linear elastic fracture mechanics and the thermodynamics of fracture to the crack propagation facet of fatigue is proposed as an approach to the prediction of critical lengths of stable fatigue cracking and unstable fracturing before failure. Author (GRA)

N72-10984*# Lockheed-California Co., Burbank. Science and Engineering Branch.
STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS, VOLUME 1 Final Report, Jun. 1970 - May 1971
E. G. Stout, P. H. Kesling, H. C. Matteson, D. E. Sherwood, W. R. Tuck, Jr., and L. A. Vaughn Jun. 1971 173 p 4 Vol.
(Contract NAS2-5989)
(NASA-CR-114340) Avail: NTIS CSCL 05C

An analysis of an effective short range, high density computer transportation system for intraurban systems is presented. The seven county Detroit, Michigan, metropolitan area, was chosen as the scenario for the analysis. The study consisted of an analysis and forecast of the Detroit market through 1985, a parametric analysis of appropriate short haul aircraft concepts and associated ground systems, and a preliminary overall economic analysis of a simplified total system designed to evaluate the candidate vehicles and select the most promising VTOL and STOL aircraft. Data are also included on the impact of advanced technology on the system, the sensitivity of mission performance to changes in aircraft characteristics and system operations, and identification of key problem areas that may be improved by additional research. The approach, logic, and computer models used are adaptable to other intraurban or interurban areas. E.H.W.

N72-10985*# Lockheed-California Co., Burbank. Science and Engineering Branch.
STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS, VOLUME 2 Final Report, Jun. 1970 - May 1971
E. G. Stout, P. H. Kesling, H. C. Matteson, D. E. Sherwood, W. R. Tuck, Jr., and L. A. Vaughn Jun. 1971 198 p 4 Vol.
(Contract NAS2-5989)
(NASA-CR-114341) Avail: NTIS CSCL 05C

A cost analysis of the major items of direct operating costs in an intraurban aircraft transportation system are presented. The results are given in the form of tables and graphs. E.H.W.

N72-10986*# Lockheed-California Co., Burbank. Science and Engineering Branch.
STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS, VOLUME 3 Final Report, Jun. 1970 - May 1971
E. G. Stout, P. H. Kesling, D. E. Matteson, D. E. Sherwood, W. R. Tuck, Jr., and L. A. Vaughn Jun. 1971 209 p refs 4 Vol.
(Contract NAS2-5989)
(NASA-CR-114342) Avail: NTIS CSCL 05C

An investigation of three aircraft concepts, deflected slipstream STOL, helicopter VTOL, and fixed wing STOL, is presented. An attempt was made to determine the best concept for the intraurban transportation system. Desirability of the concept was based on ease of maintenance, development timing, reliability, operating costs, and the noise produced. Indications are that the deflected slipstream STOL is best suited for intraurban transportation. Tables and graphs are included.
E.H.W.

N72-10987*# Lockheed-California Co., Burbank. Science and Engineering Div.
STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS. VOLUME 4: APPENDIX Final Report, Jun. 1970 - May 1971
E. G. Stout, P. H. Kesling, H. C. Matteson, D. E. Sherwood, W. R. Tuck, Jr., and L. A. Vaughn Jun. 1971 273 p 4 Vol.
(Contract NAS2-5989)
(NASA-CR-114343) Avail: NTIS CSCL 05C

An appendix of the supporting data leading to conclusions and recommendations for an effective intraurban transportation

system from volumes 1, 2, and 3 is presented. The data are given in tables and graphs. E.H.W.

N72-10992# Institute for Defense Analyses, Arlington, Va.
COST GROWTH AND PRODUCTIVITY IN EUROPEAN AEROSPACE DEVELOPMENT PROGRAMS
Rolf Piekarz and Susan McIntosh Dec. 1970 74 p refs
(Contract DAHC15-67-C-0011)
(AD-725478; RP-P-684; IDA/HQ-71-12266; T-73) Avail: NTIS CSCL 05/3

The paper reports on an exploratory study to obtain tentative estimates about two aspects of European aerospace systems development costs in comparison to the U.S. experience: the percentage cost growth occurring during the program, and the absolute costs in dollar terms of foreign projects relative to costs of comparable U.S. projects. Eight major European commercial and military aerospace programs were investigated during the 1962-1969 period, and the cost outcomes of these programs were compared to the overall U.S. experience. The tentative findings suggest that proposals to adopt foreign organization, such as nationalization, to improve U.S. military technology development performance are unlikely to solve U.S. difficulties, and that applying U.S. cost models to evaluate foreign military RDT and E efforts is not recommended for estimating the outputs and size of foreign programs. GRA

N72-10998# National Aerospace Lab., Amsterdam (Netherlands).
COMPARISON BETWEEN DISCRETE AND CONTINUOUS MODELS FOR VERTICAL GUSTS
J. B. DeJonge Feb. 1971 68 p
(NLR-TR-71025U) Avail: NTIS

A number of currently existing gust load models, based either on a discrete gust concept or a continuous gust concept, have been analyzed and compared. Calculations made for three different aircraft types indicated that load spectra based on either of the two model-types show relatively small differences. How flexibility effects may be accounted for in conjunction with a discrete gust model, using a technique based on the continuous gust concept, is described. Author

N72-10999# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SOME RESULTS ON GUST ALLEVIATION
Gabriel Coupry 1971 12 p refs Presented at the R. Ae. S. Intern. Conf. on Atmospheric Turbulence, London, 18-21 May 1971
(ONERA-TP-925) Avail: NTIS

The mathematical search for a linear functional law which defines longitudinal response of delta wing aircraft to turbulence is discussed. Turbulence is measured in real time, aboard the aircraft with the help of information given by vanes, gyrometers, and accelerometers. The results indicate that with the help of the Wiener and Leguerre methods, gust alleviation can be provided without change to the flight mechanics of the aircraft. An analog computer analysis of the method and flight test results is also given. Author

N72-11001# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Stuttgart (West Germany).
ROTOR FLOW AND FLIGHT MECHANICS OF HINGELESS ROTORS [ROTORDURCHSTROEMUNG UND FLUGMECHANIK DES GELENKLOSEN ROTORS]
Jun. 1971 284 p refs In GERMAN; ENGLISH summary Proc. of the DGLR Comm. on Helicopters and Am. Helicopter Soc. Meeting, Ottobrunn, West Ger., 9 Dec. 1970
(DLR-MITT-71-12) Avail: NTIS; ZLDI Munich: 59,65 DM

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7. THE STABILITY- AND CONTROL BEHAVIOR OF THE HINGELESS BOELKOW ROTOR SYSTEM H. Huber (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, West Ger.) p 241-282 refs

N72-11002# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
SURVEY OF DIFFERENT MODELS FOR COMPUTING THE FLOW OF A LIFTING ROTOR [UEVERBLICK UEBER VERSCHIEDENE MODELLE ZUR BERECHNUNG DER ROTORDURCHSTROEMUNG]
Alfred Kussmann *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 7-75 refs In GERMAN; ENGLISH summary
Avail: NTIS; ZLDI Munich: 59,65 DM

Several methods for computing the induced velocity field and blade loads of a lifting rotor are given, especially in the forward flight regime, with particular consideration of the different wake model configurations. Author (ESRO)

N72-11003# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
INFLUENCE OF DIFFERENT PARAMETERS (LIKE JET CONTRACTION, VORTEX CORE DIAMETER) UPON ROTOR DOWNWASH CALCULATION. APPLICATION TO THE CASE OF AN AUXILIARY WING [EINFLUSS VERSCHIEDENER PARAMETER (WIE STRAHLKONTRAKTION, WIRBELKERNDURCHMESSER USW.) AUF DIE ROTORABWINDBERECHNUNG. ANWENDUNG AM BIESPIEL EINES ENTLASTUNGSFLUEGELS]
J. W. Fuhr *In* DGLR *Rotor Flow and Flight Mech. of Hingeless* Rotors Jun. 1971 p 76-107 refs In GERMAN; ENGLISH summary
Avail: NTIS; ZLDI Munich: 59,65 DM

Some changes in the geometry of a rotor wake model with helical vortex lines were introduced in order to study the influence upon rotor downwash velocity distribution by parameter variation. The parameters varied were: diameter of near field vortices, flapping, rotor speed, and contraction of rotor radius. The velocity distribution at an infinite span wing, placed in the downwash flow, is calculated, and the interaction between wing and rotor is determined by computing the velocity distribution at the rotor. ESRO

N72-11004# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Munich (West Germany).
INFLUENCE OF THE WAKE GEOMETRY ON THE VELOCITY

AND LOAD DISTRIBUTION OF VTOL PROPELLERS [EINFLUSS DER NACHLAUFGEOMETRIE AUF DIE GESCHWINDIGKEITS- UND LASTVERTEILUNG VON VTOL-PROPELLERN]
G. Schultheiss *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 108-129 refs In GERMAN

Avail: NTIS; ZLDI Munich. 59,65 DM

To determine the velocity and load distribution of VTOL propellers, a method was employed with discrete slipstream vortex stress. In using this method, the assumption of the length of the wake is a difficulty, this having repercussions on the exactitude of the relationships in the propeller plane. As the length of the wake determined the computing time, two examples were taken for upright and fast flight with a known three-bladed propeller. Induced angle of incidence, circulation distribution, thrust distribution, and the distribution of the ratios of thrust and power coefficients are compared with the results obtained from the Goldstein method. ESRO

N72-11005# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
LINEAR AERODYNAMIC ROTOR THEORY [ZUR LINEAREN AERODYNAMISCHEN ROTORTHEORIE]
S. Wagner, K. Gehr, and W. Gradl *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 130-174 refs In GERMAN
Avail: NTIS; ZLDI Munich: 59,65 DM

The mathematical models of a few known linear aerodynamic rotor theories and their basic physical assumptions are discussed. The principles and vortex models of an aerodynamic lifting surface and lift line theories for helicopter rotors are examined. The computing effort and obtainable accuracy for those theories which can be treated numerically are compared. Theoretical and practical thrust distribution generally correspond, and clearly show the advantages and disadvantages of the applied vortex models. It is shown that improvements in physical characteristics are easily obtained in the numerical treatment of a theory. ESRO

N72-11007# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
THEORETICAL CONSIDERATIONS OF A SPRING, HINGED ROTOR OF VARIABLE FLAPPING STIFFNESS AND CONSTANT PHASE SHIFT [THEORETISCHE BETRACHTUNGEN UEBER EINEN FEDERGELENKSROTOR VARIABLER SCHLAGSTEIFIGKEIT UND KONSTANTER PHASENVERSCHIEBUNG]
W. Kugler *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 210-240 refs In GERMAN

Avail: NTIS; ZLDI Munich: 59,65 DM

A rotor system with elastically attached blades in theoretically investigated for varying the flight mechanical properties while retaining constant phase shift for cyclic control. This result may be obtained if the flapping stiffness of the rotor can be reduced to relatively small values in flight when the phase shift between vibration excitation and action is changed. For good controllability of a helicopter, the obtainable moment, for a stick deviation in a certain direction, should work about the center of gravity in the same or nearly the same direction. Investigations involving the use of many parameters to obtain constant phase shift with a rotor model, and with a projected Dornier rotor system, are reported. ESRO

N72-11008# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
THE STABILITY- AND CONTROL BEHAVIOR OF THE HINGELESS BOELKOW ROTOR SYSTEM [DAS STABILITAETS- UND STEUERUNGSVERHALTEN DES GELENKLOSEN ROTORS SYSTEM BOELKOW]
H. Huber *In* DGLR Rotor Flow and Flight Mech. of Hingeless Rotors Jun. 1971 p 241-282 refs In GERMAN

Avail: NTIS; ZLDI Munich: 59,65 DM

The controllability, vibration damping, and static and dynamic stability of helicopters with hingeless rotors are examined. The feedback effects resulting from the special construction of the blades are described. In addition to elastic feedback effects based on the direct flapping angle feedback, torsional coupling effects are explained, appearing when the center of gravity and the aerodynamic center of the blade profile are shifted. The results of parametric studies, showing the influence of such blade-integrated feedback systems on control and stability characteristics of the hingeless rotor, are given, and the obtainable variation in flight-mechanical properties of rotors is shown. Tests with the BO-105 helicopter verify the treatment developed. ESRO

N72-11010*# Lockheed-Georgia Co., Marietta.
MATHEMATICAL MODEL FOR TWO-DIMENSIONAL MULTI-COMPONENT AIRFOILS IN VISCOUS FLOW
W. A. Stevens, S. H. Goradia, and J. A. Braden Jul. 1971 167 p Supplement to NASA-CR-1843
(Contract NAS1-9143)
(NASA-CR-1843) Avail: NTIS CSCL 20D

Appendices on customer utilization of card images and the program listing as used on a CDC 6600 computer are presented. N.E.N.

N72-11011# National Physical Lab., Teddington (England). Aerodynamics Div.
THE VORTEX DRAG OF A SWEPT WING WITH PART-SPAN FLAPS
H. C. Garner Sep. 1970 22 p refs
(NPL-AERO-1324; ARC-32395; Perf-2945) Avail: NTIS

Two theoretical methods of calculating the vortex drag factor from a prescribed spanwise loading and a novel third method, on the reverse-flow principle without a definitive spanwise loading, are applied to an untapered swept wing with symmetrically deflected outboard flaps. Results are consistent within + or - 1/2. The third method is used to study the large influence of flap span and chord. Author (ESRO)

N72-11012# National Physical Lab., Teddington (England). Aerodynamics Div.
CONVERGENCE OF CURRENT ROUTINES FOR EVALUATING DOWNWASH AT A LIFTING SURFACE
Doris E. Lehrian and H. C. Garner Sep. 1970 25 p refs
(NPL-AERO-Note-1095; ARC-32397) Avail: NTIS

Subsonic lifting-surface methods are used, with increasing numbers of spanwise integration points, to calculate downwash at the center line of rectangular wings with elliptic spanwise loading; simplified formulae are derived. Each method has its pattern of convergence, expressible as a single curve for arbitrary aspect ratio and chordwise position. Given a leading-edge singularity, high aspect ratio and leading-edge proximity combine to worsen the rate of convergence. Author (ESRO)

N72-11015# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
SONIC BANG MEASUREMENTS DURING EXERCISE SUMMER SKY

D. R. B. Webb, F. L. Hunt, and R. J. Pallant London Aeron. Res. Council 1971 17 p
(ARC-R/M-3659; RAE-TR-67313; ARC-30164) Avail: NTIS; HMSO: 48 p; PHI: $2.15

During July 1967, a series of supersonic flights were made over three areas in southern England under the code name exercise summer sky. The object was to observe public reaction to sonic bangs, in order to build up some information of the consequences of overflying parts of the country with supersonic transport aircraft. The RAE was asked to participate by measuring the sonic bang pressure waveforms at selected points in each of the three areas. One of the selected points in each area was in the nominal focus area of the flight paths, and for this purpose a ship was used as a monitoring station because the flight paths were arranged so that the focus areas occurred at sea. The recorded waveforms are shown and discussed, together with details of the aircraft tracks and relevant meteorological conditions. Author (ESRO)

N72-11017# Aeronautical Research Associates of Princeton, Inc., N.J.
ON THE AERODYNAMIC FORCES OF OSCILLATING TWO DIMENSIONAL LIFTING SURFACES Final Report
John E. Yates and John C. Houbolt Dec. 1970 53 p refs
(Contract AF 49(638)-1640; AF Proj. 9782-01)
(AD-726132; ARAP-156; AFOSR-TR-71-1079) Avail: NTIS CSCL 10/1

The lift on a two-dimensional airfoil that oscillates in translation and pitch and is subject to a sinusoidal gust is calculated. The high frequency asymptotic behavior of the lift due to motion and gust is derived in the case of incompressible and compressible flow. The magnitude of the lift is asymptotically smaller in all cases when compressibility is considered. Author (GRA)

N72-11018* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VARIABLE GEOMETRY ROTOR SYSTEM Patent
John F. Ward, inventor (to NASA) Issued 13 Jul. 1971 5 p
Filed 28 Aug. 1969
(NASA-Case-LAR-10557; US-Patent-3,592,559;
US-Patent-Appl-SN-853746; US-Patent-Class-416-121;
US-Patent-Class-416-115; US-Patent-Class-416-127;
US-Patent-Class-416-130; US-Patent-Class-416-149;
US-Patent-Class-416-200) Avail: US Patent Office CSCL 01C

The rotor system described is designed to control the nonuniform wake shed from a given rotor blade impinging upon the other blades of the rotor system. The rotor system utilizes blade sets which are of a different diameter than another blade set in the system. The azimuth spacing between the blade sets can be varied while the aircraft is in flight. The vertical spacing between the blade sets can also be changed. A mechanism is provided for collective pitch control of the blade sets. The planform of blade sets, as well as the configuration of their tips, are varied. Official Gazette of the U.S. Patent Office

N72-11019# Federal Aviation Administration, Oklahoma City, Okla.
SIXTH ANNUAL INTERNATIONAL AVIATION MAINTENANCE SYMPOSIUM. THE AVIATION MAINTENANCE ENVIRONMENT IN THE 1970'S
1970 311 p refs Symp. held at Oklahoma City, Okla., 8-10 Dec. 1970
Avail: NTIS HC $6.00/MF $0.95

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15. PROJECTED MAINTAINABILITY ADVANTAGES OF SOLID STATE ELECTRICAL POWER MANAGEMENT AND SOLID STATE CONTACTLESS SWITCHING SYSTEMS T. S. Miller (LTV Aerospace Corp., Dallas, Tex.) 31 p refs

16. PACIFIC AIRMOTIVE CORPORATION ACCESSORY RELIABILITY PROGRAM D. Snyder (Pacific Airmotive Corp., Burbank, Calif.) 5 p

N72-11020# Eastern Air Lines, Inc., Miami, Fla.
COMPUTER APPLICATION STRATEGY FOR CONTROL OF AIRLINE MAINTENANCE IN THE SEVENTIES
J. P. Burke, J. P. DiBella, and J. B. Sabel *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 16 p

Avail: NTIS HC $6.00/MF $0.95

The requirements and benefits of applying computer techniques to aircraft maintenance operations are discussed. It is determined that the aircraft maintenance computer applications strategy for the 1970 decade should be as follows: (1) develop and implement control, rather than information systems, (2) focus control systems at the lowest effective level where maintenance events are taking place, and (3) integrate management information systems for policy control by evolution rather than by superimposing them on the environment. Author

N72-11021# Boeing Co., Morton, Pa.
IMPROVING THE READABILITY OF MAINTENANCE MANUALS
Walter Jablonski *In* FAA 6th Ann. Intern. Aviation Maintenance

Symp. 1970 34 p
Avail: NTIS HC $6.00/MF $0.95

A discussion of methods for improving the readability of aircraft maintenance manuals is presented. Techniques for evaluating the understandability of written instructions are described. Requirements for and advantages of improved readability are discussed. Author

N72-11022# LTV Aerospace Corp., Dallas, Tex. Systems Effectiveness Dept.
HARNESSING THE DIGITAL COMPUTER FOR AIRCRAFT MAINTENANCE
R. F. Cook *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 12 p
Avail: NTIS HC $6.00/MF $0.95

The application of digital computers to the maintenance of commercial aircraft avionics systems is discussed. The specific use of computers for detection of impending failures, fault isolation, and verification of fault correction is described. It is concluded that proper use of computer techniques will result in increased availability, lower maintenance costs, and improved flight safety. Author

N72-11023# Boeing Co., Seattle, Wash.
FACILITIES, EQUIPMENT AND TOOLS TO SUPPORT WIND BODIED AIRPLANE MAINTENANCE IN THE SEVENTIES

M. Doyle *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 27 p
Avail: NTIS HC $6.00/MF $0.95

The definition and documentation of facility, equipment, and tool requirements for maintenance of large commercial aircraft are presented. The main impact of the large aircraft is the increased magnitude of the planning task. A general review of the requirements using the 747 aircraft as an example is provided. Author

N72-11024# Wall Colmonoy Corp., Detroit, Mich.
REMANUFACTURING OF JET ENGINE COMPONENTS EMPLOYING BRAZING TECHNIQUES
Robert Leon Peaslee *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 10 p
Avail: NTIS HC $6.00/MF $0.95

The application of brazing techniques for the remanufacture of jet engine components is discussed. The benefits derived from brazing of jet engine parts are described. Welding of hot section components and precision braze repair procedures are presented. Author

N72-11025# Automation Industries, Inc., Danbury, Conn. Materials Evaluation Group.
NONDESTRUCTIVE INSPECTION: AN AIRCRAFT MAINTENANCE TOOL OF THE SEVENTIES
Earl C. Mayes *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 5 p
Avail: NTIS HC $6.00/MF $0.95

The application of nondestructive techniques to maintenance of large commercial aircraft is discussed. Procedures described are: (1) radiography, (2) ultrasonic inspection, (3) eddy current, (4) magnetic particle, and (5) in penetrant. Present operations and future possibilities are presented. Author

N72-11026# General Electric Co., Houston, Tex.
OPERATING LOGIC: NEW DATA AND TRAINING CONCEPT DEVELOPMENTS OF THE APOLLO PROGRAM
J. T. Waggoner *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 29 p ref
Avail: NTIS HC $6.00/MF $0.95

The application of Apollo Project data and training concepts to the maintenance of large commercial aircraft is discussed. Subjects presented are: (1) functional understanding of system and support equipment, (2) physical characteristics of system and support equipment, and (3) procedural directions for troubleshooting and fault isolation. Author

N72-11027# Douglas Aircraft Co., Inc., Long Beach, Calif.
MAINTENANCE FAULT ISOLATION IN THE SEVENTIES
H. W. Adams and H. Bayer *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 8 p
Avail: NTIS HC $6.00/MF $0.95

The Pattern of Cockpit Indication (PCI) system for simplified, coordinated, in-flight and on-ground fault isolation is described. Simulator tests have shown PCI to provide up to an 18 to 1 improvement over systems now in use. The principles and methods of analysis, development, simulation, and presentation are described and the benefits associated with the use of PCI by the airlines are presented. Author

N72-11028# Lockheed-California Co., Burbank.
STREAMLINED L-1011 FAULT ISOLATION TECHNIQUES
W. W. Watkins *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 19 p
Avail: NTIS HC $6.00/MF $0.95

The incorporation of built-in-test-equipment and condition monitoring capabilities for aircraft systems and components is discussed. The development of fault isolation and problem correction equipment used by the L-1011 aircraft is reported. The prime feature of the technique is the graphic presentation of functional check data through the medium of logic and schematic diagrams. Elimination of conventional test procedures facilitiates the use of the maintenance data. Duplication of fault isolation tasks is avoided and appropriate maintenance procedures are followed. Author

N72-11029# Societe Nationale Industrielle Aerospatiale, Paris (France). Concorde Support Div.
AN APPLICATION OF MODERN MAINTENANCE CONCEPTS AND SAFETY ANALYSIS TO THE MULTINATIONAL CERTIFICATION OF A SUPERSONIC AIRCRAFT
J. Haas *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 24 p
Avail: NTIS HC $6.00/MF $0.95

The composition and functions of an organization for multinational certification of supersonic commercial aircraft are described. The organization is primarily concerned with establishment and enforcement of design and maintenance requirements which will promote safer aircraft operation. Author

N72-11030# Pratt and Whitney Aircraft, East Hartford, Conn.
MODULAR DESIGN CONCEPT IMPROVES JET ENGINE MAINTAINABILITY
George P. Adamson *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 32 p
Avail: NTIS HC $6.00/MF $0.95

Improvements in the maintenance of jet aircraft engines by incorporation of modular construction is discussed. In the JT9D engine, consideration was given to avoiding maintenance problems by simplification of structural features. Airline experience in maintaining the JT9D engines is presented and comparisons are made with previous engine maintenance operations. Author

N72-11031# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
ACCESSIBILITY: THE KEY TO GOOD POWERPLANT MAINTAINABILITY
R. W. Hevener *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 16 p refs
Avail: NTIS HC $6.00/MF $0.95

Of the several design criteria required to achieve good maintainability features, accessibility is considered the key one because of its contribution to the airline operator in reducing overall maintenance costs. This contribution is provided to the operator in three major areas: (1) increased inspection accessibility and capability permitting the airlines' maintenance personnel to monitor parts condition, trouble-shoot, and isolate problem areas, (2) easy access by attachment and arrangement features to permit rapid removal and replacement of engine and aircraft accessories, and, (3) modular construction of the basic engine components to permit replacement either on the airplane or off at line maintenance stations, resulting in significant reduction of the elapsed time that an engine is out of commission and is returned to spare inventory status. In addition to making a major contribution in reducing maintenance costs, good accessibility *features aid in reducing overall operating costs through improved* dispatch reliability and reduced airplane down time, thereby permitting increased ultilization of the airplane. Author

N72-11032# Beechcraft-Hawker Corp., London (England).
MAINTAINING THE BH 125 IN THE SEVENTIES
Ian F. Keith *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 20 p
Avail: NTIS HC $6.00/MF $0.95

Maintenance procedures for the Beech Hawker 125 commercial jet aircraft are presented. Subjects discussed are: (1) maintenance schedule, (2) nondestructive testing, (3) instruction handbooks, and (4) inspection requirements. Author

N72-11033# General Aviation Manufacturers Association, Washington, D.C.
THE GENERAL AVIATION MAINTENANCE OUTLOOK FOR THE SEVENTIES
Stanley J. Green *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 6 p
Avail: NTIS HC $6.00/MF $0.95

Predictions of aircraft maintenance procedures and requirements for the remainder of the 1970's are presented. Emphasis is placed on the need for improvement in aircraft safety and methods for improving the safety record. The expected expansion in numbers of aircraft and changes in aircraft power plants are described. Author

N72-11034# LTV Aerospace Corp., Dallas, Tex.
PROJECTED MAINTAINABILITY ADVANTAGES OF SOLID STATE ELECTRICAL POWER MANAGEMENT AND SOLID STATE CONTACTLESS SWITCHING SYSTEMS
T. S. Miller *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 31 p refs
Avail: NTIS HC $6.00/MF $0.95

Maintenance advantages of solid state electrical logic management and distribution of electrical power are described. The specific advantages discussed are those associated with the capabilities of the system to: (1) create a favorable power environment for avionics, (2) lower total systems maintenance by favorable interfacing of electrical signal and control functions, and (3) exploit the favorable failure delta of solid state switching. The discussions are predicted on a contemporary aircraft electrical power management and distribution system and a solid state contactless system. The possible variations of the two systems are infinite, therefore the discussions are limited to comparisons between aircraft systems based on the requirements of MIL-STD-704 and a solid state system specifically concepted to operate with power sources of a MIL-STD-704 system. Military Standard 704 in this case is deemed to connotate a constant frequency generator operating from a variable speed power take off with the necessary control and management required to deliver electrical power to an aircraft's AC and DC buses. Author

N72-11035# Pacific Airmotive Corp., Burbank, Calif.
PACIFIC AIRMOTIVE CORPORATION ACCESSORY RELIABILITY PROGRAM (PACAR) c15
David Snyder *In* FAA 6th Ann. Intern. Aviation Maintenance Symp. 1970 5 p
Avail: NTIS HC $6.00/MF $0.95

The establishment of a program for improved reliability through new maintenance procedures applied to aircraft accessories is discussed. The steps taken to insure adequate inspection and repair are described. The effects of various environmental conditions on component reliability are reported. Author

N72-11036# *Office National d'Etudes et de Recherches* Aerospatiales, Paris (France).
STUDYING THE COHERENT AND INCOHERENT STRUCTURES OF AERODYNAMICALLY GENERATED NOISE [ETUDES DES STRUCTURES COHERENTES ET INCOHERENTES DE BRUIT D'ORIGINE AERODYNAMIQUE]
Jean-Francois deBelleval, Patrick Harel, Jean Lambourion, and Mariano Perulli 1971 5 p refs In FRENCH Presented at the 7th Intern. Congr. on Acoustics, Budapest, 18-26 Aug. 1971
(ONERA-TP-983) Avail: NTIS

The coherent and incoherent structures of aerodynamically generated noise is outlined using theoretical models. Space-time correlations are then used to analyze the pressure near the field of a compressor and the infrared emission of a hot jet. From this analysis the source structure is determined. Author

N72-11037# Douglas Aircraft Co., Inc., Long Beach, Calif.
A FLIGHT SIMULATOR STUDY OF STOL TRANSPORT DIRECTIONAL CONTROL CHARACTERISTICS Final Report
Robert A. Berg, W. Allen Shirley, Gary L. Teper (Systems Tech., Inc., Hawthorne, Calif.), and Samuel J. Craig (Systems Tech., Inc., Hawthorne, Calif.) Jun. 1971 134 p refs Prepared in cooperation with Systems Tech., Inc., Hawthorne, Calif.
(Contract DOTFA-70-WA-2395)
(FAA-RD-71-81) Avail: NTIS

A systematic investigation was conducted of STOL transport terminal area directional control characteristics to identify the significant considerations and to establish appropriate directional control criteria. The investigation consisted of an analysis of existing data and moving-base flight simulator program using the NASA S-16 Moving Cab Transport Simulator. The simulator test program covered a broad range of lateral and directional aerodynamic characteristics representative of typical STOL transport aircraft. The study revealed the existence of an appreciable interaction between the roll and the heading control tasks which suggests that roll-mode damping requirements should be specified in terms of the heading delay characteristics. Lateral control sensitivity tests were conducted which corroborated previously obtained results. Author

N72-11038*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THREE-TRACK RUNWAY AND TAXIWAY PROFILES MEASURED AT INTERNATIONAL AIRPORTS E AND F
Albert W. Hall Washington Nov. 1971 100 p refs
(NASA-TN-D-6567; L-7977) Avail: NTIS CSCL 01E

Three-track runway and taxiway profiles are presented for use in studies of airplane response to ground roughness. This report presents the tabulated and plotted data for two international airports (designed airports E and F). Author

N72-11039# Joint Publications Research Service, Washington, D.C.
SYSTEMS OF AIRCRAFT AUTOMATIC CONTROL
I. A. Mikhalev, B. N. Okoyemov, I. G. Pavlina, M. S. Chikulayev, and N. M. Eydnov 27 Oct. 1971 47 p Transl. into ENGLISH from the book "Sistemy Avtomaticheskogo Upravleniya Samoletom" Moscow, Mashinostroyeniye Publishing House, 1971 p 2-9, 87-128
(JPRS-54332; UDC-697.7.05.001) Avail: NTIS

Methods of analysis and calculation of the basic parameters of aircraft automatic control system components are discussed. Analysis and calculation are done with the problem stated in linear form. The materials are reduced to simple, practical calculation equations. The report contains 22 bibliographic references. Author

N72-11040# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
NOISE-ABATEMENT FLIGHT PROFILES FOR CTOL AND V/STOL AIRCRAFT
P. Hamel 1971 49 p refs
(DLR-FB-71-10; DK-658.517.2) Avail: NTIS; DFVLR, Porz, West Ger.: 12,50 DM

An overall survey of problems associated with noise abatement flight profiles for CTOL and V/STOL aircraft is presented. It is shown how aircraft design parameters and control variables, such as thrust vector control, power loading, and aerodynamic efficiency, influence the intensity of the noise source. The distance between noise source and observer, and the noise exposure duration may be influenced by steep climbout combined with moderate thrust and steep landing. Several stability and control problems due to steep noise abatement landing procedures are discussed. ESRO

N72-11042# Royal Aircraft Establishment, Farnborough (England).
CATEGORY 2: A SIMULATION STUDY OF LOW VISIBILITY APPROACHES AND LANDINGS AT NIGHT
A. D. Brown Mar. 1971 105 p refs
(RAE-TR-71044; UDC-629.13.089) Avail: NTIS

The design, execution and results of a flight simulator experiment to investigate the problems of aircraft operating in Category 2 conditions. Both military and airline pilots participated and over 500 manual approaches were performed using a flight director. The effects of decision height, contact time, lateral offset, visual sequence and visual segment on the approach success (the ratio of landings to approaches) are examined and a curve relating this parameter to visual segment, the predominant factor, is determined. The influence of different visual sequences on pilot performance during the approach and landing is also considered and some observations are made about the crew techniques employed during the experiment; techniques which appeared to have certain deficiencies. Author ESRO

N72-11043# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
CIVIL AIRCRAFT AIRWORTHINESS DATA RECORDING PROGRAMME. MANOEUVRE LOADS DURING TRAINING AND TEST FLYING
G. E. King London Aeron. Res. Council 1971 13 p refs Supersedes RAE-TR-70226; ARC-32850
(ARC-CP-1176; RAE-TR-70226; ARC-32850) Avail: NTIS; HMSO: 20p; PHI: $0.80

Using continuous photographic trace records, the maneuver accelerations experienced in 35 hours of training flying were counted and measured to provide an estimate of the total numbers and magnitude of loads for a fleet's flying training over a five year period. These data are compared with counting accelerometer data giving the estimated total number of gust plus maneuver loads for five years of revenue flying by the same fleet. Both estimates were found to be of the same order in the number and magnitude of loads although the ratio of training to revenue flying hours was one in fifty. The particular test flight analyzed, which included an unusually large number of stalls, produced approximately as many extreme negative accelerations as one year's revenue flying. Author (ESRO)

N72-11044# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
AN HYPOTHESIS FOR THE PREDICTION OF FLIGHT PENETRATION OF WING BUFFETING FROM DYNAMIC TESTS ON WIND TUNNEL MODELS
D. G. Mabey London Aeron. Res. Council 1971 33 p refs Supersedes RAE-TR-70189; ARC-32684
(ARC-CP-1171; RAE-TR-70189; ARC-32684; UDC-533.6.013.43:533.693) Avail: NTIS; HMSO: 45p; PHI $1.80

Buffeting coefficients appropriate to the maximum flight penetration of wing buffeting for both transport and fighter type aircraft are deduced from the comparison of flight observations and measurements of unsteady wing-root strain on stiff wind tunnel models. The necessary buffeting coefficients are derived rapidly from the unsteady wing-root strain measurements. The tunnel unsteadiness is used as a given level of aerodynamic excitation to calibrate the model response at the wing fundamental frequency. Author (ESRO)

N72-11045# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
BRIEF FLIGHT TESTS OF CROSSWIND LANDINGS AND SIDESTEP MANOEUVRES ON THE BAC 221 AIRCRAFT
W. F. Dee, R. Rose, and O. P. Nicholas London Aeron. Res. Council 1971 32 p refs Supersedes RAE-TR-68251; ARC-30959
(ARC-CP-1168; RAE-TR-68251; ARC-30959) Avail: NTIS; HMSO: 45p; PHI: $1.80

A brief flight study has been made of crosswind landings and sidestep maneuvers in the BAC 221 slender-wing research aircraft. Using the crabbed approach for crosswind landings, and the coordinated S-turn for sidestep maneuvers, pilots found both tasks straightforward. The time required to complete a sidestep is little longer than for unswept aircraft, despite the oscillatory roll response to aileron inputs of the BAC 221. Results of similar tests performed in a ground based simulator show good qualitative agreement. Author (ESRO)

N72-11046# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
FLIGHT AND WIND-TUNNEL TESTS ON AN AERODYNAMICALLY COMPENSATED PITOT-STATIC HEAD FOR THE BAC 221 AIRCRAFT
C. S. Barnes and O. P. Nicholas London Aeron. Res. Council 1971 47 p refs Supersedes RAE-TR-69013; ARC-31370
(ARC-CP-1167; RAE-TR-69013; ARC-31370) Avail: NTIS; HMSO: 65p; PHI: $2.65

The BAC 221 aircraft is fitted with a special pitot-static head, insensitive to incidence, and aerodynamically compensated on similar principles to the head fitted to the Concorde, to minimize aircraft pressure field effects. Tests have been made on the head covering the Mach number range 0.2 to 1.4 in two wind tunnels and at three altitudes in flight. The compensation significantly reduces the static pressure errors at high subsonic and transonic speeds but small errors remain at low subsonic and supersonic speeds. The sensitivity to incidence and sideslip, of the pitot and static pressures sensed, is satisfactorily low. The manufacturer's prediction of the head performance agrees

reasonably well with tunnel results but poorly with flight results. It appears that the prediction of the aircraft pressure field is inaccurate. Author (ESRO)

N72-11047# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
SOME FULL-SCALE MEASUREMENTS OF THE FLOW IN THE WAKE OF A HANGAR
M. J. Colmer London Aeron. Res. Council 1971 30 p refs Supersedes RAE-TR-70202; ARC-32863
(ARC-CP-1166; RAE-TR-70202; ARC-32863) Avail: NTIS; HMSO: 40p; PHI: $1.85

An experiment to measure the flow behind a full-scale building is described. The results of one set of data show that the whole wake was slowly oscillating and that the turbulence intensity in the wake was greater than upstream. An hypothesis for the wake motion is put forward and the effect of the wake behind a building on conventional and V/STOL aircraft is considered. Author (ESRO)

N72-11048# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
PILOTED SIMULATOR INVESTIGATIONS OF FLIGHT NEAR ZERO RATE OF CLIMB SPEED
T. Wilcock London Aeron. Res. Council 1971 39 p refs Supersedes RAE-TR-70016; ARC-32171
(ARC-CP-1165; RAE-TR-70016; ARC-32171) Avail: NTIS; HMSO: 55p; PHI: $2.45

The problems associated with flight at or below the zero rate of climb speed (V sub ZRC) have been investigated in piloted flight simulations of a supersonic transport aircraft and of the BAC 221 slender wing research aircraft. The accuracy of determining V sub ZRC by piloted tests was examined, and the height losses in recoveries from below V sub ZRC were compared with theoretical calculations. Agreement was very good for one simulation, though not quite as good for the other. Tests showed that height losses are generally minimized by a rapid recovery maneuver, but no detailed study was made of the optimum recovery technique. Author (ESRO)

N72-11049# Royal Aircraft Establishment, Bedford (England). Aero F Dept.
A THEORETICAL STUDY OF HEIGHT CONTROL IN FLIGHT CLOSE TO THE GROUND AS AFFECTED BY ELEVATOR LIFT AND COCKPIT POSITION
W. J. G. Pinsker London Aeron. Res. Council 1971 19 p refs Supersedes RAE-TR-69097; ARC-31488
(ARC-R/M-3662; RAE-TR-69097; ARC-31488) Avail: NTIS; HMSO: 50p; PHI: $2.25

During the final landing approach pilots are often observed to attempt tight control of flight path by coarse elevator usage. It us shown by theoretical analysis that this form of control is inherently conducive to instability and that adverse elevator lift is detrimental in this situation. However, if the pilot is located in a cockpit far forward of the center of gravity of the aircraft, he perceives false motion cues which tend to reduce the possiblity of this form of pilot-induced oscillation. Author (ESRO)

N72-11050# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE AERODYNAMIC AND AEROELASTIC CHARACTERISTICS OF A FULL SCALE ROTOR OPERATING AT VERY HIGH ADVANCE RATIOS AND DURING START/STOP OPERATION Final Report, Feb. 1968 - May 1970
Andrew R. Trenka May 1971 183 p refs
(Contract DAAJ02-68-C-0017; DA 1F1-62204-A-139)
(AD-727653; CAL-BB-2595-S-1; USAAVLABS-TR-70-60) Avail: NTIS CSCL 01/3

The purpose of this program was to study the aerodynamic and aeroelastic behavior of a rigid two-bladed rotor system operating at steady-state advance ratios up to approximately 1.5. Also to be investigated was the operation of this rotor during periods of acceleration and deceleration which were representative of the starting/stopping sequence of a stowable rotor. The objective of the program was accomplished by conducting wind tunnel tests in the NASA-Ames 40- x 80-foot wind tunnel on a full-scale rotor. Hub forces and moments, blade pressure distributions (chordwise and spanwise), and blade flatwise, chordwise and torsional moments were measured. The experimental results were used to correlate with existing theory. GRA

N72-11051# Tri-State Transportation Commission, New York.
METROPOLITAN AIRCRAFT NOISE ABATEMENT POLICY STUDY, JOHN F. KENNEDY INTERNATIONAL AIRPORT, NEW YORK, NEW YORK
1970 21 p Sponsored in part by HUD
(PB-200164; TSTC-2053-3580-1M) Avail: NTIS CSCL 01B

Alternative measures or combinations of measures to provide relief from aircraft noise in affected communities around John F. Kennedy International Airport are considered, and methods for reducing aircraft-noise problems are recommended. A study was made of present land use, local development policies and codes, sound insulations of structures, redevelopment, future land-use alternatives, legal aspects and airport operations. Author (GRA)

N72-11052# National Transportation Safety Board, Washington, D.C.
BRIEFS OF ACCIDENTS INVOLVING CORPORATE/EXECUTIVE AIRCRAFT: US GENERAL AVIATION, 1968
Jun. 1971 58 p
(PB-201439; NTSB-AMM-71-3) Avail: NTIS CSCL 01B

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

N72-11053# Trans-Sonics, Inc., Burlington, Mass.
HELICOPTER LIFT-MARGIN SYSTEM, VOLUME 2 Final Report
Bradford W. Edgerton and Sidney B. Williams Dec. 1970 149 p Sponsored in part by ECOM
(Contract N00014-68-C-0300; NR Proj. 213-067)
(AD-725207; JANAIR-701218-Vol-2; Rept-80001-Vol-2) Avail: NTIS CSCL 01/4

Helicopter power requirements are generally maximum when hovering out of ground effect. Thus, takeoff and landing maneuvers are the most critical, since the power requirements may not be clear to the pilot at the time he must make the corresponding decisions. Power deficiencies at takeoff or landing are very hazardous. To maximize safety of takeoff and landing operations, a system has been devised which presents to the pilot his lift margin, a figure which represents the excess weight which could be accommodated under locally-existing barometric pressure, outside-air-temperature conditions, and rotor system condition. The system includes two kinds of compensators of which the first corrects available engine torque for ambient conditions and the second makes a similar correction for the ratio of gross weight to required power. Author (GRA)

N72-11054# Air Force Flight Test Center, Edwards AFB, Calif.
THEORY OF THE MEASUREMENT AND STANDARIZATION OF IN-FLIGHT PERFORMANCE OF AIRCRAFT Final Technology Document
Everett W. Dunlap and Milton B. Porter Apr. 1971 281 p refs
(AD-725741; AFFTC-TD-71-1) Avail: NTIS CSCL 14/2

The contents of this report were prepared to give those engaged in aircraft flight test an understanding of the analysis required to arrive at standardized flight data. Toward that end, considerable attention was given to the derivation of equations. In contrast to earlier reports, simplifying assumptions were not made; rather, efforts were made to keep the derivations of all equations as nearly exact as possible. Emphasis has been placed on climbs and level accelerations since these tests, particularly for supersonic aircraft, consume a large part of a test program and require calculations which are much more lengthy than for other tests. The information in this document was the basis for the development of uniform digital computer programs which are being constructed for use in processing flight data and correcting it to standard conditions. These programs have been given the name Uniform Flight Test Analysis System (UFTAS).
Author (GRA)

N72-11056# Dynamic Science, Irvine, Calif.
ANALYSIS OF AIRCRAFT FUEL TANK FIRE AND EXPLOSION HAZARDS Final Report, 1 Jul. 1969 - 15 Dec. 1970
Thomas C. Kosvic, Laurence B. Zung, and Melvin Gerstein Mar. 1971 88 p refs
(Contract F33615-69-C-1895; AF Proj. 3048)
(AD-725027; SN-166-F; AFAPL-TR-71-7) Avail: NTIS CSCL 13/12

Under simulated flight environments, fuel/air ratios at various locations of the ullage space were determined using in-line gas chromatograph measurement. Using the shallow tank experimental data showed that during ascent and cruise portion of the flight profile, uniform fuel/air mixtures were found to exist within the entire ullage volume. Significant fuel/air gradients existed during the descent portion of the flight profile, with mainly air near the vent inlet. Evaporation lag was observed during ascent and level flight when liquid Jet A fuel was maintained at 80 degree F. When the liquid fuel temperature was increased to 120F, evaporation rate was found to be rapid enough that the evaporative lag phenomena was no longer observed. By vibrating the fuel tank, it greatly increased the rate of off-gassing of dissolved air in the liquid fuel. This in turn significantly changed the fuel/air ratio in the ullage space. Two separate and complementary models were developed to predict fuel/air concentrations within the ullage. Author (GRA)

N72-11057# American Nucleonics Corp., Woodland Hills, Calif.
ANALYSIS AND DESIGN STUDY OF A PILOT ASSIST SYSTEM FOR HELICOPTERS Final Report, Jan. - Dec. 1970
Arthur J. Welch and Edward L. Warren Apr. 1971 190 p refs
(Contract DAAJ02-70-C-0019)
(AD-725590; ANC-72R-14; USAAVLABS-TR-71-11; Task-1F162204A13905) Avail: NTIS CSCL 01/3

The purpose of the work performed under this contract was to conduct an analytical investigation of advanced flight control systems (AFCS) requirements for light and medium size helicopters and to design a pilot assist system based on the analytical results. The pilot assist system (PAS) design goal was to develop an AFCS that is relatively light and inexpensive and that can be readily installed in a UH-1B. Author (GRA)

N72-11058# Serendipity Associates, Arlington, Va. Eastern Operations Div.
AIRPORT/AIRCRAFT SYSTEM COMPUTER MODELS BURROUGHS 5500-MOD 0, IBM 7094-MOD 1
Jun. 1971 56 p refs Sponsored by Dept. of Transportation
(PB-201432; DOT-OST-ONA-71-4) Avail: NTIS CSCL 09B

The report contains a computer listing of the airport/aircraft system computer model developed during the course of a study on transporation noise. GRA

N72-11059# Boeing Co., Philadelphia, Pa. Vertol Div.
HELICOPTER DEVELOPMENT RELIABILITY TEST REQUIREMENTS. VOLUME 1 Final Report
Kirk G. Rummel Apr. 1971 317 p
(Contract DAAJ02-70-C-0039)
(AD-725595; D210-10207-1; USAAMRDL-TR-71-18A; Task-1F162203A14301) Avail: NTIS CSCL 01/3

The report covers a study to identify optimum reliability problem identification and demonstration test concepts for helicopter dynamic components, in order to facilitate formulation of cost-effective reliability test programs for future helicopters. Detailed failure mode test technique problem identification capability and cost data are presented from CH-47 helicopter development experience to aid in calculating specific test costs for future development programs. Sample test plans are presented for two helicopters representing size extremes. A plan is outlined for revising selected existing design and test military specifications and supplementing them with additional handbooks and specifications. Author (GRA)

N72-11060# Oceanics, Inc., Plainview, N.Y.
MODEL STUDIES OF HELICOPTER TAIL ROTOR FLOW PATTERNS IN AND OUT OF GROUND EFFECT Final Technical Report
August F. Lehman Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Apr. 1971 32 p refs
(Contracts DAAJ02-68-C-0069; DAAJ02-68-C-0103; DA Proj. 1-F-162204-A-14232; DA Proj. 1-F-1-62204-A-14231)
(AD-725591; Rept-70-79; USAAVLABS-TR-71-12) Avail: NTIS CSCL 01/3

Water tunnel studies of a model helicopter which entailed a visualization of the main and tail rotor wakes, the inflow patterns, and their subsequent interactions as the wind velocity and wind heading were changed resulted in a significant gain in knowledge ultimately applicable to direction control of helicopters. Of significant interest was the impingement of the main rotor wake with a ground plane, its subsequent spreading outward in a radial manner and the roll-up of the wake into a standing vortex at the outer edge of this radial expansion of the wake.
Author (GRA)

N72-11061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELECTING THE BASIC PARAMETERS OF CIVIL AIRCRAFT FOR SPECIFIED RANGES AND COMMERICAL LOAD
G. N. Yun 3 Mar. 1971 22 p refs Transl. into ENGLISH from "Primeniye Matematicheskikh Metodov v Ekonomicheskikh Issledovaniyakh i Planirovanii, Seminar" Kiev, no. 1, 1968 p 64-75
(AD-727231; FTD-MT-24-353-70) Avail: NTIS CSCL 01/3

A digital computer method of selecting the basic parameters of aircraft, using freight charges as a criterion, is described.
Author (GRA)

N72-11147 World Meteorological Organization, Geneva (Switzerland).
UTILIZATION OF METEOROLOGICAL RADAR FOR AERONAUTICS [L'UTILISATION DES RADARS METEOROLOGIQUES POUR L'AERONAUTIQUE]
H. Treussart, W. B. Beckwith, S. G. Bigler, K. Otani, V. V. Kostarev, and R. Schwarz 1971 108 p refs In FRENCH; ENGLISH summary
(OMM-264-TP-148; UDC-551.501.81; NT-110) Copyright. Avail: Issuing Activity

The detection and identification of hail and turbulence associated with thunderstorms are discussed. The question of measuring the height of echoes observed by radar is presented. Echo height is an index of storm activity. The interpretation of echoes for different types of radar is considered. The data from weather radar depend not only on meteorological phenomena

but also, to a great extent, on the characteristics of the radar. Processing and transmission of radar information is reviewed in great detail. Transmission of radar information to aircraft in flight is also considered a subject important for aviation. New techniques for radar observations are summarized. Author

N72-11289*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONTRIBUTION TO METHODS FOR CALCULATING THE FLOW ABOUT THIN LIFTING WINGS AT TRANSONIC SPEEDS: ANALYTIC EXPRESSIONS FOR THE FAR FIELD
E. B. Klunker Washington Nov. 1971 16 p refs
(NASA-TN-D-6530; L-7917) Avail: NTIS CSCL 20D

The problem of determining the small-disturbance flow about two-dimensional airfoils at transonic speeds has been successfully treated by the process of matching a numerical solution of the near field to analytic expressions for the far field. The three-dimensional problem, it would appear, can be treated in a similar way with the aid of algorithms adapted to high-speed and high-capacity computers. The far-field potential for both lifting and nonlifting three-dimensional wings at transonic speeds is developed herein for a subsonic free stream. This potential could be used for a three-dimensional-wing computation similar to the computation made for the two-dimensional wing. Author

N72-11291# National Physical Lab., Teddington (England). Aerodynamics Div.
EFFECTS OF REYNOLDS NUMBER AND FREQUENCY PARAMETER ON CONTROL-SURFACE BUZZ AT HIGH SUBSONIC SPEEDS
Y. Nakamura Feb. 1970 22 p refs
(NPL-AERO-1312; ARC-31897) Avail: NTIS

Oscillatory hinge-moment derivatives and limit cycle amplitudes were measured on an airfoil-flap combination model over the Mach number range 0.78 to 0.81 within a buzz region. Stagnation pressure was varied from 100,000 N/sq m to 200,000 N/sq m. The magnitude of both derivatives and the limit cycle amplitude tended to increase with increasing Reynolds number. The effect of increasing frequency was to produce a relatively large decrease in limit cycle amplitude and the magnitude of the derivatives. Author (ESRO)

N72-11295# National Physical Lab., Teddington (England). Aerodynamics Div.
PITOT-STEM BLOCKAGE CORRECTIONS IN UNIFORM AND NON-UNIFORM FLOW
R. W. F. Gould London Aeron. Res. Council 1971 30 p refs Supersedes NPL-AERO-1322;ARC-32283
(ARC-CP-1175; NPL-AERO-1322; ARC-32283) Avail: NTIS; HMSO: 42.5p; BIS: $1.80

Wind tunnel measurements are described which determine the error introduced into static pressure measurements in a pipe or duct by the presence of a pitot (or other) stem downstream of the plane of measurement. The effects measured in a uniform stream are used to calculate corresponding stem-blockage corrections in nonuniform flow. The method is applied to fully developed pipe flow measurements in circular and rectangular ducts. Author (ESRO)

N72-11308# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.
RESEARCH ON ADVANCED AXIAL COMPRESSOR CONCEPTS Final Scientific Report, 1 Nov. 1970 - 31 Jan. 1971
F. A. E. Breugelmans, J. Chauvin, H. Rottiers, J. Salvage, and B. Roberts 25 Feb. 1971 65 p refs
(Contract F61052-69-C-0025; AF Proj. 7065)
(AD-725789; ARL-71-0093) Avail: NTIS CSCL 13/7

The report covers work carried out on advanced axial compressor concepts. Cascade calculations and testing on blunt trailing edge (BTE) blades and conventional blades are described covering optimization of external and internal diffusion in BTE blade passages, low Reynolds number performance and detailed secondary flow investigations. The effort on the BTE diffusion optimization was concentrated on the experimental study of the flow from the trailing edge to infinity. Relative trailing edge thickness and trailing edge form have an influence on the Strouhal number. The latter is most prevalent. Author (GRA)

N72-11312# Air Force Systems Command, Wright-Patterson AFB, Ohio.
EXPERIMENTAL STUDY OF SHOCK IMPINGEMENT ON A BLUNT LEADING EDGE WITH APPLICATION TO HYPERSONIC INLET DESIGN Technical Report, Dec. 1967 - Mar. 1969
Roger R. Craig and Paul J. Ortwerth Apr. 1971 44 p refs
(AF Proj. 3012)
(AD-726111; AFAPL-TR-71-10) Avail: NTIS CSCL 20/4

An experimental study was made of the interaction of an oblique shock with the bow shock of blunt leading edge. The interactions were classified according to the interference patterns described by Edney. Peak heating rates 5.5 times those of the blunt leading edge alone were studied. All interactions appeared to be unsteady except when the slipstream of the interaction passed above the blunt leading edge. Author (GRA)

N72-11334# California Univ., Berkeley. Lawrence Radiation Lab.
CATALYTIC REDUCTION OF STRATOSPHERIC OZONE BY NITROGEN OXIDES
Harold Johnston Jun. 1971 117 p refs
(Contract W-7405-eng-48)
(UCRL-20568) Avail: NTIS

Quantitative calculations of the destruction of stratospheric ozone by nitrogen ozides omitted from SST's are presented. The calculations cover the following: (1) the rate of destruction of ozone by NO(x) relative to the ozone destruction rate by the couple, 02, 03, and by free radicals derived from water; and, (2) steady state calculations of the profile of ozone in the stratosphere for a wide range of uniform and nonuniform distributions of NO(x). Although special attention is given to NO(x) at 3, 7, 30, and 70 ppb, most calculations cover the complete range from zero to 100 ppb. Over the entire range of stratospheric variables, the oxides of nitrogen, NO and NO2, have a powerful effect in reducing ozone, and a quantity (30 ppb) previously accepted as negligible would reduce the ozone column by about a factor of two, according to two different methods of computation. Author

N72-11368# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDY AND CALIBRATION OF PRESSURE SENSORS IN PARTICULAR ENVIRONMENTS [ETUDE ET ETALONNAGE DE CAPTEURS DE PRESSIONS EN AMBIANCES PARTICULIERES]
Bernard Baerd, Alain Julienne, and Rene Nantois 1971 5 p refs In FRENCH Presented at the 7th Intern. Congr. on Acoustics, Budapest, 18-26 Aug. 1971
(ONERA-TP-982) Avail: NTIS

The design and calibration of unsteady pressure sensors used to measure aerodynamic noise are discussed. The sensitivity of the sensors under difficult environmental conditions such as high noise levels, surrounding flow, static overpressure, vibrations, and high temperature are determined. The sensors are also designed to measure the effects of turbomachine interior and jet interior on pipe flow. Author

N72-11370# Civil Aeromedical Inst., Oklahoma City, Okla.
CALIBRATION OF THE CONCORDE RADIATION

DETECTION INSTRUMENT AND MEASUREMENTS AT SST ALTITUDE
Wallace Friedberg and John M. Nelson Jun. 1971 21 p refs
(FAA-AM-71-26) Avail: NTIS

Performance tests were carried out on a solar cosmic radiation detection instrument developed for the Concorde SST. The instrument calibration curve was reasonably linear from 0.004 to 1 rem/hr for both gamma radiation and fast neutrons. Nonlinearity in the calibration curve was observed at dose rates below 0.003 rem/hr. The instrument responded normally after exposure to 30 rem/hr of gamma radiation. The charged particle detectors showed a directional response because of the neutron moderator. The neutron detector did not show a directional response. Measurements made with the Concorde instrument at 60,000 ft and high geomagnetic latitudes indicated a galactic cosmic radiation dose rate of 0.7-0.9 millirem/hr. Author

N72-11375# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
A THREE COMPONENT GUN TUNNEL BALANCE DESIGNED FOR TESTING THIN DELTA WINGS
T. Opatowski Aeron. Res. Council 1971 36 p refs
Supersedes ARC-31278
(ARC-R/M-3664; ARC-31278) Avail: NTIS; HMSO: 95p; BIS: $3.60

The design, development, and performance of a three component strain gage balance system designed for testing thin wings in a gun tunnel is described. The balance was machined out of high strength steel and employed miniature silicon strain gages on tension and compression links in order to meet the difficult strength/stiffness requirements. Natural frequencies were attenuated with parallel T filters. Various problems which arose in its development were successfully overcome and some excellent results were obtained. Author (ESRO)

N72-11428*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPRESSIVE BEHAVIOR OF TITANIUM ALLOY SKIN-STIFFENER SPECIMENS SELECTIVELY REINFORCED WITH BORON-ALUMINUM COMPOSITE
Harvey W. Herring, Robert L. Carri, and Rosa C. Webster Washington Nov. 1971 27 p refs
(NASA-TN-D-6548; L-7938) Avail: NTIS CSCL 20K

A method of selectively reinforcing a conventional titanium airframe structure with unidirectional boron-aluminum composite attached by brazing was successfully demonstrated in compression tests of short skin-stiffener specimens. In a comparison with all-titanium specimens, improvements in structural performance recorded for the composite-reinforced specimens exceeded 25 percent on an equivalent-weight basis over the range from room temperature to 700 K (800 F) in terms of both initial buckling and maximum strengths. Performance at room temperature was not affected by prior exposure at 588 K (600 F) for 1000 hours in air or by 400 thermal cycles between 219 K and 588 K (-65 F and 600 F). The experimental results were generally predictable from existing analytical procedures. No evidence of failure was observed in the braze between the boron-aluminum composite and the titanium alloy. Author

N72-11473# Naval Ordnance Lab., White Oak, Md.
SOLVENT REMOVAL OF EC-2273 POTTING COMPOUND FROM F-4 AIRCRAFT ELECTRICAL COMPONENTS Final Report, 1 Jul. 1969 - 31 Dec. 1970
Porter W. Erickson and Joseph M. Augl 14 May 1971 32 p refs
(NOL Proj. 341/AIR-520C01)
(AD-725493) Avail: NTIS CSCL 13/8

A safe, fast, and effective solvent system was developed for the removal of EC-2273 encapsulant. This material, which is now showing signs of failing, is the potting compound used in several hundred components of a large number of Navy F-4 aircraft. The preferred solvent system consists of a mixture of N-methyl-2-pyrollidone (M-Pyrol), benzyltrimethylammonium hydroxide and methanol. Virgin, as well as deteriorated, EC-2273 is cleanly removed from a typical electrical connector simply by immersion of the component in the solution for a period of a few hours. Author (GRA)

N72-11526# Weather Wing (1st), San Francisco, Calif. 96553
FORECASTING LOW LEVEL TURBULENCE FOR LIGHT AIRCRAFT IN HAWAII Final Report
Donald L. Best Apr. 1971 6 p
(AD-726107; Rept-1WW-TS-23) Avail: NTIS CSCL 04/2

The proposition is to forecast the intensities of turbulence below 10,000 ft MSL for aircraft weighing less than 10,000 pounds operating along the Hawaiian Island Chain during the 24 hour period beginning at 1200Z (0200 local standard time). The intensities of turbulence to be forecasted are light, moderate, and severe. Light turbulence cases slight, erratic changes in altitude, and/or attitude. Moderate turbulence is similar to light but of greater intensity while the aircraft is still in positive control. Severe turbulence causes large, abrupt changes in altitude and/or attitude and the aircraft may be momentarily out of control. Author (GRA)

N72-11527*# Massachusetts Inst. of Tech., Cambridge.
DISPLAY RESEARCH COLLISION WARNING SYSTEM Patent Application
Renwick E. Curry, Lawrence R. Young, Thomas B. Smith, III, and John R. Hatfield, inventors (to NASA) Filed 25 Jun. 1971 15 p
(Grant NGR-22-009-444)
(NASA-Case-HQN-10703; US-Patent-Appl-SN-156724) Avail: NTIS CSCL 17G

An improved head-up display for a pilot warning indicator (PWI) system is discussed. The system includes a plurality of elongated light sources which are attached about the cockpit windshield and side windows. Whenever a target in a sector, which is viewable from the cockpit, is detected by a corresponding detector at least one of the light sources is illuminated. The illuminated light source (or sources) provides an indication of the sector in which the target was detected. The length of the light source (or sources) provides a convenient indication of the sector's bearing boundaries. The novelty of the invention seems to reside in the use of elongated, rather than spot, light sources to indicate to the pilot sector bearing boundaries and thereby speed-up target detection. Author

N72-11668# Advisory Group for Aerospace Research and Development, Paris (France).
AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY
Aug. 1971 401 p refs Presented at 37th Meeting of the AGARD Propulsion and Energetics Panel, The Hague, 10-14 May 1971
(AGARD-CP-84-71) Avail: NTIS HC $6.00/MF $0.95

Papers are presented on aircraft fuels, their production, analysis, and testing. Fuel handling, fuel and fire safety, and lubricants are also discussed, using impact tests and crash simulations.

N72-11669# National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.
JET FUEL SPECIFICATIONS
L. Gardner and R. B. Whyte *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs

Avail: NTIS HC $6.00/MF $0.95

Various military and civil jet fuel specifications are compared and their differences noted, particularly with reference to different types of additives which are used on a mandatory or optional basis. Specification test procedures and their importance in relation to limits are discussed and the increased complexity of quality control for jet fuel specifications is noted. Author

N72-11670# France. Service Technique de l'Aeronautique, Paris.

AERONAUTICAL SIGNIFICANCE OF POLYCYCLIC SATURATED HYDROCARBONS [INTERET AERONAUTIQUE DES HYDROCARBURES POLYCYCLIQUES SATURES]

G. Verdie *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs In FRENCH

Avail: NTIS HC $6.00/MF $0.95

The range of an airplane depends on the amount of energy used. When reservoir capacity is too limited, it is possible to extend the range by using a higher energy fuel. In this sense, high energy polycyclic saturated hydrocarbons are possible fuels for supersonic aeronautics in the near future, especially since their thermal stability is superior to that of present fuels. Essential fuel characteristics are presented together with the results of experimentation. Industrial fabrication problems and future perspectives are considered. Transl. by K.P.D.

N72-11671# Shell Research, Ltd., Chester (England). Thornton Research Centre.

FUELS FOR SUPERSONIC AND HYPERSONIC AIRCRAFT

A. Lewis, H. Strawson, and J. G. Kirtley *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs Sponsored in part by Min. of Aviation Supply

Avail: NTIS HC $6.00/MF $0.95

The first generation of supersonic aircraft is being designed to operate on existing kerosene-type fuels. The limitations of these fuels are reviewed and possiblities considered for propellants for higher-speed aircraft, serving the triple purpose of cooling the airframe, cooling engine components, and providing propulsive energy. Problems of vapor deposition in hot fuel systems are covered and the possibilities explored of increasing the cold-sink value of the fuel by precooling or by endothermic decomposition. The calorific values of different fuels and the importance of recombination of dissociated combustion products is stressed. Ways of speeding such recombination are indicated. Author

N72-11672# Shell Development Co., Emeryville, Calif.

COOLING OF ADVANCED ENGINES BY ENDOTHERMIC REACTIONS OF HYDROCARBON FUELS

L. E. Faith, G. H. Ackerman, and H. T. Henderson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs Sponsored by AFAPL

Avail: NTIS HC $6.00/MF $0.95

The fuel used in an engine is a convenient coolant, absorbing heat as sensible heat and latent heat of vaporization. Certain hydrocarbon fuels can furnish additional heat sink in the form of endothermic reactions. Possible endothermic reactions include thermal reactions such as cracking, and catalytic reactions such as dehydrogenation, dehydrocyclization, and depolymerization. Of these, the catalytic dehydrogenation of naphthenes to aromatics is the most promising type of reaction. For example, the dehydrogenation of methylcyclohexane over platinum/alumina catalyst furnishes a reaction heat sink of approximately 1000 Btu/lb fuel, which is slightly greater than the cooling capacity due solely to sensible heat and latent heat of vaporization. This reaction is very selective and proceeds rapidly to achieve high conversion of methylcyclohexane to toluene and hydrogen. The total heat sink for such a reaction system compares favorably with that of hydrogen, when these heat sinks are normalized by the heat of combustion of the fuel. Author

N72-11674# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtreib- und Schmierstoffe.

THE POSSIBILITIES OF ACTUALLY TESTING THE COMBUSTION CHARACTERISTICS OF AVIATION FUELS WITH APPROPRIATE EQUIPMENT

H. Gemperlein *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs

Avail: NTIS HC $6.00/MF $0.95

Small-scale combustion chamber rigs are described, with which combustion characteristics of aviation fuels are being tested. The relationship of the chemical constitution of the fuels and their chemical-physical properties, and the processes during preparation and combustion of fuel is determined. Investigation is conducted at different air and fuel temperatures and at differently high pressures in the combustion chamber in a parallel flow. Temporally consecutive processes during fuel preparation and combustion may also be specially separated and thereby provide for a measurement with customary probes as well as spectroscopic methods. Author

N72-11676# Pisa Univ. (Italy). Lab. Prova Combustibili.

LOW EMISSION FUELS AND DEVICES FOR AVIATION ENGINES

G. Nardi *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs

Avail: NTIS HC $6.00/MF $0.95

Reduction of harmful emissions of turbine engine exhaust system is reviewed. The type of fuel used, combustion chambers, and operating conditions of combustors are also investigated. Author

N72-11676# National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.

FUEL CLEANLINESS

L. Gardner *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs

Avail: NTIS HC $6.00/MF $0.95

Dual purpose filter/separators were developed which could remove both dirt and water. Improvements in the performance of filter/separators was achieved by compliance with increasingly severe specifications. Methods of determining undissolved water and dirt in fuel and their development both for filter/separator testing and field use are discussed. Fuel contamination by microorganisms and surfactants has led to serious cases of aircraft corrosion and filter plugging. Measures to control or eliminate these two contaminants are discussed. Author

N72-11677# Lucas Gas Turbine Equipment, Ltd., Burnley (England).

FUEL RELATED PROBLEMS IN AIRCRAFT FUEL SYSTEMS

S. L. Forgham and R. G. Beckett *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 14 p refs

Avail: NTIS HC $6.00/MF $0.95

Aircraft fuel problems are discussed, emphasizing problems associated with hydrogen treated fuels. Some of the problems were overcome by fuel system design modification, and other changes are reviewed which were instituted by refinery industries. Research on fuel sealing is also described. J.A.M.

N72-11678# BP Trading Ltd., London (England).

AIRCRAFT FUELLING OPERATIONS AND QUALITY CONTROL

G. R. Parker *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs

Avail: NTIS HC $6.00/MF $0.95

Aviation fuelling facilities and the fuelling operation are described. Comments on the types of aircraft are restricted to those aspects directly affecting fuelling. Author

N72-11679# Esso Development Co., Ltd., Abingdon (England). Research Centre.
AVIATION FUEL LUBRICITY
R. A. Vere *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs
Avail: NTIS HC $6.00/MF $0.95

A laboratory test rig was developed to evaluate European jet fuels with regard to lubricity. This has shown differences in the lubricity levels of different fuels. Active lubricity agents were identified as fully saturated heterocyclic compounds and polynuclear aromatics. The addition of a surface active additive such as a corrosion inhibitor also significantly improve lubricity but can incur conductivity problems in the field due to its synergistic effects with antistatic additive. The feasibility of a fuel lubricity test by chemical, physical or mechanical techniques are being studied. Author

N72-11680# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
FLAME INHIBITION CHEMISTRY
R. M. Fristrom and R. F. Sawyer *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety refs
(Grant NSF GI-12)
Avail: NTIS HC $6.00/MF $0.95

Techniques involving diverse mechanisms are employed in extinguishing flames and fires. Mechanisms were divided into two broad categories: (1) physical mechanisms when mechanical or thermal effects are dominant, and (2) chemical mechanisms when chemical effects are involved. Flame extinguishment viewed from the standpoint of the effects on the elementary reaction processes is reviewed. A simplified hydrogen-oxygen flame chemistry is used as an illustration. The complications introduced by chemical inhibition are pointed out. The chemical kinetic information in the area of hydrogen atom scavenging and oxygen flame radical recombination is surveyed. Author

N72-11681# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
FLAMMABILITY PROPERTIES OF JET FUELS AND TECHNIQUES FOR FIRE AND EXPLOSION SUPPRESSION

B. P. Botteri *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs
Avail: NTIS HC $6.00/MF $0.95

Results of investigative efforts to establish the practical flammability envelopes and associated combustion damage potential for conventional jet fuels such as JP-4, JP-8 (similar to JET A-1), and JP-5 under simulated hostile operating environment conditions are presented. Testing included liquid-space gunfire hits to assess external fire hazard and vertical (liquid to vapor) firing trajectories to determine explosion hazard associated with projectile-induced fuel sprays and mists. All tests were performed in instrumented replica target tanks varying in volume from 15 to 90 gallons. Principal test variables were fuel temperature, pressure, fuel depth, external void space, and internal and external air flow. All tests were conducted utilizing 0.50-caliber armor piercing incendiary projectiles. These tests indicate a considerable extension in the flammability range of all fuels compared to the equilibrium flammability limit values which are commonly utilized for fire safety analysis. In view of the fire and explosion potential exhibited by all conventional jet fuels, additional measures must be employed to achieve an effective fire-protection capability. Progress in the use of reticulated polyurethane foam, halogenated hydrocarbon chemical extinguishants, and other fuel-tankinerting techniques is also reviewed. Author

N72-11683# Princeton Univ., N.J. Guggenheim Lab.
IGNITION OF FUELS BY A HOT PROJECTILE
O. P. Sharma and W. A. Sirignano *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 16 p refs

Avail: NTIS HC $6.00/MF $0.95

Theoretical investigations were performed by approximating: (1) the flow at the forward end of the projectile to a stagnation flow towards a hot axisymmetric body, (2) the flow over its surface to a laminar flow over a hot plate, and (3) the flow in the wake of the projectile to a plane laminar mixing of the cold unreacted mixture with the hot combustion products. After the premixed mixture is exhausted, there is a possibility of ignition of unmixed reactants by the hot inert products which are left behind and are sandwiched between the oxidizer and the fuel. A theoretical analysis for the ignition delay time as a function of the temperature and the width of the hot gas region is also presented. Author

N72-11685# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.
CONTRIBUTION TO THE SELECTION OF FIRE EXTINGUISHING SYSTEMS AND AGENTS FOR AIRCRAFT FIRES

R. Fiala *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 10 p refs
Avail: NTIS HC $6.00/MF $0.95

A fire extinguishing-system in aircraft is described, which uses the exhaust gases of a solid-propellant gas generator to pressurize the extinguisher bottle. The extinguishing efficiency of this hot-bottle-system is compared with that of the current extinguishing system. The amount of agent which is necessary to extinguish a diffusion flame was measured for a number of halons, dry powders, and mixtures of dry powders and halons. The ability of agents to prevent reignition of the extinguished fuel surface by hot parts was also tested. Author

N72-11686# Shell Research, Ltd., Chester (England).
ELECTROSTATIC CHARGING IN THE HANDLING OF AVIATION FUELS
H. Strawson and A. Lewis *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs

Avail: NTIS HC $6.00/MF $0.95

Electrostatic charging of the fuel during fueling can result in the possibility of incendiary sparking in aircraft tanks; some of the more recent experimental results on the different phases of this process are presented. These results confirm that, in the absence of special precautions, discharges creating a tank explosion hazard can exist during aircraft refueling in certain circumstances. Unless the fuel conductivity is controlled, however, these hazardous circumstances cannot be precisely predicted. The use of a static dissipator additive eliminates the hazard. Methods of introducing the additive and of maintaining the correct conductivity during fuel distribution are discussed, as well as possible side effects and interactions with other fuel additives. On the basis of world-wide airline use over many years, supported by many laboratory tests, it is concluded that the additive provides a safe, simple and trouble-free solution to the problem. Author

N72-11687# National Aviation Facilities Experimental Center, Atlantic City, N.J.

CRASH SAFE TURBINE FUEL DEVELOPMENT BY THE FEDERAL AVIATION ADMINISTRATION, 1964 - 1970

R. A. Russel, Jr. *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 10 p refs

Avail: NTIS HC $6.00/MF $0.95

Crash-safe fuel program, a segment of a primary mission to improve the overall crashworthiness of aircraft, is discussed. The reduction of the probability and severity of fire during aircraft ground crash situations is also examined. Author

N72-11688# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.

EMULSIFIED FUELS AND AIRCRAFT SAFETY

W. D. Weatherford, Jr. and F. W. Schaekel (Army Coating and Chem. Lab.) *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs

(Contracts DAAD05-70-C-0250; DAAJ02-69-C-0030)

Avail: NTIS HC $6.00/MF $0.95

Research and development program aimed at improving the post-crash fire safety of helicopter turbine-engine fuels is reviewed. Primary emphasis was placed on high-internal-phase-ratio aqueous emulsions. Interrelations among rheological and physical properties, composition, and fire safety characteristics of various fuel formulations are discussed. Implications of these results on the total safety envelope of rotary wing aircraft are examined. Author

N72-11689# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.

FIRE HAZARD EVALUATION OF THICKENED AIRCRAFT FUELS

J. M. Kuchta, J. N. Murphy, A. L. Furno, and A. Bartkowiak *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 11 p refs

Avail: NTIS HC $6.00/MF $0.95

Various gelled or emulsified fuels were proposed for reducing the aircraft crash-fire hazard. Results are presented from bench-scale tests for screening the fuels and from large-scale drop tests for evaluating their fire hazard under simulated crash conditions. Jet A and Jet B type thickened fuels were investigated. Their minimum autoignition temperatures and burning rates varied little, whereas their flash points, volatility rates, self-spread rates, and flame spread rates varied noticeably with either the base fuel or thickening agent composition; minimum ignition energies are also compared for liquid sprays. The performance of the thickened fuels, particularly Jet B emulsions, was not very promising under impact conditions. In fuel drops made from a 150-ft three-tower facility, the fireball size and radiation intensity varied with impact velocity, impact angle, and type of fuel container. Author

N72-11690# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.

FIRE AND EXPLOSION PROTECTION OF FUEL TANK ULLAGE

J. A. MacDonald and H. W. G. Wyeth *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 7 p refs

Avail: NTIS HC $6.00/MF $0.95

The conditions that can lead to an explosion within aircraft fuel tank ullages are examined, and the need for protection systems is reviewed. Principles employed in providing the desired degree of protection are outlined, such as oxygen reduction, vapor or mist inerting, and plastic foam fillers. Comparisons were made between the various sytems, and their relative merits were also discussed. It is concluded that plastic foam is an effective system provided that the material is compatible with the environment. Liquid nitrogen is also attractive from the weight aspect but could impose logistic problems. Author

N72-11691# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.

INVESTIGATION OF FIRE EXTINGUISHING POWDERS BY MEANS OF A NEW MEASURING PROCEDURE

R. Fiala and G. Winterfeld *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs

Avail: NTIS HC $6.00/MF $0.95

In order to optimise fire extinguishing systems it is necessary to compare the extinguishing efficiency of solid and gaseous (or liquid) extinguishing agents. A measuring procedure is described which allows this direct comparison. It makes use of the relationship between the maximum flow velocity at the burning limit of a flame-holder stabilized flame and the laminar burning velocity of the fuel-air-mixture which is given by DAMKOHLER's first number. Comparative results achieved with this procedure for several fire extinguishing agents are given. Author

N72-11692# Royal Aircraft Establishment, Farnborough (England). Materials Dept.

SIMULATED CRASH TESTS AS A MEANS OF RATING AIRCRAFT SAFETY FUELS

R. E. Miller and S. P. Wilford *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs

Avail: NTIS HC $6.00/MF $0.95

Two tests are described for assessing the fire resistance of Avtur containing polymeric additives which reduce its ability to form flammable mists. In the standard test a tank containing ten or twenty gallons of fuel is propelled on a rocket sled at speeds of 114 or 188 ft/sec and decelerated after contact with an aircraft arrester wire. Fuel is allowed to spill from a slit in the tank onto a series of ignition sources. In the run on test the tank travels at speeds up to 240 ft/sec past a series of ignition sources while spilling fuel from a slit on the leading edge. The velocities of spilled fuel relative to the surrounding air which occur in these tests are shown to be comparable to those occurring during survivable aircraft crashes. Author

N72-11693# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

SURFACE ACTIVE CONSIDERATIONS IN FUEL FIRES

Richard L. Tuve *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 4 p refs

Avail: NTIS HC $6.00/MF $0.95

The problem of efficient extinguishment of fires in burning fuels is dealt with. The use of low density water, in the form of foam, is considered as a means of achieving some solutions to the mechanical and physical needs involved. Emphasis is placed on the utilization of fluorocarbon surfactants which combine foam requirements and fuel-water interfacial activities benefitting fire extinguishing action. Recent development and test of these materials are discussed. D.L.G.

N72-11694*# General Electric Co., Cincinnati, Ohio. Material and Process Technology Labs.

LUBRICANT AND FUEL INTERACTIONS IN ADVANCED AIRCRAFT GAS TURBINES

E. N. Bamberger, D. B. Hester, and M. W. Shayeson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p refs Sponsored in part by NASA, AFAPL, and FAA

(NASA-CR-122842) Avail: NTIS CSCL 11H

The interactions and relationships between lubricants and fuels and their properties as related to systems in aircraft gas turbine engines are dealt with. Three areas of recent research are cited to illustrate the impact of lubricant and fuels capabilities on

modern engines: (1) a study of the influence of lubricant properties on turbine engine design characteristics, especially with regard to high speed supersonic applications, (2) the development of a precise and meaningful test procedure for measuring the thermal stability of kerosene fuels, and (3) the evaluation of advanced high temperature lubricating fluids and their effects on engine bearing performance. Author

N72-11695# Esso Development Co., Ltd., Abingdon (England). Research Centre.
STABILITY OF SYNTHETIC AVIATION GAS TURBINE LUBRICANTS AT HIGH TEMPERATURES
R. Robson *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs
Avail: NTIS HC $6.00/MF $0.95

The development of ester based synthetic aviation lubricants over the last 20 years is reviewed. Methods of assessing the high temperature stability of the lubricants are described and the main factors controlling stability are discussed. The suitability of alternative synthetic fluids is considered. Author

N72-11696# Institut Francais de Petrole, Grenoble (France).
SYNTHESIS AND PROPERTIES OF ESTERS OF TETRA-METHYL-2,2-7,7 OCTANE DIOL-1,8 [LES ESTERS DU TETRA METHYL-2,2-7,7 OCTANE DIOL-1,8 SYNTHESE ET PROPRIETES]
P. Bedague, B. Sillion, and G. DeGaudemaris *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 8 p refs In FRENCH
Avail: NTIS HC $6.00/MF $0.95

A diol of the neopentylic type was obtained by a series of simple reactions proceeding from cyano-4 dimethyl-2,2 butyraldehyde. Esters of linear acids and alpha alpha prime dimethylated acids were synthesized. Their physical characteristics were determined. Thermal stability and resistance to hydrolysis and oxidation in the presence of metals were examined.
Transl. by K.P.D.

N72-11697# Rolls-Royce, Ltd., Bristol (England). Engine Div.
LUBRICANT EXPERIENCE AND DUTIES IN A CIVIL SUPERSONIC GAS TURBINE ENGINE c15
E. W. Doherty *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 12 p ref
Avail: NTIS HC $6.00/MF $0.95

A description is presented of the Olympus 593 Mk 602 oil system generally, and particular reference is given to the design precautions against the oil fire risk, the use of oil in engine failure warning devices, and in engine health monitoring. Current engine test and flight experience with the lubricant is covered especially with respect to oil consumption, high temperature breakdown areas, prevention of oil carbon formation, mixing of lubricants brands, erosion/corrosion effects, and policy in approval processes of lubricants. Author

N72-11698# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtreib- und Schmierstoffe.
EARLY STAGE DETECTION OF OIL CHANGES IN AIRCRAFT ENGINES c15
E. Jantzen *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs
Avail: NTIS HC $6.00/MF $0.95

Potential analytical methods for detection of changes in aircraft turbine oils in the early state are reported and their possible advantages and disadvantages as well as their informative value are discussed. In addition, the cause of prematured or sudden oil changes in an aircraft engine is investigated. A test rig for simulating such oil changes and the results obtained are discussed. In conclusion, the possibilities of a simultaneous wear control of aircraft turbine oils are briefly explained. Author

N72-11699# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THERMAL STABILITY OF A TRI-METHYL-PROPANE ESTER BASED LUBRICATING OIL [CHAMP D'APPLICATIONS D'UNE HUILE BASEE SUR UN ESTER DU TRIMETHYLOL-PROPANE]
F. Reynaud *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 22 p refs In FRENCH; ENGLISH summary
Avail: NTIS HC $6.00/MF $0.95

Following a general discussion on the increased performance requirements of lubricating oils made mandatory by increased operating temperatures, the operational possibilities of a tri-methyl-propane ester in two domains of application are described. The first area of application considered was a conventional circuit with oil temperature around 230 C. By adding appropriate additives, a formula was developed with very satisfactory characteristics, particularly in regard to oxidation corrosion. The second area of usage studied was at the 380 C level. The formula appeared not to be well adapted to the new conditions, with some additions losing their efficiency. However the ester remained valid as a base. D.L.G.

N72-11700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
SOLID LUBRICATION FOR AERO PROPULSION SYSTEMS
M. R. Chasman *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 13 p refs
Avail: NTIS HC $6.00/MF $0.95

Self contained solid lubricated bearings were developed for application to current and future aircraft propulsion and power generation equipment. The capability for long life operation over a wide range of temperatures in an air environment was demonstrated. The approach was to use solid lubricants as a sacrificial retainer material in 20 mm and 35 mm bore bearings. In some cases stainless steel and titanium shrouds were used to provide added strength to the solid lubricant retainers. Lubricants were selected based on their strength, oxidation, friction, and wear properties. It was necessary to deviate from oil and grease lubricated bearing design to achieve acceptable life. Bearing clearance, number of balls, retainer to land clearance, and ball pocket size were optimized. Hundreds, and in some cases thousands, of hours of life were demonstrated. Author

N72-11701# BP Benzin und Petroleum AG, Munich (West Germany).
SYNTHETIC LUBRICANTS FOR SUPERSONIC AIRCRAFT
H.-D. Dorn *In* AGARD Aircraft Fuels, Lubricants, and Fire Safety Aug. 1971 6 p
Avail: NTIS HC $6.00/MF $0.95

Classifications and characteristics of synthetic aero turbine oils are reviewed. These oils are classified as type 1 and type 2 lubricants. The type 1 lubricants are defined as blends of a diester basestock and an additive package. Although still being used in jet engines, their use in advanced turbines is considered to be limited by marginal resistance to thermal and oxidative stress. Type 2 lubricants, developed to meet the increased requirements of more sophisticated aircraft, are defined as blends of a hindered tri- or tetraester basestock and an additive package. The burden placed on these lubricants by sustained flight at supersonic speeds is discussed, and the development of an advance complex ester lubricant with a novel additive package for Mach 2 + engines is reported. D.L.G.

N72-11706# Phillips Petroleum Co., Bartlesville, Okla. Research and Development Dept.
EFFECT OF VERY LOW SULFUR IN JP-5 FUEL ON HOT CORROSION
Robert M. Schirmer and Harold T. Quigg 20 May 1971 33 p refs Presented at the 10th Natl. Conf. on Environ. Effects on

Aircraft and Propulsion Systems, Trenton, 18-20 May 1971; Sponsored by Naval Air Propulsion Test Center
(AD-725819) Avail: NTIS CSCL 20/4

The report discusses an investigation to determine whether the present limit of 0.4 percent by weight (4000 ppm) of sulfur in JP-5 fuel is a safe level for the protection of turbine-blade materials from hot corrosion in high-performance engines when operated in a marine environment. The present study shows that a 100-fold reduction in the sulfur limit to 40 ppm would not reduce hot corrosion significantly. Such reductions in the sulfur limit would drastically curtail fuel availability, since they approach the mean and the minimum of current production, and could cause critical problems in logistics. It was found that the use of an essentially sulfur-free fuel, containing only 4 ppm sulfur, significantly decreased both the surface scale on specimens and the weight lost by specimens of a wide variety of superalloys and superalloy-coating systems when exposed under conditions which simulate those in an aircraft-turbine engine ingesting air with 1 ppm sea salt. Thus, indications are that the sulfur in fuel must be below a 'threshold' concentration to improve the durability of turbine-blade materials. Author (GRA)

N72-11711*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT INVESTIGATION OF AIRFRAME INSTALLATION EFFECTS ON AN AUXILIARY INLET EJECTOR NOZZLE ON AN UNDERWING ENGINE NACELLE
Richard R. Burley Washington Nov. 1971 71 p refs
(NASA-TM-X-2396; E-6208) Avail: NTIS CSCL 21E

The local flow field approaching an installed nozzle may vary from isolated test conditions, thereby affecting exhausting nozzle performance. An installation of general interest is a podded engine mounted near the aft lower surface of the wing. The effect of this installation on the performance of an auxiliary inlet ejector nozzle was investigated over a Mach number range of 0.7 to 1.3 by using a modified F-106B aircraft. Both floating and fixed-open door configurations were examined. The ejector nozzle trailing-edge flaps were simulated in the closed position with rigid structure which provided a boattail angle of 15 deg. Primary nozzle area was varied as exhaust gas temperature was varied between 982.2 and 2003.3 K. Author

N72-11713# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
INVESTIGATION OF FEASIBILITY OF INTEGRAL GAS TURBINE ENGINE SOLID PARTICLE INLET SEPARATORS. PHASE 2: FEASIBILITY DEMONSTRATION Final Report
William J. McAnally, III and Max T. Schilling Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Apr. 1971 65 p refs
(Contract DAAJ02-70-C-0003; DA Proj. 1-G-162207-AA-71)
(AD-725593; PWA-FR-4197; USAAVLABS-TR-71-13) Avail: NTIS CSCL 21/5

Two different sand and dust particle separator test rigs were fabricated and tested to evaluate separation efficiency, aerodynamic performance characteristics, and operation in rain and foliage ingestion conditions. The semi-reverse-flow separator utilized fixed turning vanes on a contoured hub to induce swirl in an annular duct. At design airflow of 8 lb/sec and 40% scavenge flow, the semi-reverse-flow separator demonstrated 88.5% separation efficiency with AC coarse test dust at an average pressure drop of 2.8 in. H2O. The powered mixed-flow separator attempted to utilize the strong centrifugal field available in a mixed-flow impeller turning at the high speeds characteristic of small gas turbine engines to achieve particle separation. At the design airflow of 8 lb/sec, it demonstrated a maximum separation efficiency of 58.7% with 8.4% scavenge flow and an average pressure rise of 6.76 psi. Both separator concepts were determined to be feasible and the semi-reverse-flow separator is considered to be superior to current engine air particle separators for the majority of aspects investigated. Author (GRA)

N72-11714# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A STUDY OF NOISE GENERATION BY A ROTATING BLADE ROW IN AN INFINITE ANNULUS Interim Scientific Report, 7 Jul. 1969 - 31 Mar. 1971
John A. Lordi May 1971 73 p refs
(Contract F44620-69-C-0130; AF Proj. 9781)
(AD-726126; CAL-AI-2836-A-1; AFOSR-TR-71-1485) Avail: NTIS CSCL 13/1

Discrete-tone noise generation by high-speed fans and compressors has been studied by applying existing theories for the flow through a rotating blade row in an infinitely long annulus. McCune's analysis for the linearized, three-dimensional, compressible flow through a nonlifting blade row and its recent extension to lifting blades have both been used to find the acoustic disturbances produced by such flows. These analyses contain the cutoff condition for the duct acoustic modes, including the effect of through flow, and relate the amplitudes of the propagating modes to the blade thickness and loading. In the present work these relationships have been evaluated for some specific thickness and loading distributions to find the pressure and velocity fields away from the blade row. Methods have been developed to calculate the sound intensity flux upstream and downstream of the blade row and results are presented which demonstrate the influence of blade geometry and operating conditions on noise generation. Author (GRA)

N72-11803*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ELECTRONIC STRAIN LEVEL COUNTER Patent Application
Felix L. Pitts and John L. Spencer, inventors (to NASA) Filed 8 Jul. 1971 12 p
(NASA-Case-LAR-10756-1; US-Patent-Appl-SN-160859) Avail: NTIS CSCL 20K

An electronic strain-level counter for obtaining structural strain data on in-flight aircraft is described. The device counts the number of times the strain at a point on a structural member of the aircraft exceeds each of several preset levels. A dead band is provided at each level to prohibit the counting of small strain variations around a given preset level. NASA

N72-11820# Grumman Aerospace Corp., Bethpage, N.Y.
AN AUTOMATED PROCEDURE FOR THE OPTIMIZATION OF PRACTICAL AEROSPACE STRUCTURES. VOLUME 1: THEORETICAL DEVELOPMENT AND USER'S INFORMATION Final Report, 15 Jan. 1969 - 15 Aug. 1970
Walter J. Dwyer, Robert K. Emerton, and Irving U. Ojalvo Wright-Patterson AFB, Ohio AFFDL Apr. 1971 208 p refs
(Contract F33615-69-C-1278; AF Proj. 5710)
(AD-726112; ADR-02-01-71-Vol-1; AFFDL-TR-70-118-Vol-1) Avail: NTIS CSCL 01/3

The report documents the development of a new structural optimization algorithm, which is a combination of a modified fully stressed design technique and a redesign procedure based on gradients to deflection constraint surfaces. The algorithm is incorporated into a large finite element program based on the displacement method of structural analysis. Using an IBM 360/75 computer, the program is capable of obtaining near optimum distributions of material for structural idealizations consisting of up to three thousand elements and six thousand degrees of freedom, and subjected to a maximum of twenty loading conditions. Constraints may be placed on the maximum and minimum size of any of the elements, on the stresses in the elements, and on the displacements of the nodal points of the structure. Several examples of structures that were optimized are included to demonstrate the various features of the program, and to compare results with previously obtained solutions. To help make the program useful in the design of major aircraft structures, care has been taken to simplify the input and to present the program output in a form that is meaningful to the aircraft stress engineer. Results of an exploratory investigation into the optimization of dynamically loaded structures are presented, and the conversion of two existing blast-response shell codes into a unified synthesis program is documented. Author (GRA)

N72-11845*# Boeing Co., Seattle, Wash.
STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS, SAN FRANCISCO BAY AREA
Sep. 1971 541 p refs
(Contract NAS2-5969)
(NASA-CR-114347) Avail: NTIS HC $6.00/MF $0.95 CSCL 05C

The nine-county San Francisco Bay area is examined in two time periods (1975-1980 and 1985-1990) as a scenario for analyzing the characteristics of an intraurban, commuter-oriented aircraft transportation system. Aircraft have dominated the long-haul passenger market for some time, but efforts to penetrate the very-short-haul intraurban market have met with only token success. Yet, the characteristics of an aircraft transportation system-speed and flexibility-are very much needed to solve the transportation ills of our major urban areas. This study attempts to determine if the aircraft can contribute toward solving the transportation problems of major metropolitan areas and be economically viable in such an environment. Author

N72-11849# RAND Corp., Santa Monica, Calif.
PROCEEDINGS OF A CONFERENCE ON REGIONAL TRANSPORTATION PLANNING
Joseph S. Desalvo, ed. May 1971 526 p refs Conf. held at Santa Monica, Calif., 25-27 Jan. 1971
(Contract DOT-OS-00074)
(PB-200076; R-706-DOT; DOT-OS-00074) Avail: NTIS HC $6.00/MF $0.95 CSCL 13B

The conference explored the idea that some form of transportation planning entity should be created between two existing levels of planning-the national level and individual states or smaller jurisdictions. The issue was to consider the advantages and disadvantages, in economic and administrative terms, of conducting transportation planning on a regional basis.
Author (GRA)

N72-11850# Center for Naval Analyses, Arlington, Va. Inst. of Naval Studies.
THE VALUE OF TIME IN AIR TRAVEL: THEORY AND EVIDENCE
Arthur S. DeVany Apr. 1971 45 p refs
(Contract N00014-68-A-0091)
(AD-725480; Contrib-162) Avail: NTIS CSCL 15/5

The roles of time and money cost in the demand for air travel are analyzed. The first step is to construct the theory of consumer demand under a time constraint and to deduce its theorems. Then these theorems are applied to air travel through use of a total price demand function. This analysis considers the effects of fare, trip time, airport delay, schedule frequency, trip distance, traveler's wage rates, and non-wage income on the demand for air travel. Many results concerning elasticities are obtained, including a necessary relationship between the time, price, and total price elasticities of demand. Tests of the theorems are performed, the various elasticities are estimates, and the relationship between the elasticities required by the theory is used to obtain an estimate of the value of time in air travel. Author (GRA)

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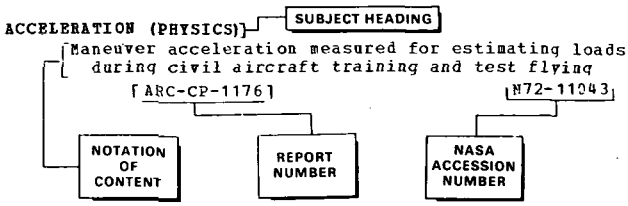

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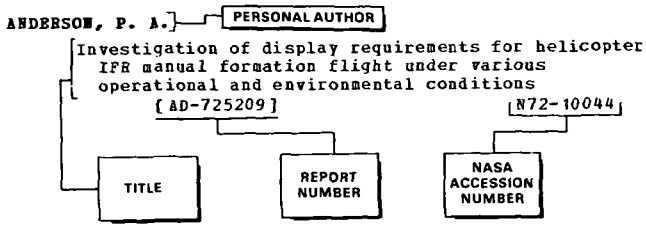

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16. Abstract

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