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AERONAUTICAL ENGINEERING

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Supplement 23

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NASA SP-7037 (23)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 23

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 September 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 378 reports, journal articles, and other documents originally announced in September 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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

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

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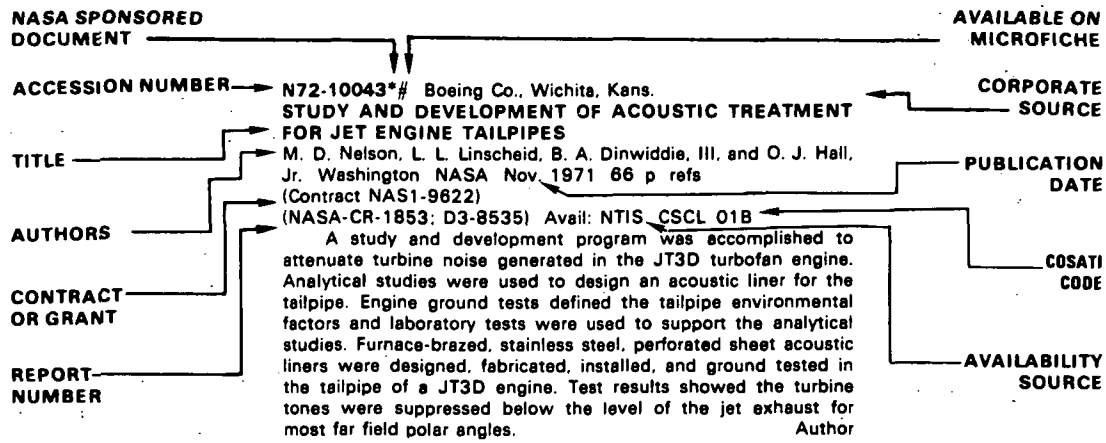

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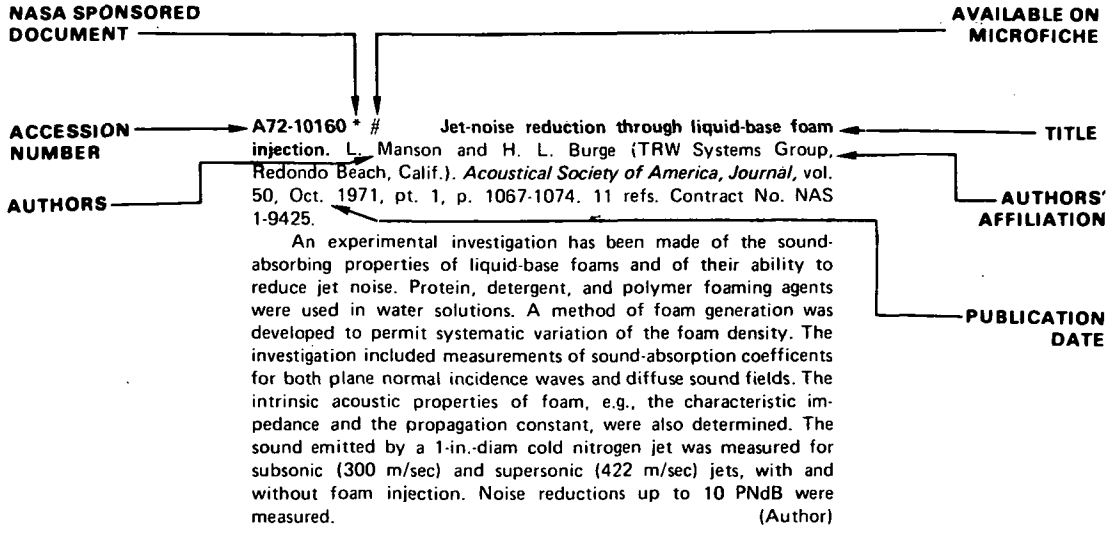


AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 23) OCTOBER 1972

IAA ENTRIES

A72-34215 **Sailplane performance measured in flight.** P. Bikle. *Aero-Revue,* June 1972, p. 333-338.

Description of the T-6, a modified HP-14 sailplane, the performance data obtained, and the test techniques, as well as the comparison tests and results obtained for seven other sailplanes. These are the Kestrel, Cirrus, Phoebus C, 16.5-m Diamant, Phoebus A, BG-12, and 1-26. The T-6 is of all-metal construction, has a shoulder-high wing, a retractable gear, simple hinged flaps with no speed brakes or tail parachute, and is of medium aspect ratio and wing loading. F.R.L.

A72-34223 **Engineering the B-1 design.** I. Stambler. *Interavia,* vol. 27, June 1972, p. 610-613.

Design features of a prototype B-1 bomber aircraft are described in terms of materials, configurations, and requirements of the moving-wing system, fuselage structural elements, hydraulic components, weapons systems, and powerplant. The wing design specifies a loading of over 200 lb/sq ft at full fuel weight and a span of 136.7 ft at full forward extension (78.2 ft with full retraction). A hydraulically powered screw jack operates the wing-pivot mechanism, and hydraulics are used almost universally for operation of the aerodynamic control surfaces. A conventional riveted structure is employed for the most part, and the breakdown of structural materials by weight is 40.7% aluminum, slightly more than 20% titanium, 15.6% steel, 0.4% boron composite, and the balance corresponding to various materials including glass reinforced plastic. Engine inlet configurations for various flight modes are illustrated, and navigational and warfare electronics are discussed. T.M.

A72-34224 **Airport planning requirements - An airline view.** R. J. Sutherland (American Airlines, Inc., New York, N.Y.). *Interavia,* vol. 27, June 1972, p. 637-639.

The planning of airport facilities is discussed from the viewpoint of airline requirements for providing efficient service to passengers. Emphasis is placed on the need for close consultation between airlines and airport administrations during preparation of traffic forecasts in the master planning stage of airport development. An omnidirectionally diverging highway system is advocated as the overall best solution to access problems at most locations, and the provision of adequate parking facilities and curbside stopping areas is considered a necessity. Additional topics considered include terminal facilities, cargo handling systems, aircraft maintenance provisions, airport operating area requirements, operational limits and restrictions, noise abatement, and exhaust pollution. T.M.

A72-34225 **Airport terminal design - The passenger's point of view.** R. H. Wild. *Interavia,* vol. 27, June 1972, p. 640, 641.

Deficiencies in access facilities and passenger processing methods at most current airport terminals are illustrated by a typical schedule for the ground mode of an airline trip originating in a major city. Excessive ground travel time to the airport, excessive distances to be covered at the airport itself, baggage handling procedures, and official documentation are shown to produce delays that can generally be identified with overall planning geared to concepts from the early days of aviation. A modular design of a terminal is proposed to relieve sequential delays caused by mutual interplay between various bottlenecks. Standard departure gates, coded boarding passes, automatic baggage delivery, and televised inspection of documents are recommended. T.M.

A72-34234 **An estimate of sonic boom damage to large windows.** A. J. Pretlove and J. F. Bowler (Reading, University, Reading, Berks., England). *Journal of Sound and Vibration,* vol. 22, May 8, 1972, p. 107-112. 10 refs.

A preliminary estimate, based on statistical data, is made of the likelihood of damage to large windows due to sonic bangs. On the basis of the mean window characteristics calculated from a field survey in Reading, it seems probable that about one large window in ten thousand will be broken by a typical sonic bang. The degree of confidence held for the result obtained cannot at the moment be very high because the effects of a number of the variables are still to be included in the analysis. These variables, listed in the report, are to be evaluated in due course. (Author)

A72-34238 * **STOL research at NASA.** G. G. Kayton (NASA, Transport Experimental Programs Office, Washington, D.C.). *Airport Forum,* June 1972, p. 18, 19, 22, 23. In English and German.

Review of the overall goals, individual objects of ongoing and proposed programs, target dates, and fund requests of NASA's STOL research effort. The realization of a separate STOL short-haul transportation system with a 2000-foot field length capability is shown likely to reduce airport acreage requirements to less than one tenth, approach speed to nearly one half, and airspace required for terminal maneuvering to less than 10% of what conventional high-performance jet aircraft necessitate, and to promise terminal congestion alleviation in areas of high traffic density, improved safety in steep approach, noise abatement, and community annoyance reduction. NASA's described programs will provide the technical foundation upon which industry can base the design and development of aircraft and avionics for the new STOL systems in the latter 1970s, and upon which the government can establish criteria for the certification and regulation of such systems. M.V.E.

A72-34239 * **STOLports must be good neighbors.** R. K. Ransone (NASA, Washington, D.C.). *Airport Forum,* June 1972, p. 30-32, 34 (7 ff.). In English and German.

Discussion of STOL aircraft and airport objectives, acceptance prerequisites, and realization requirements, and brief review of some STOL evaluation and feasibility studies performed by American Airlines. Ground, airport, and destination congestion and convenient STOLport location are examined as STOL-favoring factors, along with flight security and high-density routes. Approaches to neighborhood STOLport acceptance and the problem of STOL profit potential are given special attention. M.V.E.

A72-34240 V/STOL flight control - Trend and requirements. K. Brammer and W. Metzdorff (Dornier AG, Friedrichshafen, West Germany). *Airport Forum,* June 1972, p. 46-48, 50 (4 ff.). In English and German.

Discussion of some of the design problems of all-weather flight control and guidance systems for V/STOL aircraft. Discussed topics include mission and flight path profiles, VTOL and STOL flight characteristics, weather minima, flight safety, pilot's capacity limits, and control information display. Special attention is given to VTOL landing and touchdown navigation systems, and speed measurement and guidance computer subsystems. VTOL control laws and the reliability problem are also discussed. M.V.E.

A72-34241 The flight mechanics of STOL aircraft. K. Wilhelm (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugmechanik, Braunschweig, West Germany). *Airport Forum,* June 1972, p. 61-63, 65 (3 ff.). 9 refs. In English and German.

Discussion of some of the problems entailed for STOL aircraft by the demands their short-distance takeoff capability makes upon their design. These demands for high thrust-to-weight ratios, low wing-loading values, and lift coefficients enhanced through use of high-lift devices are examined in terms of their effects upon flying qualities, particularly in turns. M.V.E.

A72-34242 Kansas City - The airport with short walking distances. H. A. Kivett (Kivett and Myers, Kansas City, Mo.). *Airport Forum,* June 1972, p. 88, 89, 91-94 (3 ff.). In English and German.

Description of the overall design, major features, and some of the facilities of the Kansas City International Airport. At opening, late in 1972, the airport will have three of its circular buildings operational. Capacity at opening will be 12 million passengers per year. The master plan provides for a fourth terminal building to be added when required. Cost of the first three modules is a total of approximately $24 million or about $24 per square foot, not including site development, paving, roadways, bridges, furnishings, and tenant improvements. Two earlier built runways have been extended to 10,800 and 9500 ft. The decentralized processing and information display systems are reviewed. M.V.E.

A72-34243 Runway markings - A safety factor. M. Bollag (Plastiroute S.A., Geneva, Switzerland). *Airport Forum,* June 1972, p. 111, 112. In English and German.

Discussion of modern airport runway requirements and practices. The requirements discussed include: visibility by day in diffuse lighting (i.e., sufficient whiteness), adequate night reflection value, color stability, durability, antiskid properties, heat resistance up to 200 C, imperviousness to aircraft fuels and lubricants, good adhesion, and prompt applicability assuring noninterference with flight operations at airports of high traffic density. Some of the techniques used for meeting these requirements are briefly reviewed. M.V.E.

A72-34244 Planning model for German air transport. G. Mücke and W. Apfel (Flughaten Frankfurt/Main AG, Frankfurt am Main, West Germany). *Airport Forum,* June 1972, p. 119, 121-123 (3 ff.). In English and German.

Discussion of the urgent need for country-wide, instead of merely regional, planning of German air transportation facilities. The absence of such planning is shown to prevent timely legal reservation of specific areas for aviation facilities and their preparation on a long-term basis, and to expose to mediocrity the future position of Germany within the European air transport system. Following a comparison of London, Paris, Moscow, and Frankfurt air transport facilities, planning models for Germany's northern, central, and southern air traffic areas are reviewed. M.V.E.

A72-34267 A comparison of voice communication techniques for aeronautical and marine applications. S. J. Campanella and J. A. Sciulli (Communications Satellite Corp., Washington, D.C.). *COMSAT Technical Review,* vol. 2, Spring 1972, p. 173-204. 14 refs.

The intent of this paper is to make a comparative analysis of several voice modulation techniques which are candidates for aeronautical and marine satellite applications. The techniques considered are FM (either with discriminator or PLL demodulation), PCM/PSK, DM/PSK, and PDM/PSK. The objective is to determine the relative performance of each system under the power and bandwidth constraints expected for the aeronautical and marine applications. For each modulation system, a test-tone-to-noise ratio vs C/No (carrier-to-noise density ratio) characteristic is first determined. This is then converted to an articulation index vs C/No characteristic by using an analytic method based on noise masking of frequency bands with equal articulation index weight in the speech spectrum. (Author)

A72-34389 North American gears to produce B-1. R. R. Ropelewski. *Aviation Week and Space Technology,* vol. 96, June 26, 1972, p. 53, 55-57, 59.

The work concerning the B-1 advanced strategic bomber is at the moment still mostly in the engineering stage. However, the percentage of work devoted to production planning is increasing rapidly. Requirements and schedules for production engineering, tooling, manpower, and costs are being determined. Tests on several structural aircraft components are being conducted including the wing center section, the crew capsules, the wing pivot bearings, the horizontal stabilizer, soft ride control vanes, double-slotted flaps, a flexible wing fairing closure structure, and dual compression landing gear struts. G.R.

A72-34390 F100 engine draws on past technology. M. L. Yaffee. *Aviation Week and Space Technology,* vol. 96, June 26, 1972, p. 88-90, 95, 97.

The F100 turbofan engine is being developed for the Air Force/McDonnell Douglas F-15 air-superiority aircraft. Its sister engine, the slightly more powerful F401 is intended for the Navy/Grumman F-14B. The thrust-to-weight ratios of the two engines are in the 9/1 class. The two-stage, highly-loaded core turbine for the F100/F401 is discussed together with the impingement cooling scheme used, a new titanium alloy having a high strength-to-weight ratio at high temperatures, a new powder metallurgy process for use in producing IN 100 billets, the F100 balanced beam nozzle, a variable area fuel nozzle, metal composites to be employed, and a new forging process called Gatorizing. G.R.

A72-34391 Northrop streamlines A-9A management. *Aviation Week and Space Technology,* vol. 96, June 26, 1972, p. 107, 109, 111, 113.

The A-9 is a twin-engine aircraft designed to provide close-support fire, armed escort and reconnaissance against enemy ground forces. Horizontal and vertical stabilizers are used by the aircraft. A 30-mm Gatling-gun-type cannon is to be mounted along the longitudinal center-line of the fuselage. The organization used for designing and building the aircraft is discussed together with

organizational changes in connection with the production planning effort. It is pointed out that cost controls are a primary consideration in the A-9 program. Low cost is to be preferable to excess performance beyond stated requirements. G.R.

A72-34392 **A-10 prototype designed for production.** W. Hansen. *Aviation Week and Space Technology*, vol. 96, June 26, 1972, p. 114, 115, 117, 118.

The engines in the A-10A low-wing, twin-tail design are suspended from opposite sides of the fuselage just behind and above the wing. The capabilities of the aircraft for its close-support role are to be combined with an ease of maintainability for operations from airstrips close to battle lines. The nose gear of the aircraft is offset about a foot to the right of the centerline. The aircraft has two primary hydraulic flight control systems and a manual backup system. G.R.

A72-34393 **USAF places new stress on simulators.** K. J. Stein. *Aviation Week and Space Technology*, vol. 96, June 26, 1972, p. 147-154.

Various representative simulation programs are discussed, giving attention to an undergraduate navigator training system, a simulator for electronic warfare training, the A-7D trainer mission simulator aircraft, and a digital radar land mass simulator. Other simulating systems considered include two helicopter trainers for the CH-3E and HH-53, an air-to-air combat simulator, and an advanced simulator for undergraduate pilot training. Present training requirements for undergraduate pilots are listed together with requirements for specialized training. G.R.

A72-34414 **Simulation of interface systems at airports.** A. E. Brant, Jr., P. J. McAward, A. C. Cremer, and R. D. Tilles. In: Institute of Electrical and Electronics Engineers, Southwestern Annual Conference and Exhibition, 24th, Dallas, Tex., April 19-21, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 68-72.

Description of the simulation models developed and used for the performance evaluation of the airfield for the proposed Dallas-Fort Worth Regional Airport, and of the airport, terminals, and approach roadways for Maiquetia International Airport in Venezuela. Through replication of the actual movement of traffic units as they interact with the proposed airport systems, model simulation produces statistics that provide a measure of airport performance. Simulation is shown to represent a powerful tool that makes it possible to evaluate airport designs under expected traffic loads before construction is undertaken. M.V.E.

A72-34472 **Simulation of an air cargo handling system (Simulation einer Luftfrachtumschlaganlage).** C. Engen (Fried. Krupp GmbH, Essen, West Germany) and H. Pontoppidan (Fried. Krupp GmbH, Rheinhausen, West Germany). *Technische Mitteilungen Krupp, Werksberichte*, vol. 30, Feb. 1972, p. 5-11. 5 refs. In German.

It is shown that computer simulation can provide reliable statistical predictions regarding the quantification of freight flows and the functional efficiency of cargo handling systems. A concrete example involving the design of an air cargo handling center with a certain capacity is considered. The system proposed for performing the required functions is shown in a diagram. The structure of the model representing the system is discussed together with the simulation program, the testing of the model, and the simulation results. G.R.

A72-34476 **Subcommittee chairman's report to membership on aerodynamic sources of rotor noise.** C. R. Cox (Bell Helicopter Co., Fort Worth, Tex.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 625*. 8 p. 17 refs. Members, $1.50; nonmembers, $2.00.

This report summarizes the deliberations of the Noise Subcommittee on the state of knowledge of aerodynamically-generated rotor noise. It defines a classification system that relates sound radiation to specific aerodynamic sources and clarifies rotor acoustics terminology. The physical characteristics and the major controlling parameters of prominent aerodynamic noise sources are delineated. Because existing and readily derivable rotor acoustic theories are more extensive than either the analytical or experimental aerodynamic force inputs that are needed to evaluate them, the report proposes a balanced research approach of continued analytical development, model and full-scale rotor testing in wind tunnels and on whirl stands, and full-scale vehicle evaluations. (Author)

A72-34477 * **Wind tunnel simulation of full scale vortices.** J. B. Rorke, R. C. Moffitt (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.), and J. F. Ward (NASA, Langley Research Center, Hampton, Va.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 623*. 15 p. 15 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-10446.

An experimental investigation has been conducted to determine the important scaling parameters for the flow in the core region of a vortex generated by a rectangular wing tip. The effect of an unconventional planform, the ogee tip, on the tip vortex is also determined. Data were measured for wing pitch angles of 6 and 9 deg at Mach numbers of 0.2, 0.5, and 0.6 for Reynolds numbers ranging from 440,000 to 7,000,000 using a triaxial hot wire probe. The probe was located at 2 and 5 chordlengths downstream from the trailing edge of the 4.25 inch and 26.0 inch chord wings. For rectangular planform wings, the measured vortex core diameter to chord ratios, peak tangential velocity ratios, and axial velocity ratios are shown to be functions only of wing lift coefficient and elapsed time from vortex formation, and appear to be independent of both Mach number and Reynolds number. (Author)

A72-34478 **Helicopter testing of inertial navigation systems.** J. B. Hughes (Litton Systems, Inc., Woodland Hills, Calif.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 634*. 17 p. Members, $1.50; nonmembers, $2.00.

Six flight test programs have been conducted during the time from 1962 to 1972. The rate of position error buildup was used as a primary measure of the systems' performance during the investigations. On the basis of the results obtained in the studies it is concluded that the inertial navigation system is not degraded by EM interference or the vibration environment of the helicopter. Test techniques are discussed together with methods of data reduction and details of the test programs. The weight of the basic inertial sensing element for each of the systems tested is considered along with the relative cost of the inertial platforms. G.R.

A72-34479 **S-67 flight test program.** R. McCutcheon (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 653*. 12 p. 13 refs. Members, $1.50; nonmembers, $2.00.

A comprehensive flight test program has been conducted by Sikorsky Aircraft on the S-67 helicopter. The program was initiated as a limited budget study to develop a low cost tactical helicopter demonstrator. The aircraft rotors, drive train, and engines were derived from the Sikorsky S-61 series aircraft. The airframe, a narrow

body design with tandem seating, was configured with wings and integral speed brakes, a full flying horizontal tail coupled to the longitudinal cyclic, and a large cambered vertical fin. A level flight maximum airspeed of 192 knots, a new 15/25 kilometer world record, was attained four months after first flight. Four aircraft studies considered the effects of the full flying horizontal tail, the wing mounted speed brakes, the aircraft maneuverability with wings installed and removed, and the effect of an electrohydraulic cyclic feel augmentation system. (Author)

A72-34480 Secondary power system for advanced transport helicopter. G. J. Amarel (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 664.* 10 p. Members, $1.50; nonmembers, $2.00.

An optimum configuration of the secondary power system for an advanced transport helicopter is analyzed for the desirability of an on-board auxiliary power unit (APU). Alternate means of main engine starting and secondary power system checkout, such as battery or hydraulic accumulator start systems, are considered. Additional consideration is given to aircraft ground operations, such as supplying power to run an environmental control system, wheel drive, or aircraft winch. The alternate systems are compared to a system with an on-board APU on a weight, volume, and takeoff gross weight basis. Economic and operational considerations are also compared on a qualitative basis. (Author)

A72-34481 Low level night operations of Army aircraft. W. J. Kenneally and D. D. Garrison (U.S. Army, Avionics Laboratory, Fort Monmouth, N.J.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 631.* 18 p. 27 refs. Members, $1.50; nonmembers, $2.00.

The requirements for flights during the night and under conditions of reduced visibility are examined, giving attention to mid-intensity airmobile operations. A vital factor in the analysis conducted is the determination of the characteristics of specific barriers to the performance of the required maneuvers. The use of a unique airborne simulator is discussed together with problems of pilot workload measurement, specific barrier problems, and various devices for overcoming the problems of the aircraft operations. A variable parameter terrain avoidance radar is considered together with a helicopter multifunction system, night vision goggles, and the Iroquois night fighter and night tracker. G.R.

A72-34482 Boundary layer velocity profiles on a helicopter rotor blade in hovering and forward flight. D. A. Blaser and H. R. Velkoff (Ohio State University, Columbus, Ohio). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 622.* 8 p. 10 refs. Members, $1.50; nonmembers, $2.00. Army-sponsored research.

The characteristics of boundary layers on a helicopter rotor blade during hovering and forward flight are discussed on the basis of chordwise and spanwise velocity profile measurements, taking into account local flow angles within the boundary layer. Data obtained under hovering conditions indicated the presence of a laminar separation bubble in rotor blade boundary layers. The hover tests were run on a whirl tower with a single blade counterweighted rotor. Constant-temperature anemometer-amplifier systems were used for velocity measurements. V-configurations of hot wire probes were used for velocity vector measurements. V.Z.

A72-34483 The controllable twist rotor performance and blade dynamics. A. Z. Lemnios, A. F. Smith (Kaman Aerospace Corp., Bloomfield, Conn.), and W. E. Nettles (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 614.* 12 p. 5 refs. Members, $1.50; nonmembers, $2.00. Grant No. DAAJ02-67-C-0068.

A new rotor system designated the Controllable Twist Rotor (CTR) was designed on the basis of background studies. The blade twist distribution in the new system can be controlled both cyclically and collectively. Rotor performance and blade dynamic responses of the CTR were studied. The objectives of the study include an evaluation of the feasibility of the concept, the determination of a nearly optimum configuration, and a comparison of the CTR with conventional systems. The design of the system is discussed together with its modes of operation, a parametric analysis, and a mission analysis. G.R.

A72-34484 Design requirements for a quiet helicopter. N. B. Hirsh and H. W. Ferris (Hughes Tool Co., Aircraft Div., Culver City, Calif.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 604.* 8 p. Members, $1.50; nonmembers, $2.00.

Description of tests in the development of a quiet helicopter by subsystem design modifications aimed at a combined contribution to the overall sound pressure level. Details are given on tests to establish spectral noise requirements and to verify design modifications in terms of noise level improvement. Acoustical treatment was applied to system components responsible for noise on a noise attenuation test stand. The world's quietest helicopter design was developed as a result of this test and development program. V.Z.

A72-34485 Flight investigation of design features of the S-67 winged helicopter. R. C. Dumond and D. R. Simon (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 601.* 11 p. Members, $1.50; nonmembers, $2.00.

The investigation included flight evaluations of the stabilator, the speed brakes, the aircraft maneuverability and the Feel Augmentation System (FAS). The stabilator is a horizontal stabilizer. It was found that the stabilator design could be simplified by the elimination of certain characteristics. The wing-mounted speed brakes on the S-67 aircraft can increase dive angle and reduce the fuselage angle of attack. The aircraft was found to have a useful maneuvering envelope. Three types of FAS failures were demonstrated. It is pointed out that the maneuverability characteristics of the aircraft could be further enhanced by improved collective pitch stick feel augmentation. G.R.

A72-34486 An integrated system of airborne and ground-based instrumentation for flying qualities research with the X-22A airplane. J. L. Beilman (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 654.* 16 p. Members, $1.50; nonmembers, $2.00.

A72-34487 Fuselage nodalization. D. P. Shipman, J. A. White, and J. D. Cronkhite (Bell Helicopter Co., Fort Worth, Tex.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 611.* 10 p. 10 refs. Members, $1.50; nonmembers, $2.00.

Studies and tests designed to achieve a vibration level reduction in modern helicopters are described, covering nodalization principles, nodalized fuselage analysis, hardware development, and isolated floor design features. Details are given on dynamic scale model tests and a flight test for a full-scale nodalized fuselage, showing that nodaliza-

tion may significantly reduce the vibration levels of either limited areas or the entire fuselage of a helicopter. It is pointed out that the variations in rotor rpm, weight, and center of gravity have a negligible effect on the effectiveness of helicopter fuselage nodalization. It is estimated that the weight penalty of a helicopter fuselage nodalization during production may go down to less than one percent. V.Z.

A72-34488 Maneuvering heavy sling loads near hover. T. A. Dukes (Princeton University, Princeton, N.J.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 630.* 15 p. 10 refs. Members, $1.50; nonmembers, $2.00. Contract No. DA-28-043-AMC-02412(E).

The dynamic system of a helicopter with a sling load is analized in a fundamental way, using approximate models. The approach considers the three most significant degrees of freedom: translation and attitude of the helicopter and the displacement of the load with respect to the helicopter. After a simple transformation of variables, the translational motion of the center of gravity of the combined helicopter-load system is used instead of the translation of the helicopter. With large pitch damping, the translational motion is only weakly coupled to the attitude and load motions, leading to a straightforward analysis of the alternatives for damping the 'pendulous' mode of motion. 'Minimal excitation' of the pendulous motion is pursued for three distinct maneuvers: acceleration-deceleration, changing the hover location and arresting a pendulous load motion. Ideal thrust angle input functions are determined which in the absence of disturbances result in no pendulous motion at the end of the required maneuver. (Author)

A72-34489 Influence of airfoils on stall flutter boundaries of articulated helicopter rotors. R. G. Benson, L. U. Dadone, R. E. Gormont, and G. R. Kohler (Boeing Co., Vertol Div., Philadelphia, Pa.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 621.* 18 p. 5 refs. Members, $1.50; nonmembers, $2.00.

This paper reports the use of transonic airfoil technology in the design of airfoils to satisfy the complex helicopter rotor environment. The initial transonic airfoil selected for evaluation was one which demonstrated attractive dynamic lift and pitching moment damping characteristics in two-dimensional oscillatory tests. Rotor test results indicated an improved hover capability relative to the V23010-1.58 airfoil, but stall behavior was deficient. Subsequent transonic airfoils for helicopter rotors have been designed on the basis of static maximum lift capability; this effort has resulted in the development of the VR-7 and VR-8 airfoils, which have resulted in modest improvements in both hover efficiency and stall flutter boundaries. Results indicate that further improvements may be made relative to stall flutter limitations, but that little potential for further gains in hover efficiency exists due to the conflicting requirements for high lift and low drag. (Author)

A72-34490 Results of preliminary studies of a bearingless helicopter rotor concept. M. C. Cheney (United Aircraft Fluid Dynamics Laboratory, East Hartford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 600.* 12 p. Members, $1.50; nonmembers, $2.00.

A new helicopter rotor concept, designed to reduce complexity and costs through the elimination of all hinges and bearings, has been under development for several years. The ability to achieve a true bearingless rotor is made possible through the use of the unique nonisotropic properties of fiber reinforced composite materials. Specifically, the low torsional stiffness of unidirectional composites allows the root section of a helicopter blade to be elastically twisted to achieve blade pitch control while maintaining the necessary bending stiffness. Emphasis is placed on the fundamental design features and the characteristics of composite materials and how they relate to the control and operation of the rotor. Presented also are results of composite material fatigue tests, wind tunnel tests of a dynamically scaled model rotor, correlation studies comparing rotor performance and blade stresses with theoretical results, and an aeroelastic analysis evaluating the rotor dynamic stability characteristics. (Author)

A72-34491 New hubs for multi-bladed tail rotors. F. Robinson (Hughes Tool Co., Aircraft Div., Culver City, Calif.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 602.* 10 p. Members, $1.50; nonmembers, $2.00.

This paper discusses the increasing need for multibladed tail rotors on light and medium sized helicopters. The current state-of-the-art is reviewed by describing several types of multibladed tail rotors presently in use, with particular emphasis on how each design approach compensates for the potentially powerful Coriolis torques. Also compared is the relative mechanical complexity of the various hub types and the severity of their bearing requirements. This is followed by a description and discussion of several new multibladed hubs presently being developed, including several which have been flight tested. A short appendix is included which discusses the origin of the Coriolis torques and gives simplified equations for calculating their magnitude or the freedom of motion required to relieve them. (Author)

A72-34492 Design considerations of circulation control rotors. R. M. Williams and E. O. Rogers (U.S. Naval Material Command, Ship Research and Development Center, Bethesda, Md.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 603.* 12 p. 18 refs. Members, $1.50; nonmembers, $2.00.

The concept of circulation control by means of tangential blowing about bluff trailing edge airfoils is introduced. The major aerodynamic characteristics which are applicable to rotor design are described. These include such revolutionary features as the generation of lift independent of velocity and development of efficiencies comparable to present airfoils but at much higher lift coefficients. The application of these new airfoils to a rotor having no mechanical cyclic control is next discussed, and it is shown that a broad range of applications are possible. Significant improvements in rotor thrust capability, hover efficiency, cruise efficiency, and weight efficiency are predicted. A very high speed helicopter design and a heavy lift helicopter design are used to illustrate the operational improvements which may be expected with the circulation control concept. (Author)

A72-34493 Exploration of aeroelastic stability boundaries with a soft-in-plane hingeless-rotor model. J. E. Burkam and W.-L. Miao (Boeing Co., Vertol Div., Philadelphia, Pa.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 610.* 9 p. 5 refs. Members, $1.50; nonmembers, $2.00.

The air resonance aeroelastic stability boundaries of a soft-in-plane, hingeless-rotor helicopter were explored using both an 18-degree-of-freedom analysis and a Froude-scaled, 28-inch-diameter rotor model. Correlation between analytical results and test data was excellent in terms of stability boundaries, mode shapes, and frequencies, thus lending credibility to both. Some physical insights of the air resonance phenomenon were gained with both the analysis and the test. Sensitivity of the air resonance stability to some pertinent design considerations such as the precone of the feathering axis, control system flexibility, and blade in-plane damping was investigated. Again, the analytical trends agreed well with the test findings. Based on these sensitivities and the insight into the nature of the air resonance mode, some important design recommendations are made. (Author)

A72-34494 **Hingeless rotor - Experimental frequency response and dynamic characteristics with hub moment feedback controls.** W. A. Kuczynskii, G. J. Sissingh (Lockheed-California Co., Burbank, Calif.), and D. L. Sharpe (U.S. Army, Army Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 612.* 16 p. 5 refs. Members, $1.50; nonmembers, $2.00.

Research conducted to obtain experimental hingeless rotor frequency response data and to determine the stability and response characteristics of hingeless rotors with hub moment feedback controls is reported. The test model (a four-bladed, 7.5-ft-diameter rotor) was equipped with an electronic hub moment feedback control system. The rotor pitching and rolling moments are formed from the four rotating blade flapping moments which are sensed with strain gages and resolved into stationary coordinates by means of a sine-cosine (of angular velocity) potentiometer. These moments constitute the feedback signals to uncouple first order lag pitch and roll control filters which have variable gains and time constants. Results of model tests in both open and closed loop modes at advance ratios from 0.29 to 1.44 and natural flapping frequencies from 1.33 to 2.32 times the rotor angular velocity are discussed. (Author)

A72-34495 **Determination of airfoil and rotor blade dynamic stall response.** F. O. Carta, G. L. Commerford (United Aircraft Fluid Dynamics Laboratory, East Hartford, Conn.), and R. G. Carlson (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 613.* 19 p. 16 refs. Members, $1.50; nonmembers, $2.00.

Measurements were made of the unsteady lift and pitching moment on an NACA 0012 airfoil model oscillated both sinusoidally and nonsinusoidally over a range of incidence angles, including a substantial penetration into stall. The sinusoidal lift and pitching moment data were reduced and tabulated as functions of the angle of attack, the angular velocity parameter, and the angular acceleration parameter. This generalized form of the data was used to reconstruct the measured sinusoidal aerodynamic response of the model airfoil with excellent results. Additional correlations were made using nonsinusoidal pitch schedules. The agreement between predicted and measured lift and moment loops was very good. Correlation studies were also performed on the NH-3A helicopter rotor by introducing the tabulated unsteady aerodynamic data into the Normal Modes Blade Aeroelastic Analysis. Significant improvements in correlation between predicted and measured blade response were obtained compared with previous correlations. (Author)

A72-34496 **Parametric studies of instabilities associated with large, flexible rotor propellers.** R. A. Johnston (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 615.* 15 p. Members, $1.50; nonmembers, $2.00.

A parametric study of rotor propeller instabilities has identified important effects of blade inplane and out-of-plane motions on stability. Blade flapping was found to have a stabilizing influence on backward whirl instabilities but destabilized forward whirl instabilities involving blade inplane motion. Flapping also causes a forward whirl instability when the flapping frequency is less than 1.12 per rev. Blade inplane motions were also found to have a detrimental effect on system stability. For any system with a given inplane natural frequency there exists a flapping frequency which results in minimum nacelle stiffness for stability. Absolute minimum stiffnesses are obtained when the inplane frequency is greater than one per rev. and the flapping frequency is equal to 1.12 per rev. (Author)

A72-34497 **The wake geometry of a hovering helicopter rotor and its influence on rotor performance.** A. J. Landgrebe (United Aircraft Research Laboratories, East Hartford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 620.* 16 p. 9 refs. Members, $1.50; nonmembers, $2.00. Grant No. DAAJ02-69-C-0056.

Systematic model rotor performance and wake geometry data were acquired to evaluate the influence of wake geometry on rotor hover performance. Analysis of the wake data resulted in (1) the development of a simple generalized representation of the near wake which facilitates the rapid estimation of realistic wake geometries for a wide range of rotor designs and operating conditions and (2) the discovery of a reduction in wake stability with increasing distance from the rotor. The results of a theoretical method for predicting the wake geometry are also presented. Results of a prescribed wake analysis for predicting rotor hovering performance show that the incorporation of a realistic wake geometry provides significantly improved predictions of rotor performance characteristics. (Author)

A72-34498 **The nemesis of the trailed tip vortex - Is it now conquered.** R. P. White, Jr. and J. C. Balcerak (Rochester Applied Science Associates, Inc., Rochester, N.Y.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 624.* 13 p. 17 refs. Members, $1.50; nonmembers, $2.00. Grant No. DAAJ02-71-C-0036; Contracts No. N00014-69-C-0169; No. N00014-71-C-0026.

A recent experimental research program was conducted by the authors in which the outer section of an UH-1D helicopter blade was modified to incorporate a system for injecting the tip vortex produced by the blade with a mass of linearly-directed air. The effects of nozzle geometry, the velocity of injection, the turbulence wavelength, and the angle of injection on the resulting strength of the trailed tip vortex are presented in terms of quantitative measurements of the circulation strength as a function of the injected mass of air. Data obtained from flow-visualization studies in which illuminated helium bubbles, smoke and tuft grids were used are also presented. (Author)

A72-34499 **Flight test evaluation of a forward looking radar system for search and rescue applications.** F. J. Winter, Jr. (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio) and B. Schneckenburger (United Aircraft Corp., Norden Div., Norwalk, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 633.* 9 p. Members, $1.50; nonmembers, $2.00.

A requirement for a terrain avoidance/terrain following radar system was established by MAC ROC 19-70, July 1971. This requirement was specifically directed at expanding the existing ARRS night recovery capability to include low level flight in hostile territory through mountainous terrain under adverse weather conditions. An existing radar system, compatible with rotary wing aircraft, is being evaluated to establish performance parameters that will satisfy the required capability. The flight test effort is divided into two phases. Phase one consists of radar system alignment, calibration checks, and verification of design assumptions. The second phase will measure the degree of improvement in night recovery effectiveness. In addition, the man/display interface is under investigation to determine optimum symbology presentation for the night rescue mission. (Author)

A72-34500 **Maneuverability - Theory and application.** C. D. Wells and T. L. Wood (Bell Helicopter Co., Fort Worth, Tex.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 640.* 13 p. 14 refs. Members, $1.50; nonmembers, $2.00.

This paper discusses two aspects of helicopter maneuverability: the ability to change the direction of flight or accelerate within the

constraints imposed by available power and energy, and the rotor's ability to produce the thrust required to maneuver. Of particular interest are analytical predictions and flight measurements of high-speed maneuver capabilities which exceed by a considerable margin the traditional limitations set by retreating blade stall.
(Author)

A72-34501 **Helicopter stability derivative extraction and data processing using Kalman filtering techniques.** J. A. Molusis (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 641.* 23 p. 7 refs. Members, $1.50; nonmembers, $2.00.

A method is presented for extracting a six degree-of-freedom helicopter stability derivative model from flight test data. The requirements to obtain accurate derivatives are analyzed, and three problem areas unique to helicopter derivative extraction are identified. First it is established that more than one maneuver is required to properly excite all modes. A maximum likelihood algorithm is developed to process any number of maneuvers simultaneously. Second it is established that a unique six degree-of-freedom stability derivative model does not exist for helicopters. Proper interpretation of the derivative model must be made in order to yield meaningful derivatives. Third, the presence of rotor in-plane vibratory modes and high frequency rotor transients causes significant levels of process noise and thus requires special consideration.
(Author)

A72-34502 * **An experimental investigation of STOL longitudinal flying qualities in the landing approach using the variable stability X-22A aircraft.** J. M. Schuler, R. E. Smith, and J. V. Lebacqz (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 642.* 13 p. 12 refs. Members, $1.50; nonmembers, $2.00. FAA-USAF-NASA-sponsored research; Contract No. N00019-71-C-0044.

The first in-flight flying qualities experiment using the variable stability X-22A aircraft investigated longitudinal flying qualities requirements for STOL aircraft in terminal area operations. Emphasis was placed on defining minimum requirements for the short-term response in VFR and IFR landing approaches at representative steep STOL approach conditions of 65 and 80 knots. Evaluation flights were conducted in negligible and moderate turbulence for a wide range of short-term frequencies and dampings. The results were compared with the short-term requirements of MIL-F-83300. The specified Level 1 and 2 VFR boundaries were found to be approximately valid in moderate turbulence for both VFR and IFR flight conditions. In negligible turbulence, the specified VFR Level 2 boundary was also approximately valid but the Level 1 boundary was found to be too stringent. Pilot rating gradients with damping were more apparent than with frequency for the range investigated.
(Author)

A72-34503 **A review of MIL-F-83300 for helicopter applications.** D. L. Green (PACER Systems, Inc., Arlington, Va.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 643.* 12 p. 12 refs. Members, $1.50; nonmembers, $2.00.

In 1970 an original flying qualities specification for V/STOL aircraft was developed, and a Background Information and User Guide (BIUG) was subsequently issued in support of this specification. This paper represents a brief critical review of the specification and supporting BIUG as they apply to helicopter missions and designs. In some cases, sample data, piloting techniques, and mission requirements are included to frame arguments and substantiate findings. The paper concludes that the specification is generally unsatisfactory for application to Navy helicopter designs. A final suggestion is that MIL-H-8501A be rewritten to reflect the current level of knowledge in the helicopter flying qualities requirement area as part of a continuing program of requirement revision and update.
(Author)

A72-34504 * **A pilot's opinion - VTOL control design requirements for the instrument approach task.** J. M. Patton, Jr. (NASA, Langley Research Center, Research Aircraft Flight Div., Hampton, Va.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 644.* 7 p. 6 refs. Members, $1.50; nonmembers, $2.00.

This paper presents pilot opinion supported by test data concerning flight control and display concepts and control system design requirements for VTOL aircraft in the instrument approach task. Material presented is drawn from research flights in the following aircraft: Dornier DO-31, Short SC-1, LTV XC-142A, and Boeing-Vertol CH-46. The control system concepts and mechanizations employed in the above aircraft are discussed, and the effect of control system augmentation is shown on performance. Operational procedures required in the instrument approach task are described, with comments on need for automation and combining of control functions.
(Author)

A72-34505 **Helicopter/ship interface testing.** H. W. Lineback and R. Parkinson (U.S. Navy, Naval Air Test Center, Patuxent River, Md.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 650.* 10 p. Members, $1.50; nonmembers, $2.00.

Visual landing aids for a safe launch and recovery, and a rating scale are discussed as ingredients of a coordinated helicopter/ship approach, landing and takeoff operation. It is suggested that the standard lighting configuration of the DLG-26 class destroyer be evaluated for the application to other ship classes of nonaviation types. Matching of particular types of helicopters and ships for joint operations is considered. Details are given on the effects of wind speed and direction, atmospheric visibility, ship's motion and the pilot's field of view on the launch and recovery envelope. More tests are believed to be necessary for determining the dynamic interface operating limitations for specific ship and helicopter classes operating in pairs.
V.Z.

A72-34506 **The world speed records of the SA 341 - Gazelle.** R. Mouille (Aérospatiale, Marseille, France). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 651.* 18 p. Members, $1.50; nonmembers, $2.00.

On the 13th and 14th May 1971 the SA 341 'Gazelle' established new speed records in the light helicopter category, increasing the previous records by 13 to 15 per cent. The maximum speed reached was 194.2 mph. This result was fairly quickly attained after a few tests in the wind tunnel and two weeks' preliminary flight testing. The speed value obtained results solely from the equilibrium established between the drag of the aircraft and the propulsive force of the rotor; the fineness ratio of 3 corresponding to these records is good for a pure helicopter of small size. The lessons drawn from the tests carried out on this occasion made it possible to define a faster version of this aircraft and opened new prospects of research to be undertaken to achieve new progress.
(Author)

A72-34507 **Results of the reliability and maintainability demonstration of the OH-58A light observation helicopter.** J. A. Gean and J. H. Ringgold (Bell Helicopter Co., Fort Worth, Tex.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 652.* 10 p. 8 refs. Members, $1.50; nonmembers, $2.00.

This paper presents the history of the OH-58A development, identifying those programs, actions, and decisions which ensured that the OH-58A would meet its contractual reliability and maintainability guarantees. Predicted RM values are compared with test values at various stages of the OH-58A development and with contractual requirements. These are related to the program schedule of events whose RM significance is discussed. Finally, the significance of the OH-58A RM activities in providing guidance for RM tasks in future helicopter developments is evaluated. Failure rates and maintenance manhours per flight hour obtained from detailed monitoring of the test helicopters are tabulated, showing failure rates based on all maintenance actions, on failures only, and on failures which caused mission aborts. Unscheduled maintenance manhours per flight hour are examined for each helicopter subsystem and for the complete helicopter. (Author)

A72-34508 Reduction of noise and acoustic-frequency vibrations in aircraft transmissions. R. H. Badgley (Mechanical Technology, Inc., Latham, N.Y.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 661.* 11 p. 8 refs. Members, $1.50; nonmembers, $2.00. Army-supported research.

This paper presents the results of calculations of the vibration response to spiral-bevel mesh-induced disturbances for the spiral-bevel gearshafts in the Boeing-Vertol CH-47 forward rotor gearbox and the Bell UH-1D main rotor-drive gearbox. The calculations indicate logical reasons why noise is generated by these gearboxes at the bevel mesh frequencies and also the effects of typical shaft-bearing system design changes which may be useful for noise reduction at those frequencies. Comparison of predicted vibration amplitudes with measured values can be expected to yield both a qualitative understanding of the noise problem and also verified solution techniques which can be applied to other designs. (Author)

A72-34509 The starting of turbine engines in helicopters. B. Liff and R. B. Bossler, Jr. (Kaman Aerospace Corp., Bloomfield, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 662.* 8 p. Members, $1.50; nonmembers, $2.00.

The starting of turbine engines in helicopters is discussed in terms of overall starting systems weight and service behavior. A method is described of using engine specification information to calculate the starting power which must be supplied by the engine user. Electric starting systems are discussed including the relationship among the engine, starter and battery systems and some system limitations. Calculated starting power is shown for 15 current and 3 projected engines. Starting system design as affected by engine design, starter and battery characteristics, and minimum expected temperature, is discussed. Starting system weight vs starting power is given, indicating gains to be made by a rational coherent approach. (Author)

A72-34510 Application of boron/epoxy to the CH-54B Skycrane helicopter. R. T. Welge (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 670.* 10 p. Members, $1.50; nonmembers, $2.00.

The feasibility and practical soundness of the use of boron/epoxy hybrid components in primary structures of this helicopter were investigated in a series of thermal stress, shear and compression, tension/strain and fatigue tests. Details are given on a tapered composite joint design, procedures for incorporating hybrid structures into an existing aircraft, static and fatigue behavior of reinforced elements, and the structural integrity of composite units. According to preliminary estimates, a 70% saving in stiffening weight can be obtained with boron/epoxy reinforcing elements as compared to the all-metal structure of the CH-54B tail cone. V.Z.

A72-34511 Full scale airframe fatigue testing of the CH-46. R. E. Bainbridge (Boeing Co., Vertol Div., Philadelphia, Pa.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 671.* 10 p. Members, $1.50; nonmembers, $2.00.

A fatigue test on a full size CH-46 Sea Knight airframe was conducted to establish the fatigue capability of a structurally modified aft pylon. Hydraulic actuators applied simultaneous vertical, lateral, and longitudinal forces at each rotor head of the suspended airframe. Data were collected relating to modes of failure, crack propagation, malfunction rates, service life, and flight safety. In 150 hours of accelerated testing, 181 airframe fatigue cracks were identified. Static loads were applied periodically to demonstrate safety-of-flight. The suspension system was developed to minimize undesirable coupling with the test article. Test loads were related to the mission profile, flight test data, and test article strain distributions. (Author)

A72-34512 Prevention of fretting fatigue. G. L. Rodriguez and H. M. Lawton (Bell Helicopter Co., Fort Worth, Tex.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 672.* 8 p. 10 refs. Members, $1.50; nonmembers, $2.00.

This paper presents the results of an investigation of the use of the barrier approach to mitigate fretting. The test program, its origin, and application of the results are given. It is shown that detrimental effects of fretting can be eliminated by use of a suitable barrier. An example of a production helicopter part is given where the fatigue life of the part is increased by over three orders of magnitude. (Author)

A72-34513 Achieving fail safe design in rotors. D. M. Field, R. H. Finney, and W. K. Stratton (Boeing Co., Vertol Div., Philadelphia, Pa.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 673.* 7 p. Members, $1.50; nonmembers, $2.00.

Fail-safety is a design approach which provides for the unpredictable. It requires designs which continue to function with partial failures, incorporate methods of detecting incipient failures, and provide accurate prediction of remaining life at detection. This paper discusses several means of meeting these requirements for safe rotor blades. The discussion covers the following subjects: a review of metal blades, a review of glass composite blades, a review of combinations of glass composite and metal blades, failure modes and means of detection, and a summary of fail-safe design approaches. (Author)

A72-34514 Ballistic-damage-tolerant composite flight control components. L. A. Fry and S. Pociluyko (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.). *American Helicopter Society, Annual National Forum, 28th, Washington, D.C., May 17-19, 1972, Preprint 674.* 6 p. 5 refs. Members, $1.50; nonmembers, $2.00.

Description of lightweight ballistic-damage-tolerant flight control components made from fiberglass-reinforced composite material. These components incorporate a multipath load capability, are designed to function in spite of ballistic hits from small arms, and are intended to replace metal components so as to improve aircraft survivability. Methods of manufacturing these components are described, with emphasis on verification and environmental testing as well as repeatability in production. (Author)

A72-34558 Jurisdictional problems in the autopsy of aircraft accident victims. O. C. Lilienstern (U.S. Armed Forces Institute of Pathology, Washington, D.C.). *Aerospace Medicine,* vol. 43, June 1972, p. 675-678. 14 refs.

A72-34741 **S-3A Viking systems.** C. M. Gilson. *Flight International,* vol. 101, June 22, 1972, p. 906-909.

Discussion of how the Lockheed S-3A carrier-borne Viking nuclear submarine hunter demonstrates the importance of systems integration in a modern, electronically 'rich' military aircraft. Apart from the human element, the Univac 1832 general-purpose digital computer is the center of the entire avionics systems in the Viking. The software is divided into operational, test, and weapon system support categories. Operational programs are those that provide tactical and long-range navigation data and steering commands for the four-man crew. Test programs determine the operational readiness of the avionics systems and locate malfunctions. Weapon-system support includes preflight and postflight programs, the latter for assembly of data and its ultimate analysis. The various equipments are individually described. F.R.L.

A72-34744 # **Study of circular arc airfoils with asymptotic critical Mach number. I (Studio dei profili alari ad arco di cerchio con numero di Mach asintotico critico. I).** S. Nocilla. *Torino, Accademia delle Scienze, Classe di Scienze Fisiche, Matematiche e Naturali, Atti,* vol. 106, May-June 1972, p. 307-315. 11 refs. In Italian.

Review of preliminary numerical results obtained for the circular arc airfoil with asymptotic critical Mach number using a procedure suitable for solving the direct problem of transonic airfoils by the hodograph method. Formulas are presented which, through application of the transonic similarity rule, make it possible to calculate from the solution obtained on the hodograph plane the local Mach numbers on the physical plane for various values of the airfoil thickness parameter, as well as the values of the various critical Mach numbers for each such value of the thickness parameter. A.B.K.

A72-34745 # **Study of circular arc airfoils with asymptotic critical Mach number. II (Studio dei profili alari ad arco di cerchio con numero di Mach asintotico critico. II).** B. Gabutti (CNR, Laboratorio di Analisi Numerica, Pavia, Italy). *Torino, Accademia delle Scienze, Classe di Scienze Fisiche, Matematiche e Naturali, Atti,* vol. 106, May-June 1972, p. 351-369. 8 refs. In Italian.

Description of the numerical algorithm employed for the solution of the boundary value problem with a moving boundary to which an aerodynamic problem involving a circular arc airfoil is reduced. Using the finite-difference method, a problem with a fixed boundary is solved, and the solution obtained is used in solving the initial problem by an iterative method. The results obtained are presented in the form of numerical tables and graphs pertaining to the various iterations. A.B.K.

A72-34812 # **The use of airborne magnetic tape recorders for fatigue life monitoring.** C. G. Peckham (Technology, Inc., Dayton, Ohio). *Society for Experimental Stress Analysis, Spring Meeting, Cleveland, Ohio, May 23-26, 1972, Paper.* 15 p.

Consideration of the possibility of monitoring aircraft for fatigue damage with the aid of onboard magnetic tape recorders. Available recorders which satisfy some of the requirements desired in such instruments are reviewed, and the possibility of determining the remaining life of an aircraft from the reported usage and a sample of recorded data is assessed. Available devices that might be used to replace usage forms are described, noting the advantage of recording strain data along with the usual flight parameters. It is concluded that the ideal solution to the fatigue monitoring problem is a combination of magnetic tape recorders and some device that can be used to monitor strain only. A.B.K.

A72-34926 # **Helicopters - A world wide view of the 80's.** *Aircraft Engineering,* vol. 44, June 1972, p. 4-8.

Outline of the views of the Bell Helicopter Co., VFW Fokker, Mitsubishi Heavy Industries Ltd., SIAI Marchetti, Sikorsky Aircraft Division, and Westland Helicopters Ltd. concerning the use of helicopters in the near future. The helicopter industry is attempting to increase the awareness of the general aviation field to the capabilities of its machines. The design philosophy for the future will have an order of priorities (maintainability, reliability, maneuverability) resulting in optimum availability. Some current research is focused on a high speed compound helicopter. High speed helicopters are now feasible by adopting advanced technologies. The helicopter remains the only VTOL that can carry a payload safely, reliably, and under full control at speeds from hovering to more than 200 mph. Progress is being made in the development of new airfoils for the rotor blades. F.R.L.

A72-34927 # **RS 360 turboshaft engine.** *Aircraft Engineering,* vol. 44, June 1972, p. 9-11.

Description of the RS.360 engine, designed for the Westland Lynx helicopter and using state-of-the-art technology. Particular emphasis is placed on multiengine applications. A two-spool gas generator layout was chosen for overall mechanical simplicity and to provide a good acceleration characteristic over the whole speed range. An important feature of the engine is the use of a modular concept permitting the replacement of major assemblies without the need for sophisticated equipment. F.R.L.

A72-34928 # **Evolution of the hydrofluidic liquid SAS.** R. A. Evans (Honeywell, Inc., Minneapolis, Minn.) and G. W. Fosdick (U.S. Army, Mobility Research and Development Laboratory, Fort Eustis, Va.). *Aircraft Engineering,* vol. 44, June 1972, p. 12-16. 8 refs.

Development of a hydrofluidic stability-augmentation system (SAS) which can be integrated into a helicopter primary control system, offering improved reliability, maintainability, and reduced cost. The SAS demonstrated that it could decouple external cross-coupling disturbances, made possible more precise flight, did not affect turn coordination, and stabilized the phugoid mode. Oil temperature did not adversely affect performance over the operating range encountered. The system stabilized the UH-1C helicopter in a manner comparable to or better than the mechanical stabilizer bar. F.R.L.

A72-34929 # **Maintenance of the 747. II - BOAC.** *Aircraft Engineering,* vol. 44, June 1972, p. 17, 20, 21.

Discussion of BOAC maintenance procedures for the 747 which make use of a series of planning committees, the activities of which embrace the whole sphere of aircraft maintenance and overhaul. Hangars and ground facilities are described. BOAC participated with US airlines in forming the 747 maintainability committee and represented European 747 operators on the steering group. AIDS and engine health monitoring, engine oil system maintenance, maintenance checks, maintenance manpower, structural inspection, and modifications are discussed. F.R.L.

A72-34937 # **Developments in vacuum braze coating of aero-engine nozzle guide vanes.** L. J. Malcolm (Edwards High Vacuum, Ltd., Crawley, Sussex, England). *Welding Journal,* vol. 51, July 1972, p. 483-488.

A nickel-base alloy containing 20% chromium and 10% silicon (CM60) was used for vacuum braze coating of first- and second-stage high-pressure nozzle guide vanes made of the X-40 cobalt-based and CI023 nickel-based alloys, respectively. Laboratory test data and engine operational experience show that the CM60 alloy is of particular benefit on CI023 nickel-alloy vanes where it has exhibited good resistance to hot corrosion and thus effectively reduced

mid-chord cracking. It has also shown sufficiently good oxidation resistance to reduce surface degradation in many instances, thereby minimizing grain-boundary cracking effects at the trailing-edge sections. The CM60 coating on the cobalt-alloy vanes protected from surface erosion and oxidation in most cases, but sometimes it exhibited an insufficiently high remelt temperature to withstand the extremely high operational temperatures. T.M.

A72-35220 Ranging signals for aeronautical satellite systems (Entfernungsmesssignale für aeronautische Satellitensysteme). H. D. Lüke (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Archiv für Elektronik und Übertragungstechnik,* vol. 26, June 1972, p. 245-249. 17 refs. In German.

Distance measurements in the presence of white Gaussian noise are discussed, giving attention to an approach reported by Woodward (1964) for the estimation of optimum values regarding the travel time of the signal. Various types of ranging signals are compared, taking into account pulse signals, pseudo-noise pulse compression signals, FM pulse compression signals, CW ranging signals, sinusoidal tone ranging signals, digital tones, binary optimum ranging, and pseudo-noise pulse sequence signals. G.R.

A72-35229 # Rarefied hypersonic flow characteristics of delta wings and trailing edge spoilers. J. Allegre, D. Lartigue, and M.-F. Scibilia (CNRS, Laboratoire d'Aérothermique, Meudon, Hauts-de-Seine, France). *AIAA Journal,* vol. 10, July 1972, p. 900-905. 20 refs.

The present experimental research provides aerodynamic characteristics of delta wings located in a rarefied hypersonic air flow at various angles of attack. Trailing edge spoiler effects are recorded and induced boundary layer separations are investigated. The flow is characterized by a Mach number of 8.1 and a freestream Reynolds number of 2200/cm, simulating roughly a flight altitude of 40 miles. Results include drag and lift coefficients at incidences up to 50 deg, wall pressure data along the wing center-line, and external flow probing. Visualizations, obtained by means of glow discharge and oil film deposit, allow definition of incident shock such as separation and spoiler induced shock location; the three-dimensional separation spreading is limited upstream from the spoiler for various wing incidences. (Author)

A72-35243 * # Effect on supersonic jet noise of nozzle plenum pressure fluctuations. R. Kushida and J. Rupe (California Institute of Technology, Jet Propulsion Laboratory, Liquid Propulsion Combustion Research Group, Pasadena, Calif.). *AIAA Journal,* vol. 10, July 1972, p. 946-948. 6 refs.

Demonstration that pressure fluctuations in the plenum chamber to a supersonic nozzle can strongly increase the noise radiated from the jet plume. The correlation shows that jet noise acoustic efficiency increases from 0.3% to 0.8% (or 4 dB) when the chamber roughness intensity increases from essentially no plenum chamber roughness to 2%. A roughness level of 2% has been observed in some turbojet engines. It is concluded that the reduction or elimination of plenum chamber pressure fluctuations may be an important method of reducing the total noise from jet engines. F.R.L.

A72-35251 # Unified area rule for hypersonic and supersonic wing-bodies. W. H. Hui. *AIAA Journal,* vol. 10, July 1972, p. 961, 962.

The Malmuth hypersonic area rule is based upon analysis that is restricted to hypersonic flow past wing-body configurations at small incidence. Moreover, the conically subsonic flow region, on which the conical body is added, is assumed as a small portion of the wing. The presented paper extends the Malmuth area rule by showing that the area rule governing the total force applies for both hypersonic and supersonic flow with an attached shock wave past a delta wing with the addition on its compression side of a conical body of arbitrary shape. D.F.L.

A72-35257 # Vortex induced wing loads. L. T. Filotas (Maryland, University, College Park, Md.). *AIAA Journal,* vol. 10, July 1972, p. 971. 5 refs.

Discussion of a procedure for calculating the span loading of an elliptic wing in an incompressible flow. Essential in the procedure are explicit expressions for the Fourier coefficient which are obtained by a method proposed by the author (1971). The procedure is proposed as a simpler and more convenient alternative to a procedure used by Jones (1972) who applied the lifting line theory. V.Z.

A72-35258 * # Computation of transonic flow about finite lifting wings. P. A. Newman and E. B. Klunker (NASA, Langley Research Center, Loads Div., Hampton, Va.). *AIAA Journal,* vol. 10, July 1972, p. 971-973. 8 refs.

The results of Murman and Krupp (1971) are used to develop a procedure for computing a transonic flow about a finite lifting wing. A small disturbance equation describing the velocity potential of three-dimensional wings is solved in the process. The procedure is applied to a wing with a symmetric biconvex airfoil section in a zero-incidence subsonic flow, to a supersonic rectangular lifting wing with a sharp leading edge and to a subcritical nonlifting rectangular wing with a blunt leading edge. V.Z.

A72-35281 The integration of composite structures into aircraft design. M. E. Waddoups, S. K. Jackson, and C. W. Rogers (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *Journal of Composite Materials,* vol. 6, Apr. 1972, p. 174-190. 9 refs.

Review of some of the problems expected to arise in the design of advanced aircraft from large-scale application of composite material structures. It is shown that composites, which differ significantly from conventional aircraft materials, are bound to affect every facet of aircraft design. Following a review of the design process and the variety of levels it is to encompass for achieving optimum overall results, the interaction of aerodynamic configuration parameters with structural parameters is examined. The impact of composite materials upon aircraft configuration and structural integrity is illustrated in a presented design example of a lightweight aircraft. M.V.E.

A72-35324 Engine condition monitoring - The Pan Am approach: Phase II. H. J. Moss (Pan American World Airways, Inc., New York, N.Y.). *Shell Aviation News,* no. 407, 1972, p. 7-9.

Discussion of a computer program to improve engine monitoring techniques. The data from each engine is fed into a computer, corrected to standard day conditions, and then printed in graphic form. The program uses nine parameters on the JT9D engine, and eight parameters each on the JT3D, JT8D, and JT4A engines. These parameters are displayed on a vertical graph. When a parameter deviation is noted, the engine is immediately put on an alert status. One of the prime advantages of using engine condition monitoring is that it is not necessary to wait for a malfunction before taking corrective action. F.R.L.

A72-35325 SIMBAT - An advanced general aviation trainer. R. P. Terry (Oxford Air Training School, Oxford, England). *Shell Aviation News,* no. 407, 1972, p. 14-19.

Description of a simulated blind approach trainer (SIMBAT) whose primary task is to enable students not requiring a full approved instrument flying course to obtain their instrument rating more quickly. The basic concept of the unit is electromechanical via suitable systems of linkages and levers. For radio aids simulation, a well tried analog system using transistorized amplifiers and servos was employed, emphasis being placed on simplicity and economy in the use of components. A prime requirement for SIMBAT was that its cockpit should resemble that of an actual aircraft. The configuration of the Piper Twin Comanche cockpit was chosen. F.R.L.

A72-35327 # **Better marks on pollution for the SST.** A. Ferri (New York University, New York; Advanced Technology Laboratories, Inc., Jericho, N.Y.). *Astronautics and Aeronautics,* vol. 10, July 1972, p. 37-41.

Arguments are given against the contention that the exhaust gases of a supersonic transport or other aircraft using conventional chemical fuel could be prohibitive because of the damage to the upper atmosphere through water and nitrogen oxide pollution. Research results are cited which indicate that the water vapor produced by an SST has no positive harmful effect on the upper atmosphere. It is held that, as a consequence, the SST engine can now be investigated in terms of acceptable levels of nitrogen oxides as a pollution problem. It is shown that the nitrogen oxide contents in exhaust can be reduced to 1 or 2 parts per million by advanced technology. V.Z.

A72-35374 # **A series of aerodynamic experiments on superstall (Una serie di esperienze aerodinamiche sul superstallo).** G. Rotondi (Milano, Politecnico, Milan, Italy). *(Associazione Italiana di Aeronautica e Astronautica, Congresso, 1st, Palermo, Italy, Oct. 29, 1971.) Ingegneria,* May 1972, p. 315-322. In Italian.

Description of a series of wind-tunnel experiments designed to shed light on the effect of certain parameters of primary importance in the genesis of superstall. The problem of longitudinal centering and longitudinal static stability is briefly reviewed, and descriptions are given of the models used in the tests and of the manner in which the tests themselves were executed. The results of the tests are regarded as clearly indicating that the so-called T-tail leads invariably, regardless of the wing plan, to superstall phenomena. The tests also show the practical impossibility for the pilot to regain control of the aircraft once it has entered superstall conditions. A.B.K.

A72-35375 # **Metals in flight.** A. J. Murphy (Cranfield Institute of Technology, Cranfield, Beds., England). *Tech Air,* vol. 28, July 1972, p. 15-19, 21.

Review of aircraft structure materials contemplated for use or used since Leonardo da Vinci advocated the use of tanned leather and silk. Later pioneers of aircraft concepts recommended bamboo and wood, and, for the first powered heavier-than-air aircraft, spruce and birch were the favored airframe materials. Timber has held its position up to the end of World War I, and even as late as 1945 the all-wood-construction Mosquito bomber was still flying its combat missions. The first practical metal aircraft construction attributed to Junkers, in Germany, in 1915, led to the next phase of competition between high-tensile steels and heat-treated aluminum alloys for airframes and skins. Following a discussion of the mechanical properties of the various available grades of these materials and, in particular, of their fatigue and fracture toughness, the considerations underlying the selection of structural materials for the Concorde are reviewed. A survey of the merits of titanium and of its present and future uses in airframes concludes the lecture. M.V.E.

A72-35439 # **The air bus as the aircraft of near future. II (Der Airbus - Das Flugzeug der nächsten Zukunft. II).** V. Sheinin. *(Grazhdanskaia Aviatsiia,* no. 2, 1972.) *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 4, 1972, p. 152-158. In German. (Translation).

A72-35440 # ***Aerodynamic analysis of various flight conditions of conventional aircraft. III* - Mechanical fundamentals /Dynamics of a point mass/ (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. III - Mechanische Grundlagen /Dynamik der Punktmasse/).** F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 4, 1972, p. 161-170. In German.

A72-35441 # **Problems of the control of the maintenance process (Probleme der Steuerung des Instandhaltungsprozesses).** P. Bork (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 4, 1972, p. 183-196, 170. 9 refs. In German.

Aspects of planning the maintenance process are considered together with questions of process guidance, work distribution patterns, and time schedules. Formulas for the determination of aircraft availability are provided together with examples showing the calculation of the number of aircraft which are operational. The time required for the maintenance of an aircraft is a function of the manpower available for maintenance operations. Required statistical data and questions of an evaluation of the maintenance process are also discussed. G.R.

A72-35448 # **Aircraft design /3rd revised and enlarged edition/ (Konstruktsiia samoletov /3rd revised and enlarged edition/).** M. N. Shul'zhenko. Moscow, Izdatel'stvo Mashinostroenie, 1971. 416 p. 29 refs. In Russian.

This third edition is revised to include advances made since 1953 as well as new chapters dealing with joints between structural elements, aeroelasticity, and vibrations. Aircraft flight characteristics and operating conditions are modernized. This applies also to the design characteristics of such elements as fuselages, wings, tail surfaces, landing gears, power plants, and control systems. The discussion of the elements includes the specific requirements and loading conditions, diagrams of transverse forces and moments in bending and torsion, weight characteristics, production methods, and methods of stress analysis. V.P.

A72-35451 # ***Calculation and analysis of flight-vehicle motion*: Engineering handbook (Raschet i analiz dvizheniia letatel'nykh apparatov: Inzhenernyi spravochnik).** S. A. Gorbatenko, E. M. Makashov, Iu. F. Polushkin, and L. V. Sheftel'. Moscow, Izdatel'stvo Mashinostroenie, 1971. 353 p. 17 refs. In Russian.

The kinematic equations of motion used in various homing methods are solved in rectangular and relative polar coordinates. Methods treating a flight vehicle as a linear or nonlinear plant, which make it possible to assess the stability and quality of motion along a trajectory and about the center of mass, are outlined. Problems of optimum control and of selecting the design parameters which minimize or maximize a flight-vehicle quality criterion are formulated, together with the necessary optimality conditions of control on the basis of the maximum principle, dynamic programming, and calculus of variations. The book outlines numerical methods of integrating equations of motion, methods of calculating equilibrium flight conditions, methods of solving boundary value problems, and numerical methods of optimizing control functions in various problems of flight mechanics. Results are obtained in a form convenient for practical applications. The procedures of the individual methods are illustrated by examples. V.P.

A72-35456 # **Production of the principal elements and units of aircraft engines /2nd revised and enlarged edition/ (Izgotovlenie osnovykh detalei aviadvigatelei /2nd revised and enlarged edition/).** M. I. Evstigneev, I. A. Morozov, A. V. Podzei, A. M. Sulima, and I. S. Tsukanov. Moscow, Izdatel'stvo Mashinostroenie, 1972. 479 p. 23 refs. In Russian.

The design characteristics, operating conditions, materials, and production processes of aircraft elements are discussed. The elements considered are: shafts, disks, blades, impellers, gear wheels, turbine casings, flanges, sheet-metal units, fuselage components, combustion-chamber injectors, nozzles, manifolds, control elements, plungers, elements prepared from high melting materials, and heat releasing elements of nuclear engines. Inspection methods and methods of performing the principle technological operations are examined. V.P.

A72-35476 **Flight safety by means of redundancy (Flugsicherheit durch Redundanz).** R. Abraham (Deutsche Lufthansa AG, Hamburg, West Germany). *Flug Revue/Flugwelt International,* July 1972, p. 27-32. In German.

Redundancy concerning functional equipment in air traffic provides aspects of technological reinsurance. It also improves the punctuality of flight service and the economy of maintenance operations. The concepts of active and standby redundancy are considered. In the case of active redundancy, there are several units which provide simultaneously the desired functional services. In the case of standby redundancy, a reserve unit, which is normally not in operation, will take over the function of the device in service when it ceases to operate satisfactorily. A number of examples for redundancy in specific cases are presented. G.R.

A72-35477 **New VTOL transport aircraft designs by VFW Fokker. II (Neue VTOL-Transportflugzeug-Entwürfe von VFW-Fokker. II).** M. Lichte (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Flug Revue/Flugwelt International,* July 1972, p. 33, 34. In German.

The latest alternative projects regarding the VC180 are discussed. The projects are based on the assumption that propulsion systems providing a thrust of 20000 lbs are available. The aircraft is to have 101 seats. Allowance has been made in the arrangement of the seats and the emergency exits to ensure the rapid evacuation of the aircraft in case of emergency. A delta and a tandem configuration are discussed, giving attention to differences in the location of the fuel tanks. The wing of the delta configuration contains enough space for the required amount of fuel. In the case of the tandem configuration a tank in the fuselage had to be provided. G.R.

A72-35479 # **Transonic viscous flow around lifting two-dimensional airfoils.** J. Erdos, P. Baronti, and S. Etzweig (Advanced Technology Laboratories, Inc., Jericho, N.Y.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-678.* 27 p. 10 refs. Members, $1.50; nonmembers, $2.00. Contract No. N00014-71-C-0197.

Study of viscous-inviscid interaction effects in the analysis of flow around transonic supercritical airfoils. An indirect method, based on specification of the airfoil contour over part of the chord and the pressure distribution over the remainder, is developed. The inviscid solution is obtained by relaxation of the transonic, small disturbance equation, subject to the mixed boundary conditions at the airfoil associated with the indirect method. The viscous solution is obtained by a new implicit finite-difference technique that accounts for the occurrence of reverse flow near the wall. Several results are presented to demonstrate the significance of the singularity occurring at the intersection of the shock with the airfoil surface. The boundary layer solution is compared with available velocity profile measurements in a laminar, subsonic flow over an elliptic cylinder, both upstream and downstream of the separation point. (Author)

A72-35481 # **The inviscid flowfield of an unsteady airfoil.** W. J. McCroskey (U.S. Army, Air Mobility R & D Laboratory, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-681.* 10 p. 24 refs. Members, $1.50; nonmembers, $2.00.

Simple formulas have been developed from thin airfoil theory to describe the detailed inviscid, incompressible flow field of an unsteady airfoil with thickness and camber. The solutions allow the various physical aspects of the problem and the effects of the parameters of the unsteady motion to be identified easily. The results agree well with numerical calculations and pressure measurements. The unsteady phase lag and attenuation of the inviscid pressure gradients near the leading edge explain the dynamic delay in laminar boundary layer separation on oscillating airfoils, but not the characteristics of dynamic stall. (Author)

A72-35486 * # **The estimation of nonstationary spectra from moving acoustic source distributions.** E. McDaid and L. Maestrello (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-667.* 10 p. Members, $1.50; nonmembers, $2.00.

It is shown that the Blackman-Tukey estimation procedure provides a natural estimate of a nonstationary spectrum defined in terms of the acoustic sources. The pressure field from the moving source distribution is discussed together with the estimation procedure. The spectrum can be considered as a time-dependent partition of the variance of the pressure field over a Doppler shifted continuum of frequencies. It is found that the effect of nonstationarity on the bias and variance of the estimate is small in cases of practical interest, provided sources directionality is excluded. G.R.

A72-35505 # **Getting the horse to drink - The importance of popular appeal in designing alternatives to existing urban transportation.** D. S. Lawrence (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Urban Technology Conference and Technical Display, 2nd, San Francisco, Calif., July 24-26, 1972, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972. 7 p.

The problem of convincing the American car-loving public to exchange the automobile as a means of urban transportation for space-conserving alternatives is discussed. In view of the apparent failure of approaches to this problem which were based on two-dimensional trade-offs of time and cost, a new 'behavioral' approach, in which convenience considerations are emphasized, is proposed. The technology available for this approach is the S-65-40 helicopter (which, with 50 passengers, will cruise at 150 kts) and the turbotrains. The need for conducting comfort studies aimed at improving short-haul ride comfort is pointed out. V.P.

A72-35551 **NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972.** Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1972. 263 p. Members, $10.00; nonmembers, $13.50.

The papers deal with the latest technical developments and advances in the fields of reconnaissance, navigation, management, secondary power, solid state microwave integrated circuits, computers, and the enhancement of aircraft performance through electronics (theory and implementation).

V.P.

A72-35555 **Cobra Night Fire Control System.** R. E. Rooney (RCA, Aerospace Systems Div., Burlington, Mass.). In: NAECON '72; Proceedings of the National Aerospace Electronics

Conference, Dayton, Ohio, May 15-17, 1972.
New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 38-43.

The Cobra Night Fire Control System was a quick reaction program conceived in response to the ENSURE-100-SEA requirement to add night reconnaissance and attack capability to the AH-1G 'Huey Cobra' helicopter. This paper describes the system in detail, which includes the first LLLTV tactical application of the Silicon Intensifier Target (SIT) tube. Results of the extensive field tests and the outstanding system simplicity and reliability are discussed along with a brief review of state-of-the-art improvements. (Author)

A72-35557 Configuration and flight test of the only operational Air Force area navigation system. T. Arndorfer (USAF, Andrews AFB, Md.) and T. Hodges (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 49-55.

A72-35558 The evolution of ESG technology. R. R. Warzynski (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 56-63.

The development and current status of two electrostatic gyro (ESG) navigation systems are discussed. One is the Gimbaled ESG Aircraft Navigation System (GEANS), the other is the strapdown ESG Micro-Navigator (MICRON). The suspension of the beryllium rotor in the vacuum chamber is described, together with the spin, damp, and thermal stabilization and the spin axis attitude readout. The drift error sources of the systems are examined, and possible applications are noted. V.P.

A72-35561 Multimode flight control for precision weapon delivery. R. Quinlivan and G. Tye (General Electric Co., Aircraft Equipment Div., Binghamton, N.Y.). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 103-109. Contracts No. F33615-70-C-1172; No. F33615-71-C-1485.

Significant benefits can accrue from simple changes in control augmentation associated with the precise delivery of different types of unguided weapons, rather than designing a single augmentation system which is a compromise among all the various modes of weapon delivery. Realization of the benefits, however, requires a direct display of the particular controlled variable so that it may be observed with respect to the appropriate reference. Results from man-in-the-loop simulation of various control and display configurations are presented. Flight control requirements for air-to-ground gunnery are shown to be significantly different from those most appropriate for air-to-air gunnery from fixed-gun fighter aircraft. (Author)

A72-35562 Investigation of data rate requirements for low visibility approach with a scanning beam landing guidance system. J. D. Dillow, P. R. Stolz, and M. D. Zuckerman (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 110-117.

A72-35563 B-1 structural mode control system design considerations. A. S. Mori (North American Rockwell Corp., Los Angeles, Calif.). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 118-124.

Description of a structural mode control system (SMCS) which is being designed for the B-1 to improve ride qualities during atmospheric turbulence and terrain following. The SMCS design is based upon locating accelerometers and a small control surface near the pilot location to reduce the structural mode vibrations. A block diagram of the SMCS and various design considerations for the selection of the control system configuration are discussed. Design considerations include: simultaneous utilization of the control vane deflection and rate potentials, compromising between small amplitude threshold and large amplitude saturation nonlinear effects and compromising between complexity and performance. (Author)

A72-35564 Analysis of piloted weapon delivery. R. Rankine, R. Hovde, T. Minnich, and D. Morton (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 126-135. 20 refs.

Description of a model of the pilot-aircraft system which can relate the pilot tracking performance attainable with specific aircraft dynamics to the overall accuracy of tactical weapon delivery is required in order to realistically determine essential flight control system dynamic performance characteristics. The approach taken is to derive an expression for projectile impact error in terms of errors in the task variables which are directly under the pilot's control. Mathematical representations of the aircraft and control system dynamics, the turbulence environment, and the human pilot are used to estimate the tracking error contribution. The resulting weapon delivery model provides a mission-oriented basis for comparing the effectiveness of display, computation, and control system designs as illustrated by an F-4C example. (Author)

A72-35565 300 C rotating rectifier alternator. A. E. King (Westinghouse Electric Corp., Aerospace Electrical Div., Lima, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972.
New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 136-142. 5 refs.

Description of an alternator which is a wound field, rotating rectifier synchronous machine constructed of high temperature electrical materials capable of operating in a 300 C, 100,000-ft altitude cooling environment. The goal of the development was to establish design feasibility and experience with the materials, SiC diodes and dry-lubricated bearings. The special high-temperature capabilities of the machine are applicable to advanced supersonic aircraft where accessory cooling system requirements on the airframe must be minimized. (Author)

A72-35566 Internal engine generator application to commercial transport aircraft. H. L. Ernst and A. W. Schmidt (Boeing Co., Commercial Airplane Group, Renton, Wash.). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 143-150.

A72-35568 Sizing new generation aircraft wire and circuit breakers utilizing computer techniques. C. R. Hand (Boeing Co., Seattle, Wash.). In: NAECON '72; Proceedings of the National

Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 154-161.

A72-35574 **Multifunction microwave apertures - Concepts and potential.** M. Isaac and L. Osterman (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 197-204.

Demonstration that phased arrays are cost-effective if they are considered on a total avionics system basis. The multifunction microwave aperture (MMA) concept is a cost-effective concept. Besides solving the obvious physical problem of many avionic functions vying for the same prime aperture real estate, the MMA concept has the potential of reducing total avionics system weight and cost and at the same time providing higher reliability. (Author)

A72-35575 **The fly-by-wire systems approach to aircraft flying qualities.** R. L. Kisslinger (McDonnell Aircraft Co., St. Louis, Mo.) and R. C. Lorenzetti (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 205-210.

A72-35576 **Flight control system mechanization.** D. K. Bird (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 212-219.

The expansion of the required flight regime for new airplanes as well as other requirements relating to both direct and indirect performance benefits has increased the criticality of flight control systems. Although the use of 'fly-by-wire' techniques is a powerful tool for increasing flight control system performance, the total use of these techniques does not appear practical for some time. For this reason, a need exists to be as sure as possible that the present generation of hybrid electrical-mechanical systems are mechanized and integrated on a total system basis for maximum performance, reliability, safety, and maintainability. This paper discusses some of the present hybrid mechanical-electrical mechanizing techniques, problem areas, and presents a somewhat unique design approach to mechanize a hybrid system. This concept features the use of aerodynamic summing to separate the electrical and mechanical signal transmission paths and stresses the benefits thus obtainable by removing troublesome mechanical-electrical summing functions within the system. (Author)

A72-35577 **A stall inhibitor system for the F-111.** C. A. Anderson and J. E. Walker, III (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: NAECON '72; Proceedings of the National Aerospace Electronics Conference, Dayton, Ohio, May 15-17, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 222-226.

The F-111 airplane, like most other century series fighters, does not possess adequate aerodynamic warning of impending stall or loss of control. Consequently, the aircraft were equipped with an artificial stall warning in the form of a rudder pedal shaker. Recently, a Stall Inhibitor System (SIS) has been developed for the F-111 and tested extensively on the F-111 high-angle-of-attack simulator. The SIS is much more effective than an ordinary stall warning device in that it provides positive angle-of-attack limiting. Additionally, the SIS incorporates features to improve turn coordination at high angles of attack so as to reduce the possibility of inadvertent departure from controlled flight. Flight hardware has been fabricated and subjected to Safety-of-Flight testing. Flight testing is pending. (Author)

A72-35653 **Data generation for engineering design with advanced composites.** J. Hertz and J. D. Forest (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: Advanced materials: Composites and carbon; Proceedings of the Symposium, Chicago, Ill., April 26-28, 1971. Columbus, Ohio, American Ceramic Society, 1972, p. 19-28.

The properties of graphite-epoxy composite materials for application in aircraft and missile structural components are evaluated. The mechanical tests results are given for some high-strength graphite-epoxy systems. Anisotropy of these composites is indicated as a factor making the development of adequate elastic and strength properties in these materials more challenging than in isotropic materials. Their brittleness and the resulting high stress peaks at discontinuities are shown to complicate specimen designs. Also their laminated structures are found to influence their consolidation characteristics and their mechanical and physical properties. As a consequence, they require substantially more design data and tests than more conventional materials. V.Z.

A72-35663 **Forming and processing advanced composites.** L. W. Davis (Harvey Aluminum Co., Torrance, Calif.). In: Advanced materials: Composites and carbon; Proceedings of the Symposium, Chicago, Ill., April 26-28, 1971. Columbus, Ohio, American Ceramic Society, 1972, p. 117-132. 9 refs.

Discussion of boron-epoxy, graphite-epoxy and boron-aluminum advanced composites as potential aircraft structural materials. The tensile strength, elongation, modulus and production cost of these materials are covered. Considerations are given as to how the cost of these materials could be reduced from the present $500 to $200 per pound. Metal matrix composite production forecasts are made running in excess of 3 million pounds in 1985. V.Z.

A72-35763 **The onboard authority of the aircraft commanding officer as provided by the 1963 Tokyo Convention (Die Bordgewalt des Flugzeugkommandanten in ihrer Ausgestaltung durch das Tokioter Abkommen von 1963).** A. Rudolf. *Zeitschrift für Luftrecht und Weltraumrechtsfragen,* vol. 21, July 1, 1972, p. 151-160. 26 refs. In German.

A72-35790 # **Meteorological problems of supersonic air transport (Meteorologische Probleme des Überschallflugverkehrs).** R. Duckrow. *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 5, 1972, p. 201-205. In German.

Evaluation of the role of certain meteorological variables on the performance of supersonic aircraft. The effects of temperature, wind, turbulence, hydrometeors, ozone, and radiation on supersonic flights are considered, and recommendations are made concerning the need for improved weather prediction, in particular, for the altitudes from the transonic acceleration phase up to the cruising altitude. A.B.K.

A72-35791 # **Technical experience in operating the equipment in the IL-62 aircraft (Technische Einsatzerfahrungen des Fachbereiches Geräteausrüstung mit dem Flugzeug IL-62).** J. Lehwess-Litzmann (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 5, 1972, p. 206-208. In German.

Detailed account of the training program devised for the engineers and technicians responsible for the maintenance of the

onboard instrumentation of the IL-62 aircraft. The aircraft navigation system, the navigation computer, and the flight control system of the IL-62 are compared with those of earlier aircraft such as the Tu-134 and the IL-18. The training plan, which included training of specialists in the Soviet Union and further training at the maintenance sites in East Germany, is described in detail, and the experience gained by the maintenance personnel in handling the air data system, the navigation computer, and the flight control system is reviewed, noting a steady reduction in complaints lodged by the crews. A.B.K.

A72-35792 # **Pilot - Aircraft - Environment (Flugzeugführer - Flugzeug - Umwelt).** V. Denisov, A. Korotkov, V. Shcherbakov, and G. Shitikov. *(Grazhdanskaia Aviatsiia,* no. 12, 1971.) *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 5, 1972, p. 209-213. In German. (Translation).

Application of human engineering techniques to the problem of lightening the load on pilots and improving their efficiency by better adaptation of the cockpit characteristics to the psychophysiological capabilities of the pilots. The need for appropriate initial criteria to develop an effective human engineering model of the pilot/cockpit/environment complex is stressed. A method in which human engineering concepts are applied to the initial phase of cockpit design is described. The proposed method is based on the algorithmization of the crew activity and subsequent normalization of the work time of the crew. Among the benefits of this method is a significant reduction in the instrumentation required and a consequent improvement in the conditions of acquisition of data by the crew. A.B.K.

A72-35793 # **Tetrafluorodibromoethane - A new fire extinguishing agent in civil aviation (Tetrafluordibromäthan - Ein neues Feuerlöschmittel in der zivilen Luftfahrt).** R. Herrmann (Ministerium für Verkehrswesen, Prüfstelle für Luftfahrtgerät, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 5, 1972, p. 227-230. In German.

Comparative study of the efficiency of a number of halogen fire extinguishing agents commonly used in extinguishing fires on and in civil aircraft. Of the fire extinguishing agents considered tetrafluorodibromoethane is found to be superior to the others not only because of its higher fire quenching efficiency but also because of its greatly reduced danger of toxicity to humans, since even when used in considerable excess it does not reach a concentration level which may be regarded as dangerous to humans. A.B.K.

A72-35794 # **Flight mechanical analysis of various flight states of conventional aircraft. IV - Mechanical fundamentals /Statics of rigid bodies/ (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. IV - Mechanische Grundlagen /Statik des starren Körpers/).** F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 5, 1972, p. 231-244. In German.

Study of the statics of rigid bodies with several points of application of forces. The analysis of forces with different points of application is discussed, as well as the displacement of forces along their lines of application, and the analysis of parallel and nonparallel forces with different points of application in a single plane. The effect of a force couple on a rigid body is considered, as well as the action of arbitrary force systems on a rigid body. A.B.K.

A72-35800 # **Minimum operational characteristics for vertical guidance equipment used in airborne volumetric navigation systems.** Washington, D.C., Radio Technical Commission for Aeronautics (Document No. DO-152), 1972. 68 p. $6.00.

The need for basic characteristics for navigation and communication systems used in air traffic control is discussed together with minimum operational characteristics of the airborne system elements, equipment specifications, environmental standards, international standards, the preparation of minimum operational characteristics for airborne systems elements, and the applicability of minimum operational characteristics for airborne system elements. System characteristics for airborne vertical guidance systems are considered, giving attention to system functions, questions of applicability, functional objectives, and means of implementation. G.R.

A72-35839 **Around-the-world atomic clocks - Observed relativistic time gains.** J. C. Hafele (Washington University, St. Louis, Mo.) and R. E. Keating (U.S. Naval Observatory, Washington, D.C.). *Science,* vol. 177, July 14, 1972, p. 168-170. 12 refs. Navy-supported research.

Four cesium beam clocks flown around the world on commercial jet flights during October 1971, once eastward and once westward, recorded directionally dependent time differences which are in good agreement with predictions of conventional relativity theory. Relative to the atomic time scale of the U.S. Naval Observatory, the flying clocks lost 59 (plus or minus 10) nanoseconds during the eastward trip and gained 273 (plus or minus 7) nanoseconds during the westward trip, where the errors are the corresponding standard deviations. These results provide an unambiguous empirical resolution of the famous clock paradox with macroscopic clocks. (Author)

A72-35950 **Computer control of aircraft landing.** M. H. Hamza and W. Prater (Calgary, University, Calgary, Alberta, Canada). *Automatic Control Theory and Applications,* vol. 1, Jan. 1972, p. 18-23. 6 refs. National Research Council of Canada Grant No. A-5102.

The feasibility of using an on-line digital computer to solve the optimal tracking problem for a twentieth order realistic dynamic system is demonstrated. A large transport aircraft is adaptively controlled in the flare-out phase of landing to follow a particular trajectory. Prediction is used, also a quadratic performance criterion. (Author)

A72-35952 **Air transport and the environment /Twenty-ninth Brancker Memorial Lecture/.** A. Thomson. *Chartered Institute of Transport, Journal,* vol. 34, May 1972, p. 385-397.

The development of air traffic is discussed together with aspects of future growth, the value of air transport to the economy, the importance of the price as growth-governing factor, and arguments for environmental protection. Other subjects considered include the powers of the government to control airport use, airport location, pollution, the responsibility of the planners for the development of airports, and the trend toward quieter aircraft. Relative effects of air transport developments on economy and environment are examined, giving attention to problems caused by uncoordinated measures. G.R.

A72-35961 * # **Externally blown flap impingement noise.** T. W. Putnam and P. L. Lasagna (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-664.* 8 p. 8 refs. Members, $1.50; nonmembers $2.00.

An investigation of externally blown flap impingement noise was conducted using a full-scale turbofan engine and aircraft wing. The noise produced with a daisy nozzle installed on the engine

exhaust system was greater than that produced by a conical nozzle at the same thrust. The daisy nozzle caused the jet velocity to decay about 35 percent at the flap. The presence of the wing next to the conical nozzle increased the noise, as did increasing the flap deflection. Compared with the conical nozzle, the daisy nozzle produced slightly less noise at a flap deflection of 60 deg but produced more noise at the lower flap deflections tested. (Author)

A72-36000 # Comparison of two types of blade profile for axial-flow fans (Porownanie dwoch typow profili lopatek wentylatorow osiowych). A. Wszelaczynski. *Instytut Maszyn Przeplywowych, Prace,* no. 58, 1972, p. 49-63. 8 refs. In Polish.

A72-36040 Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. Conference sponsored by the American Society of Mechanical Engineers. Edited by C. W. Grennan (Chandler Evans, Inc., West Hartford, Conn.). New York, American Society of Mechanical Engineers, 1972. 64 p. Members, $10.00; nonmembers, $12.50.

The papers deal with centrifugal pumps for high turndown ratios, fluid machinery for air-assisted gas turbine fuel systems, inlet-throttled centrifugal pumps, and fuel pumps for aircraft gas turbine engines. Causes for unstable pump performance, means of increasing pump efficiency, the performance of gerotor lube and scavenge pumps, servo pump nozzle area controls, and a centrifugal oil filter concept are examined.

V.P.

A72-36041 Centrifugal pumps for high turn down ratio. R. L. Brown (Crane Co., Burbank, Calif.). In: Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. New York, American Society of Mechanical Engineers, 1972, p. 1-4.

It is shown that by using a movable shutter over the impeller discharge, it is possible to reduce internal circulation in the suction pipe, impeller, and volute. This reduces power input (and, therefore, temperature rise) and improves the pressure stability at low flow. The position of the shutter is controlled by the application of a pressure signal to the shutter control cylinder. V.P.

A72-36043 Fluid machinery for air-assisted gas turbine fuel systems. P. Cooper (TRW, Inc., Cleveland, Ohio). In: Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. New York, American Society of Mechanical Engineers, 1972, p. 15-20.

A single-stage 65,000 rpm centrifugal compressor, driven by a small fuel-powered hydraulic turbine, and a single-stage pad-driven 20,000 rpm rotary-lobe compressor, both designed to provide air pressure for assistance in fuel atomization, were tested. The air flow rate characteristics were found to be roughly similar. A choice between the two compressors depends on how well their characteristics match the requirements of air inlet, flow rate, and pressure rise conditions of air-assist for a specific engine. V.P.

A72-36044 Experience with inlet throttled centrifugal pumps. L. W. Manson (Dowty Fuel Systems, Ltd., Cheltenham, Glos., England). In: Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. New York, American Society of Mechanical Engineers, 1972, p. 21-27.

The problems encountered during the development of the Vapor Core Pump over a period of 17 years are discussed. It is shown that most of the basic engineering problems have been solved, and that the pump performance may be considered near optimum for Shp 200 to 400, flows 4000 to 10,000 gph, and flow range up to 60/1. Some modifications currently under consideration are described.

V.P.

A72-36048 Servo pump nozzle area controls for gas turbines. K. F. Becker (Sperry Rand Corp., Vickers Div., Troy, Mich.). In: Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. New York, American Society of Mechanical Engineers, 1972, p. 39-42.

The servo pump concept and the block diagram of a typical positional servo system employing a servo pump are discussed. Small servo valves of both the jet pipe and flapper configuration are used to demonstrate the excellent control gain and performance obtained in the control of the servo pump actuation system and nozzle area controls. Application of servo pump technology combined with either hydraulic or engine lubrication systems is shown to lead to an advanced power control concept for turbine-engine nozzle area controllers. V.P.

A72-36049 Fuel pump design considerations for aircraft gas turbine engines. D. Petro (Avco Corp., Avco Lycoming Div., Stratford, Conn.). In: Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. New York, American Society of Mechanical Engineers, 1972, p. 43-50. 7 refs.

The principal design considerations aimed at obtaining the desired operational characteristics for a composite gas-turbine fuel pump are outlined. The analysis is performed for a hypothetical main fuel pump for a military gas-turbine engine in the 10 to 30 lb/sec mass airflow range. The considerations underlying the formulation fuel-pump selection factors are outlined, and solutions to some specific problem areas are given. Fuel pump sizing relations are diagrammed, and a procedure for calculating fuel-pump temperature rise is developed. V.P.

A72-36050 The pump: Centrifugal oil filter concept - A rationale for its design and application to advanced turbine engines. J. J. Sherlock (Pure Carbon Co., Inc., St. Marys, Pa.). In: Gas turbine pumps; Proceedings of the Joint Conference, San Francisco, Calif., March 26, 27, 1972. New York, American Society of Mechanical Engineers, 1972, p. 51-60. 6 refs.

The principles of designing a centrifugal oil filter to combine the functions of a pump, a filter, and a deaerator are discussed. In addition to saving engine weight, such a package will provide excellent filtration, thereby extending the life of engine oil and of all oil-wetted engine parts. Deaeration of the lubricant will improve its heat transfer properties as well as the heat rejection of the engine.

V.P.

A72-36064 Vibration technology: Balancing flexible rotors; Conference, Technische Universität Berlin, Berlin, West Germany, March 23, 24, 1970, Summaries (Schwingungstechnik: Auswuchten wellenelastischer Rotoren; Kolloquium, Technische Universität Berlin, Berlin, West Germany, March 23, 24, 1970, Referate). Conference sponsored by the Technische Universität Berlin. *VDI-Berichte,* no. 161, 1971. 56 p. In German and English.

Directives, standards, and customary approaches for balancing flexible rotors are considered together with methods for balancing large turbine rotors, and the stability of unbalanced shafts. A comparison of various methods for balancing a flexible rotor is presented along with some comments regarding the balancing of flexible rotors. Other subjects discussed include a theoretical analysis regarding the general conditions for balancing a flexible rotor and the balancing of a flexible rotor by means of mode separation.

G.R.

A72-36375 # **Theory and experiment in vibration analysis.** F. W. Slingerland (Université Laval, Quebec, Canada). In: Experimental mechanics in research and development; Proceedings of the International Symposium, Waterloo, Ontario, Canada, June 12-16, 1972. Volume 2. Waterloo, Canada, University of Waterloo, 1972, p. 33-1 to 33-20. 8 refs. Research supported by the National Research Council.

A theory is formulated to describe the linear vibrations of flat beams from vibration mode measurements by microscopic and micrometric observations. The use of eddy currents for studying the vibrations of such beams as prototypes of turbine compressor blades is discussed. The Myklestad method and Runge-Kutta integration are used for programming a bending-torsion vibration model used in the study. A moiré technique is proposed as an approach to an analysis of deformation in such beams. A differential equation of flexural vibration is also given to determine the vibrational behavior of such beams. V.Z.

A72-36385 **Vortex breakdown.** M. G. Hall (Royal Aircraft Establishment, Farnborough, Hants., England). In: Annual review of fluid mechanics. Volume 4. Palo Alto, Calif., *Annual Reviews, Inc.*, 1972, p. 195-218. 24 refs.

Results and interpretations of various investigators concerning the breakdown of vortex cores are reviewed with particular reference to the importance of vortex breakdown in the field of aeronautics. However, breakdowns observed in swirling flows through nozzles and diffusers and in combustion chambers are also covered. The occurrence and position of breakdown, the forms of breakdown, and the analogy to separation of two-dimensional boundary layers are examined. Complementary explanatory elements of the various interpretations of breakdown are put together in an attempt to construct a framework for explaining breakdown that would cover the main gaps of the individual proposals. V.P.

A72-36390 **Wing-body aerodynamic interaction.** H. Ashley (Stanford University, Stanford, Calif.) and W. P. Rodden. In: Annual review of fluid mechanics. Volume 4. Palo Alto, Calif., Annual Reviews, Inc., 1972, p. 431-472. 113 refs. Contract No. F44620-68-C-0036.

The most effective methods of analyzing the near flow field and aerodynamic loading experienced by three-dimensional combinations of slender elements in subsonic and supersonic main streams are outlined and are demonstrated by examples. A partial survey of significant past contributions is presented. Methods for the simultaneous determination of complete flow fields for general systems are examined, and nonlinear numerical methods for supersonic flight are outlined. Particular attention is given to the kernel function method in lifting surface theory and to the method of images for predicting wing-body interference. V.P.

A72-36409 * # **Vibrations of circular elastic plates due to sonic boom.** L. J. Pavagadhi and M. D. Yajnik (North Carolina State University, Raleigh, N.C.). *Acoustical Society of America, Journal*, vol. 52, July 1972, pt. 2, p. 260-269. 14 refs. NASA-supported research.

The problem of transient axisymmetric vibrations of thin circular elastic plates due to sonic boom excitation is investigated. The equation of motion for a solid circular plate is solved by applying the modified finite Hankel transform and the Laplace transform, and the numerical results are obtained with the help of the digital computer. From the analysis of the data, obtained for the dynamic deflections of the plates for the boom duration, it is concluded that for a normal flight the boom duration has a significant effect on the vibrations of plates as compared to the overpressure of the boom. (Author)

A72-36414 # **Simple pressure source model of jet noise.** T. D. Scharton and P. H. White (Bolt Beranek and Newman, Inc., Canoga Park, Calif.). *Acoustical Society of America, Journal*, vol. 52, July 1972, pt. 2, p. 399-412. 25 refs. USAF-supported research.

The simple pressure source model of the sound radiated by a sonic jet is investigated analytically and experimentally. From the simple source model, the ratio of the frequency spectra of the radiated sound power and the jet pressure is derived for an assumed form of the jet-pressure cross correlation. The spatial variation of the overall jet pressures, the frequency spectra of the jet pressures, the axial and radial cross correlations of the jet pressures, and the cross correlation between jet pressure and farfield sound pressure are measured for a cold jet. Some implications of the simple source model with regard to noise suppression are also discussed. (Author)

A72-36417 # **Observations of acoustic ray deflection by aircraft wake vortices.** D. Burnham, R. Kodis, and T. Sullivan (U.S. Department of Transportation, Cambridge, Mass.). *Acoustical Society of America, Journal*, vol. 52, July 1972, pt. 2, p. 431-433.

Acoustic ray deflection by aircraft wake vortex flows has been observed during landing operations of large aircraft. The phenomenon has been used to detect and locate vortex traces in a plane perpendicular to the runway centerline. The maximum deflection angles observed for a variety of aircraft show qualitative agreement with values predicted for a viscous core. (Author)

A72-36503 **The quiet side of NASA.** T. Wilding-White. *Flight International*, vol. 102, July 6, 1972, p. 17-20.

Review of the magnitude and nature of recent and current work performed or sponsored by NASA in the field of noise reduction technology. Figures of NASA 1971-1973 budget allocations to experimental quiet engine and quiet STOL aircraft programs are presented. The briefly reviewed programs include the 1969 award to General Electric of a $20 million contract to supply and test a series of experimental quiet engines, the full-scale-fan acoustic tests performed at NASA's Lewis Research Center in Ohio, Boeing's engine-noise suppressing nacelle, and the currently performed and planned quiet experimental STOL aircraft design studies. M.V.E.

A72-36505 **Generation of combustion noise.** J. S. Arnold. *Acoustical Society of America, Journal*, vol. 52, July 1972, pt. 1, p. 5-12. 21 refs.

Analytical description of the generation of noise in burning fuel-air mixtures. Fluctuating pressure (noise) is shown to result when the heat release rate of the mixture passing through the reaction zone is variable with time. Experimental evidence in support of this view is presented and referenced from the literatures of acoustics and combustion. Several illustrative examples from common experience are pointed out. Premixed and diffusion flames of gas and liquid fuels are considered, and the role of flame and mixture turbulence in causing a varying heat release rate and noise is noted. The possibility appears to exist for substantially reducing the noise output of large combustion systems (jet engines, for example) by more effective control of the flame configuration and stability. (Author)

A72-36506 **Theoretical and experimental studies of the focus of sonic booms.** J.-C. L. Wanner, J. Vallee, C. Vivier, and C. Thery (Service Technique de l'Aéronautique, Paris, France). *Acoustical Society of America, Journal*, vol. 52, July 1972, pt. 1, p. 13-32. 28 refs.

Theoretical and experimental studies of the effects of accelerations and curvatures of the flight path on sonic booms. Theoretical studies of the propagation of the shock waves have helped identify the different cases of focus: linear acceleration, turn, and pushover,

and of superfocus: entry to turn. During four experimental exercises the accuracy of prediction of propagation and guidance of the airplane has shown that focus factors are higher than those expected. F.R.L.

A72-36524 # Hydraulic systems for driving helicopter tail rotors. II (Przekladnie hydrostatyczne do napedu smigiel ogonowych smiglowcow. II). B. Bolinski. *Technika Lotnicza i Astronautyczna,* vol. 27, June 1972, p. 24-26. 6 refs. In Polish.

A72-36526 Application of weld bond to aerospace structures. K. Forsberg (Lockheed Research Laboratories, Palo Alto, Calif.) and F. R. Sullivan (Lockheed Missiles and Space, Inc., Sunnyvale, Calif.). *Society of Manufacturing Engineers, Paper AD72-710,* 1972. 21 p. 10 refs. Members, $1.50; nonmembers, $2.00. Research supported by the Lockheed Aircraft Corp.; Contract No. F33615-69-C-1867.

The weld bond process of joining sheet metal parts employing a combination of resistance spot welding and adhesive bonding is described. Manufacturing process development, design feasibility studies, and structural test results are presented. The application of the weld bond process to the manufacture of thin wall cryogenic tankage, space vehicle payload fairings and aircraft fuselage structure is discussed. (Author)

A72-36529 A primer of aircraft multiplexing. *SAE Aerospace Information Report,* AIR 1207, Jan. 1972. 10 p. 39 refs.

The principles of Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) are outlined, and the major features of FDM and TDM are compared. The modulation methods used in FDM and TDM telemetry, the type of signal which can be handled by each system, and the type of cable required are reviewed. The areas of aircraft systems amenable to multiplexing are examined, using a typical military aircraft weapon system as an example. V.P.

A72-36530 Performance of low pressure ratio ejectors for engine nacelle cooling. *SAE Aerospace Information Report,* AIR 1191, Nov. 1971. 37 p. 6 refs.

A72-36532 Procedure for the continuous sampling and measurement of gaseous emissions from aircraft turbine engines. *SAE Aerospace Recommended Practice,* ARP 1256, Oct. 1, 1971. 16 p.

A72-36535 Characteristics and utilization of aircraft electric power. *SAE Aerospace Standard,* AS 1212, Dec. 1971. 33 p.

A standard is presented which outlines the characteristics of electric power supplied to airborne equipment at the equipment terminals, as well as the requirements for the utilization of the electric power by the equipment. The aim is to provide compatibility between aircraft electric systems or ground support electric systems and airborne utilization equipment to the extent of confining the aircraft and ground support electric power characteristics within definite limits, and restricting the requirements placed on the power by the airborne utilization equipment. V.P.

A72-36538 # On the prediction of acceleration response of air cushion vehicles to random seaways and the distortion effects of the cushion inherent in scale models. D. R. Lavis, R. J. Bartholomew (Aerojet-General Corp., Tacoma, Wash.), and J. C. Jones (Liquid Rocket Co., Sacramento, Calif.). *American Institute of Aeronautics and Astronautics, Society of Naval Architects and Marine Engineers, and U.S. Navy, Advanced Marine Vehicles Meeting, Annapolis, Md., July 17-19, 1972, AIAA Paper 72-598.* 23 p. Members, $1.50; nonmembers, $2.00.

A72-36561 Air/ground digital communications in airline operations. J. B. Thoren (American Airlines, Inc., New York, N.Y.). *Journal of Air Traffic Control,* vol. 14, July 1972, p. 8-11.

The evaluation of the data link (DL) system of American Airlines currently conducted by the company is discussed. Under this program a 747 aircraft was wired and equipped with a prototype DL system, a Potter instrument line printer was installed in the flight engineer's panel, and a printer with a microswitch keyboard was installed in the forward wall of the upper first class lounge. A DL control unit is used for self-testing the airborne DL installation and for displaying the system status. The ground system consists of a computer and a radio terminal at San Francisco and seven radio sites across the country to provide a limited transcontinental DL radio coverage. The first phase of evaluation, now in progress, has demonstrated the viability of air/ground digital communications. V.Z.

A72-36574 Internal noise reduction in hovercraft. D. Anderton (Southampton, University, Southampton, England). *(British Acoustical Society, Spring Meeting, Birmingham, England, Apr. 5-7, 1971.) Journal of Sound and Vibration,* vol. 22, June 8, 1972, p. 343-359. 11 refs. Research supported by the Department of Trade and Industry.

The aim of this paper is to summarize the results of several years work on the internal noise of hovercraft. The basic mechanism of noise production is described and methods for controlling it are put forward. A case history is also described. Internal noise measurements from other forms of transport are compared to those of hovercraft, and it is shown that comparatively small overall noise reductions of 4 dBA would make the internal noise the same as that of short-haul jet aircraft. Structure-borne noise is shown to be a major source of noise in at least one current production craft. Low structural damping combined with lightweight and rigidly mounted machinery are found to be the major causes of structure-borne noise. (Author)

A72-36674 Investigation of Freon fire-extinguishing systems with a nucleonic gage. A. Notea and Y. Segal (Technion - Israel Institute of Technology, Haifa, Israel). *Materials Evaluation,* vol. 30, July 1972, p. 153-156. Research supported by the Israel Aircraft Industries, Inc.

The dynamic properties of the fire-extinguishing system in an aircraft were examined using a three channel-gamma attenuation gage connected to each outlet of the system. The extinguishing agent was Freon 13B-1, and the tube internal diameter was 0.774 cm. The gamma source, Am-241, was selected by optimization of the standard deviation due to statistical counting fluctuations. The collimator arrangement allowed checking of 65% of the tube cross section. The results of mass changes with time during discharge of the system are shown. The changes of characteristic parameters - discharge time and full width half maximum time - are presented for different nozzle configurations. (Author)

A72-36771 # Analysis of a partially cracked panel. J. T.-S. Wang (Georgia Institute of Technology, Atlanta, Ga.) and T.-M. Hsu (Lockheed-Georgia Co., Marietta, Ga.). *Journal of Aircraft,* vol. 9, July 1972, p. 503-505.

Analysis of a partially cracked panel by treating it as a plane elasticity problem, the effects caused by the variation of the panel thickness being considered negligible. Solutions satisfying exactly the governing differential equations, and all but one boundary condition,

are obtained. The last boundary condition, which is one of the two conditions along the crack line, is made to be satisfied by collocation approximation. The bandwidth is then determined according to an engineering approach by considering that the panel material within the bandwidth becomes fully plastic. A numerical example based on typical C-5A panel material and geometry is included for illustrative purposes. F.R.L.

A72-36773 # **Angle of attack increase of an airfoil in decelerating flow.** T. Strand (Air Vehicle Corp., San Diego, Calif.). *Journal of Aircraft,* vol. 9, July 1972, p. 506, 507.

Determination, using inviscid theory, of the aerodynamic characteristics of a two-dimensional airfoil whose angle of attack is increasing at a constant rate and whose velocity is decreasing at a constant rate. It is shown that the predicted lift coefficient change due to inviscid flow conditions is negligible compared to the test results obtained, both for jet transports and also for helicopter rotor blades. It is concluded that the measured large increases in maximum lift coefficients in unsteady flow are associated with boundary-layer phenomena, rather than being caused by the inviscid flow. F.R.L.

A72-36774 # **Evaluation of Reissner's correction for finite span aerodynamic effects.** B. K. Donaldson (Boeing Co., Wichita, Kan.). *Journal of Aircraft,* vol. 9, July 1972, p. 507-509. 5 refs.

Investigation of the accuracy of the Reissner method (1947) for calculating the effect of finite span upon the unsteady airloads acting upon a harmonically oscillating wing. To evaluate that accuracy, the Reissner method was applied to 10 moderate aspect ratio wings. The Reissner flutter speeds that were the result of the analyses are compared to experimental flutter speeds obtained from repeated wind tunnel testing, and also to basic strip theory results. The flutter airspeed results indicate a marked improvement in analytical accuracy when the Reissner theory results are contrasted to the basic strip theory results. F.R.L.

A72-36776 **Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971.** Conference sponsored by the American Society of Civil Engineers and Airport Operators Council International. New York, American Society of Civil Engineers, 1972. 288 p. $6.00.

Public relations and the airport image, economics of a new regional airport, and effects on the environment are among the topics covered in papers concerned with the interaction of airports with their surrounding communities. Other areas covered include the impact of airports and airways legislation; design for new and existing airports; and airport safety, certification, and pavements. M.V.E.

A72-36777 # **Airports and airways system planning.** D. R. Miller (Daniel, Mann, Johnson, and Mendenhall, Los Angeles, Calif.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971.
New York, American Society of Civil Engineers, 1972, p. 7-33.

Evaluation of the impact of recent federal legislation on airport and airway system planning, and review of the current 'state of the art' of such planning. The Airport and Airway Development Act of 1970 is shown to have a fundamental effect on aviation system planning and development. The transition to systems planning is not expected to be easy. Aviation planning agencies must become familiar with the techniques of systems planning and plan their programs in harmony with prevailing budget and schedule requirements. Relationships must be established by federal, state, and local agencies with the aviation industry and the public. As examples of current state airport system planning, the South Dakota State Airport System Plan and the California Statewide Master Plan of Aviation are discussed. M.V.E.

A72-36778 # **Environmental considerations in airport development.** R. F. Bacon (FAA, Washington, D.C.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 35-48.

Discussion of approaches to problems of airport development within environmental protection constraints. As an example, a study approach used for a proposed medium sized airport to accommodate airline turbojet aircraft in southwest Puerto Rico is outlined in a manner dispelling any illusion that the required scope of evaluation is not difficult and onerous to achieve. Guidelines governing the processing of proposed airport development projects by FAA field offices are reviewed. M.V.E.

A72-36779 # **Economics of a new regional airport.** J. D. Downey (Dallas/Fort Worth Regional Airport, Arlington, Tex.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971.
New York, American Society of Civil Engineers, 1972, p. 57-71.

Review of the many factors that affect the economy of a planned airport, and discussion of the prerequisites to an effective control of these factors. Recommended measures include: total-costs encompassing estimates; liberal spending in the preparation of an effective bond sales campaign; early establishment of proper relations with all the people involved in the development and expenditure of funds for the planned airport; and careful timing of the airport construction operations in order to avoid escalation and interest on unused capital at the end. M.V.E.

A72-36780 # **What's new in airport planning.** W. M. Schoenfeld (Los Angeles Dept. of Airports, Los Angeles, Calif.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971.
New York, American Society of Civil Engineers, 1972, p. 81-86.

Description of ongoing programs of interaction with communities surrounding airports in the Los Angeles area. In this area, no 'edge of town' exists where the citizenry will not in some way be affected by the presence of an airfield, and any planned airport becomes a matter of immediate interest to the community and is subject to scrutiny and evaluation as are all other elements of community planning. It is felt that the described programs in progress are resulting in a better relationship and in a twofold benefit to both the community and the airport. M.V.E.

A72-36781 # **Redesign of the existing airport - Is it really feasible.** G. H. Ridgeway, Jr. (Atlanta Airport, Atlanta, Ga.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971.
New York, American Society of Civil Engineers, 1972, p. 87-98.

Discussion of the redesign and expansion program of Atlanta airport to relieve present congestion by an effective capacity increase using immediately available means, and review of some of the problems of planning for the more distant future. Immediate improvements considered include: reconfiguration of existing runways; addition of complementary runways, utilizing presently unused airport real estate; and modifying or relocating existing taxiway system as well as passenger and cargo terminal system to facilitate ground circulation of aircraft and to accommodate the anticipated increase in passenger and freight volume. M.V.E.

A72-36782 # **Evaluation of design criteria in view of 747 experience.** W. E. Downes, Jr. In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society

of Civil Engineers, 1972, p. 99-113.

Discussion of some of the problems encountered at Chicago-O'Hare airport in accommodating the Boeing 747 aircraft. Some of the planned changes considered to eliminate or reduce these problems are reviewed. The impact of the Boeing 747 on airport design criteria is made apparent by contrasting the requirements used in determining the characteristics of the planned changes with the normal standards of design. M.V.E.

A72-36783 # **Design of V/STOL ports.** R. J. Sutherland (American Airlines, Inc., New York, N.Y.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 115-123.

Review of a recent feasibility study of floating V/STOL airport facilities on the Hudson River, in midtown Manhattan, next to the West Side Highway. The discussion of the study covers the site, floatation structure, superstructure, passenger terminal, apron area, flight deck, ground access, and expansion possibilities. M.V.E.

A72-36784 # **Airport improvements needed for safety.** D. D. Thomas (Flight Safety Foundation, Inc., Arlington, Va.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971.
New York, American Society of Civil Engineers, 1972, p. 139-147.

Summary of the views held by the aviation community on safety problems at airports, and comparative review of the incidence and nature of aircraft accidents at airports. Discussed problems include those of vertical guidance improvements, adequate design for draining and preventing standing water on runways and taxiways, design of pavements with adequate braking coefficients, dispersing ice from runway surfaces, and foreign object damage prevention. M.V.E.

A72-36785 # **Airport certification.** C. G. Bowers (FAA, Airports Service, Washington, D.C.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 149-164.

Review of the provisions and background of the legislation authorizing and directing a program of airport certification to be implemented by FAA. The means of achieving airport safety, basic certification concepts, and minimum safety standards are discussed along with the airport operations manual and emergency plan, standards for fire and rescue service, and pavement requirements. M.V.E.

A72-36786 # **Concrete airport pavement design - Where are we.** G. K. Ray, M. L. Cawley, and R. G. Packard (Portland Cement Association, Skokie, Ill.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 183-226. 13 refs.

Four methods for designing and determining the thickness of concrete airport pavement are compared, and the requirements for each layer in the pavement system are discussed. The comparisons show that concrete pavement thicknesses derived from these methods are comparable when similar loadings, subgrade support, and subbase support conditions are used. It is concluded that concrete pavement performance is predictable within a range of known loadings and traffic conditions. The design life for comparable thicknesses varies depending on safety factors used. The need for research in five areas relating to pavement and aircraft interaction is discussed. M.V.E.

A72-36787 # **Airfield flexible pavement design - A state of the art paper.** R. W. Brandley. In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 227-240.

Review of current flexible airfield pavement designs, covering the design methods of U.S. Army and Navy, the Load Classification Number design method, the McLeod design method, the Asphalt Institute method, the Brandley method, and the Federal Aviation Administration method. It is pointed out that, considering the present state of the art, a single design can be developed for both rigid and flexible pavements, with the effects of base-course and subbase-material stabilization taken into account in this design procedure. V.Z.

A72-36788 # **Airfield pavement research trends.** R. L. Hutchinson and H. H. Ulery, Jr. (U.S. Army, Soils Div., Vicksburg, Miss.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 241-261. 24 refs.

The transition from the initial empirical and semiempirical procedures to improved analytical procedures of airfield pavement design which take into account the principal parameters affecting pavement performance is reviewed. The role of improved computational techniques in the development of sophisticated design procedures is pointed out. Application of the system approach to the development of an integrated plan for design, construction, operation, and maintenance of airfield pavements is seen to be helpful in defining areas where future research is needed most. V.P.

A72-36789 # **Industry needs - Airport pavement strength evaluation system.** R. C. O'Massey (Douglas Aircraft Co., Long Beach, Calif.). In: Airports: Key to the air transportation system; Proceedings of the Conference, Atlanta, Ga., April 14-16, 1971. New York, American Society of Civil Engineers, 1972, p. 263-291. 11 refs.

The background and contemporary approaches to the problem of evaluating airport pavements are discussed with particular reference to the needs of airlines and aircraft manufacturers. A typical data system required to support the varied needs of the aircraft manufacturer is developed, together with optional output formats that are useful in supporting aircraft design and pavement evaluation efforts. The needs of the airline/aircraft industry in airport pavement evaluation are outlined and summarized. V.P.

A72-36893 # **Hypersonic flow past wings with a Mach system of shock waves (Giperzvukovoe obtekanie kryl'ev s Makhovskoi sistemoi udarnykh voln).** A. L. Gonor and N. A. Ostapenko. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1972, p. 104-116. 5 refs. In Russian.

Gonor's (1970) theory of a triangular wing in hypersonic flow is applied to the calculation of the symmetric flow at angles of attack past a conical wing. The theoretical relations obtained demonstrate the superiority of the conical wing over triangular and other equivalent wings with respect to the optimal L/D ratio. The flow conditions involving the Mach reflection, from the symmetry plane, of a shock wave incident from the leading edge are analyzed, and the conditions for the existence of flows with convex and concave waves are established. V.P.

A72-36900 # **Calculation of an unsteady separation flow past a slender profile (K raschetu sryvnogo nestatsionarnogo ob-**

tekaniia tonkogo profilia). S. M. Belotserkovskii and M. I. Nisht. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1972, p. 177-182. 7 refs. In Russian.

A72-36942 **Special control of spiral flight curves with the neutral and maneuver points as ultimate positions of the indifference points (Eine spezielle Steuerung der Spiralflugkurven mit Neutral- und Manöverpunkt als Grenzlagen der Indifferenzpunkte).** H. Stümke (Stuttgart, Universität, Stuttgart, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 20, June 1972, p. 237-241. In German.

It is assumed that along a spiral curve both the sideslip angle and the bank angle of the wind axes system are fixed to suitably chosen values. For further simplification the velocity is kept constant and the gyro moment about the pitch axis is compensated by an elevator moment. Under these assumptions a simple relationship results between the bank angle and the position of the indifference point (between the neutral point and the maneuver point). Discussed are the stability conditions of the system and the asymptotic variations of the trajectory at a small elevator deflection. (Author)

A72-36975 # **A vortex model for the study of the flow at the rotor blade of a helicopter (Ein Wirbelmodell zur Behandlung der Strömung am Rotorblatt eines Hubschraubers).** W. H. Isay. *Zeitschrift für angewandte Mathematik und Mechanik,* vol. 52, June 1972, p. 283-309. In German.

A72-36976 **The ins and outs of swing wings.** B. R. A. Burns (British Aircraft Corp., Ltd., Preston, Lancs., England). *Flight International,* vol. 102, July 13, 1972, p. 54-58.

Review of the operational advantages of variable sweep for a multirole combat aircraft, with discussion of the associated problems and their solutions. In subsonic flight, at minimum sweep, the high-aspect ratio thick wing generates high lift with low induced drag; in supersonic flight with wings fully swept, wave drag due to volume is minimized and the lift is spread efficiently over a broad chord, minimizing lift-dependent wave drag. The most obvious effect of varying sweep is the trim change. Also, since the slope of the lift/angle-of-attack curve reduces with increasing sweep, lift diminishes. Factors affecting lateral stability and control are considered. F.R.L.

A72-37010 # **Certain achievements of the aircraft industry in the area of technology (Niektore osiagniecia przemyslu lotniczego w dziedzinie technologii).** J. Trebinski. *Technika Lotnicza i Astronautyczna,* vol. 27, May 1972, p. 30-34. In Polish.

Improved production and fabrication techniques in the Polish aircraft industry are described, covering precision casting, rolling, and forging; machining by lathes equipped with digital control; and electrochemical and chemical shaping methods. Mold preparation and casting of centrifugal-flow compressor rotors and blade elements are described, along with the rolling and forging methods employed for stator blades. Cost savings attained by incorporating these procedures are delineated. T.M.

A72-37032 # **Integrity of flight control system design.** I. S. Mant (Smiths Industries, Ltd., Wembley, Middx., England). *Aircraft Engineering,* vol. 44, July 1972, p. 4, 5.

Determination, for airborne systems, of the effect of failures on the airworthiness of an aircraft. The limit on acceptable unreliability shows that economics are not permitted to dictate where safety is concerned. In general, things fail because they are overstressed. Electronic components, and hence systems, follow this rule. Various methods of improving reliability are outlined. If it is required to show in advance of in-service experience that certain failures of a system have a very low probability, there is no practical alternative to that of designing a system with redundancy so that the failure rate of its constituent parts can be established in a reasonable time and computation of the effect of redundancy carried out. F.R.L.

A72-37033 # **USSR electric impulse de-icing system design** I. A. Levin. *Aircraft Engineering,* vol. 44, July 1972, p. 7-10.

A72-37034 # **Remote power control for aircraft generating and distribution systems.** D. O. Burns. *Aircraft Engineering,* vol. 44, July 1972, p. 14-19.

Review of various technical aspects of remote control of electrical power in aircraft, with an attempt to point out fruitful avenues of development. The geometry of generation and distribution systems is discussed. If over the next 10 yr further research and development were to produce a 10% reduction in generator plus constant speed drive (CSD) weights, a saving of about 50 lb on four generator channels for the Concorde would be achieved. On the other hand a change to a remote power control (RPC) system might well produce a weight saving several times greater. Types of RPC, part application of RPC, and multiplexing are considered. It is conceivable that the better protection available with RPCs and electrical control units will be of greater value than the reduction of cable weight that their general employment might assure. Various remote control devices are compared. F.R.L.

A72-37046 **Airport surveillance radar.** B. S. McConachie (Raytheon Canada, Ltd., Waterloo, Ontario, Canada). *Electronic Progress,* vol. 14, Summer 1972, p. 2-7.

Description of the ASR-803 air surveillance radar, which is designed to maximize clutter rejection while minimizing loss of wanted signals. It incorporates the techniques of sharp antenna beam cut-off, circular polarization, electronic beam switching, frequency diversity, microwave sensitivity time control (STC), a digital moving target indicator (MTI), logarithmic fast time constant, and video integration. The antenna, transmitter, diplexers, receivers, and signal processor are described. F.R.L.

A72-37047 **Cossor precision secondary radar.** M. C. Stevens (Cossor Electronics, Ltd., Harlow, Essex, England). *Electronic Progress,* vol. 14, Summer 1972, p. 8-13.

Outline of methods to significantly improve the accuracy of bearing measurements by ATCRBS/SSR (Air Traffic Control Beacon System/Secondary Surveillance Radar). The methods involve additions and some changes to existing ground equipment, but in no way affect system characteristics. In measurement of azimuth, errors can be substantially reduced by the use of monopulse. The monopulse technique involves the use of an antenna divided into two parts, each producing an output. Results support predicted bearing errors of 5 min of arc rms at a range of 60 mi and 10 min rms at 160 mi. F.R.L.

A72-37048 **ATC transponder - Cossor SSR 2700.** V. R. Potter (Cossor Electronics, Ltd., Harlow, Essex, England). *Electronic Progress,* vol. 14, Summer 1972, p. 14-18.

Discussion of the SSR 2700 transponder, which operates in conjunction with the ground element, the secondary radar, and exemplifies modern airborne equipment design. It is small, light, and has low power consumption. With the exception of the transmitter output tube and the electromechanical latching fault indicators, all active components are solid-state. In the intermediate frequency amplifier linear integrated circuits are used, while the logic circuits for the decoding and encoding function use digital integrated circuits. The transmitter receiver module, the video processor, and the decoder and encoder are described. A comprehensive self-test

system is employed within the transponder which takes two basic forms: continuous on-line and manual. F.R.L.

A72-37049 Atmospheric turbulence and the ATC system. A. V. Jelalian (Raytheon Co., Equipment Div., Sudbury, Mass.). *Electronic Progress,* vol. 14, Summer 1972, p. 19-25.

Discussion of turbulence, with special reference to clear air turbulence (CAT) and its prediction. General types of turbulence which may attain sufficient amplitude to be dangerous are caused by mountain waves, wind shears, convective activity, and wake vortices generated by the wing tips of aircraft. Although CAT causes personal injury and property damage and accounts for 35% of all turbulence accidents, it does not contribute to very many air carrier fatalities. Due to the invisibility of CAT, pilot sighting and weather radar cannot help. A CAT detection system based on the fact that even at high altitudes the atmosphere contains aerosols which are large enough to produce a sensible backscatter of light has been proposed. The system envisions a coherent laser radar transmitter on the airplane which would radiate short pulses which would be reflected by the aerosols in the turbulent area. Doppler methods have also been suggested. F.R.L.

A72-37050 # Right- and left-hand dominance in navigation. L. F. E. Coombs. *Journal of Navigation,* vol. 25, July 1972, p. 359-369. 24 refs.

Discussion of the 'keep to the right' rule of navigation which has evolved over the past 3000 years. It would seem that this rule arose from an increasing number of accidents which occurred when appropriate regulations were either nonexistent or not always observed. In the case of aircraft, just as right-hand preference affected the actions of horsemen, sailors, and the drivers of road vehicles, so it has affected the arrangement of aircraft controls and, possibly, the customs and rules of aviation in general. The positioning of the command pilot on the left appears to be due to the general use of left-hand traffic patterns. F.R.L.

A72-37092 Air transport development between the UK and Europe - The next twenty years. K. G. Wilkinson (British European Airways Corp., Ruislip, Middx., England). *Aeronautical Journal,* vol. 76, June 1972, p. 343-349; Discussion, p. 349-351.

A72-37093 The future of general aviation in Europe. G. F. Brewer (Cessna Aircraft Co., Wichita, Kan.). *Aeronautical Journal,* vol. 76, June 1972, p. 352-357; Discussion, p. 357-361. 5 refs.

A72-37096 V/STOL developments in Hawker Siddeley Aviation Limited. M. J. Brennan (Hawker Siddeley Aviation, Ltd., Kingston-upon-Thames, Surrey, England). *Aeronautical Journal,* vol. 76, June 1972, p. 391-401.

The development of STOL or V/STOL air transport systems provides a solution to problems connected with the vast increase in air traffic volume. The size of CTOL, STOL, and VTOL airports is compared. There is a dramatic difference in land requirements, from 2400 acres for the CTOL airport to about 10 acres for the VTOL airport. Military and civil V/STOL developments are discussed, giving attention to a number of different aircraft designs. Areas in which the airlines and airport authorities may gain profits from the introduction of V/STOL are considered. G.R.

A72-37204 The acoustics of axial flow machines. C. L. Morfey (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 22, June 22, 1972, p. 445-466. 43 refs.

Applications of linear acoustics to axial flow machines are reviewed. The main emphasis is on Lighthill's acoustic analogy as a means of describing sound generation and scattering by blades; this leads to simple estimates for the blade-passing sound field of a rotor in nonuniform flow. Theoretical predictions of the sound excited by blade forces are compared with measurements on subsonic fans and compressors. (Author)

A72-37212 Comparative analysis of the operative costs of large amphibious hovercraft (Analisi comparativa dei costi operativi di aeronavi anfibie di grandi dimensioni). G. Bonsignorio and C. Voto (Aerfer S.p.A., Naples, Italy). *(Associazione Italiana di Aeronautica e Astronautica, Congresso Nazionale, 1st, Palermo, Italy, Oct. 27-29, 1971.) L'Aerotecnica - Missili e Spazio,* vol. 51, Apr. 1972, p. 129-139. 10 refs. In Italian.

A72-37214 Contribution to the study of adhesive-bonded aerospace structures (Contributo allo studio delle strutture aerospaziali unite con adesivi). G. Quozzo (Roma, Università, Rome, Italy). *(Associazione Italiana di Aeronautica e Astronautica, Congresso Nazionale, 1st, Palermo, Italy, Oct. 27-29, 1971.) L'Aerotecnica - Missili e Spazio,* vol. 51, Apr. 1972, p. 148-158. 8 refs. In Italian.

Consideration of the stresses and displacements occurring in two typical adhesive-bonded joints. The stresses and displacements occurring in a double lap adhesive-bonded joint are analyzed. Then the stress diffusion in a reinforced structure is determined, and for this problem an approximate solution of easy use is also given. It is shown that, in addition to the stress concentrations typical of adhesive-bonded joints, flexural stress is a significant part of the total stress of lap-jointed and reinforced plates. A.B.K.

A72-37215 V/STOL - Selection and problems of the new medium (V/STOL - Scelta e problemi del nuovo mezzo). E. Lo Casto and L. La Franca (Palermo, Università, Palermo, Italy). *L'Aerotecnica - Missili e Spazio,* vol. 51, Apr. 1972, p. 159-168. In Italian.

Description of all the types of V/STOL transport presently existing either as prototypes or still in the design phase. For all types considered the principal operative and structural characteristics are presented, noting the arrangements used to obtain short or vertical takeoffs. After citing some cost factors, a hypothetical study is made of problems related to the possible introduction of such aircraft in commercial airlines. A.B.K.

STAR ENTRIES

N72-25994 Connecticut Univ., Storrs.
PASSAGE OF AN AIRFOIL THROUGH A THREE-DIMENSIONAL DISTURBANCE Ph.D. Thesis
John Joseph Adamczyk 1971 114 p
Avail: Univ. Microfilms Order No. 71-29839

An analysis was undertaken to determine an explicit expression for the pressure field generated by the passage of a three dimensional disturbance over an airfoil. This work was based on an extension of the formulation to solve the problem of an isolated airfoil oscillating in a compressible fluid. The present analysis was applied to the problem of determining the pressure field generated by the passage of an acoustical wave, viscous wakes, and a turbulent flow over an airfoil. Dissert. Abstr.

N72-25996*# Wichita State Univ., Kans. Dept. of Aeronautical Engineering.
EFFECTS OF LEADING-EDGE CAMBER ON LOW-SPEED CHARACTERISTICS OF SLENDER DELTA WINGS: TECHNIQUES AND TABULATED DATA
W. H. Wentz [1972] 346 p refs
(Contract NAS1-10082)
(NASA-CR-112016) Avail: NTIS HC $19.50 CSCL 01A

Special tests to determine the importance of transition fixing and Reynolds number variation on forces produced by thin delta wings are discussed. Transition fixing was achieved by applying cement to models and sprinkling grit on wet adhesive. Strips were applied along lines emanating from the apex located along sixty-five percent semi-span rays. Tests were made with grit on both surfaces, upper surface only, lower surface only, and on clean surfaces. Reynolds number varied by testing at three dynamic pressures. Correspondence between dynamic pressure and Reynolds number based on the mean aerodynamic chord are shown. No significant changes are noted due to either Reynolds number variation or transition fixing, within the range of Reynolds numbers used for the test. Author

N72-25998*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL INVESTIGATION OF STABILITY AND STALL FLUTTER OF A FREE-FLOATING WING V/STOL MODEL
Robert A. Ormiston Washington Jun. 1972 45 p refs
Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TN-D-6831; A-4088) Avail: NTIS HC $3.00 CSCL 01A

An experimental investigation was made of the static and dynamic stability characteristics of a one-fourth scale model of a tilt-propeller free-wing V/STOL aircraft. The effects of wing pivot location, wing chord, trailing-edge angle, propeller tilt angle, and thrust were studied, and a limited evaluation was made of high-lift devices. A dynamically similar wing was used to measure frequency and damping ratio from transient response data in the linear aerodynamic regime and the results were compared to quasi-steady and unsteady aerodynamic theory. It was found that at high trim angles of attack, in the nonlinear aerodynamic regime, stall flutter oscillations occurred with typical amplitudes ranging from 15 to 20 deg. Wing control tab deflection was effective in initiating and terminating stall flutter but variations in configuration or operating conditions did not greatly influence the occurrence of characteristics of the oscillations. Author

N72-26000*# Translation Consultants, Ltd., Arlington, Va.
SIMULATION OF AN INCREASED REYNOLDS NUMBER PRODUCED BY ROUGHNESS ON AN AIRCRAFT MODEL IN TRANSONIC RANGE
X. Vaucheret Washington NASA Jun. 1972 25 p refs
Transl. into ENGLISH from Rech. Aerospatiale (Paris), no. 6, Nov. - Dec. 1971 p 335-346 and from rept. ONERA-TP-1070 dated 1971
(Contract NASw-2038)
(NASA-TT-F-14290) Avail: NTIS HC $3.25 CSCL 01A

A high level of Reynolds number simulation for obtaining in a wind tunnel the aerodynamic characteristics of a transport aircraft in the transonic range is discussed. Simulating an increased Reynolds number with roughness set on an aircraft model is an inexpensive way to make use of existing wind tunnels. Sticking near the leading edge glass balls or chordwise threads, at a rather broad pitch, provides the most efficient roughness. The influence of this roughness on the shock-boundary layer interaction pattern contributes to increase the lift gradient and to carry rearwards the neutral point. The parietal visualization technique using fluid paints, of which a few examples are shown in color, is a practical means for investigating flow separation. This method helps to understand the working of roughness. Author

N72-26001# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
CALCULATION OF PRESSURE DISTRIBUTIONS FOR AN AIRFOIL IN SUBCRITICAL FLOW INCLUDING THE EFFECT OF THE BOUNDARY LAYER
S. Anders, L. Gustavsson, Robert S. Hillgren, and Goeran I. Toll 1971 26 p refs
(FFA-AU-901) Avail: NTIS HC $3.50

An approximate method for calculating the pressure distribution on a thick cambered airfoil in subcritical viscous flow is presented. The method calculates the inviscid potential solution for a contour consisting of the airfoil, the associated boundary layer and the wake displacement surfaces, by means of successive iterations. The method is programmed on a digital computer and the results obtained show good agreement with experimental results for low subcritical Mach numbers. For higher subcritical Mach numbers the approximate compressibility correction is not sufficiently accurate. However if the difference between the exact and the approximate inviscid theoretical results is used to correct the approximate results for viscous flow a significantly better agreement with experimental results is obtained. Author

N72-26003# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AEROFOIL STALL PREDICTION IN INCOMPRESSIBLE FLOW
Michel VincentdePaul 1972 16 p refs In FRENCH; ENGLISH summary
(ONERA-TP-1088) Avail: NTIS HC $3.00

A method is proposed to calculate the small separation zones which are initiated near the leading edge of an airfoil at incidence. This calculation analyzes the details of the separation process and predicts the maximum lift that may be obtained within a certain Reynolds number range. Author

N72-26004*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXTRAPOLATION OF SONIC BOOM PRESSURE SIGNA-

TURES BY THE WAVEFORM PARAMETER METHOD
Charles L. Thomas Washington Jun. 1972 35 p refs
(NASA-TN-D-6832; A-4232) Avail: NTIS HC $3.75 CSCL 01B

The waveform parameter method of sonic boom extrapolation is derived and shown to be equivalent to the F-function method. A computer program based on the waveform parameter method is presented and discussed, with a sample case demonstrating program input and output. Author

N72-26005*# North Carolina State Univ., Raleigh.
RIDING AND HANDLING QUALITIES OF LIGHT AIRCRAFT: A REVIEW AND ANALYSIS
Frederick O. Smetana, Delbert C. Summery, and W. Donald Johnson Washington NASA Mar. 1972 411 p refs
(Contract NAS1-9603)
(NASA-CR-1975) Avail: NTIS HC $6.00 CSCL 01B

Design procedures and supporting data necessary for configuring light aircraft to obtain desired responses to pilot commands and gusts are presented. The procedures employ specializations of modern military and jet transport practice where these provide an improvement over earlier practice. General criteria for riding and handling qualities are discussed in terms of the airframe dynamics. Methods available in the literature for calculating the coefficients required for a linearized analysis of the airframe dynamics are reviewed in detail. The review also treats the relation of spin and stall to airframe geometry. Root locus analysis is used to indicate the sensitivity of airframe dynamics to variations in individual stability derivatives and to variations in geometric parameters. Computer programs are given for finding the frequencies, damping ratios, and time constants of all rigid body modes and for generating time histories of aircraft motions in response to control inputs. Appendices are included presenting the derivation of the linearized equations of motion; the stability derivatives; the transfer functions; approximate solutions for the frequency, damping ratio, and time constants; an indication of methods to be used when linear analysis is inadequate; sample calculations; and an explanation of the use of root locus diagrams and Bode plots. Author

N72-26006*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF LIGHT, TWIN-ENGINE, PROPELLER-DRIVEN AIRPLANES
Chester H. Wolowicz and Roxanah B. Yancey Washington Jun. 1972 371 p refs
(NASA-TN-D-6800; H-646) Avail: NTIS HC $3.00 CSCL 01B

Representative state-of-the-art analytical procedures and design data for predicting the longitudinal static and dynamic stability and control characteristics of light, propeller-driven airplanes are presented. Procedures for predicting drag characteristics are also included. The procedures are applied to a twin-engine, propeller-driven airplane in the clean configuration from zero lift to stall conditions. The calculated characteristics are compared with wind-tunnel and flight data. Included in the comparisons are level-flight trim characteristics, period and damping of the short-period oscillatory mode, and windup-turn characteristics. All calculations are documented. Author

N72-26007*# Boeing Co., Seattle, Wash.
STUDY OF THE APPLICATION OF ADVANCED TECHNOLOGIES TO LONG RANGE TRANSPORT AIRCRAFT. VOLUME 2: ADVANCED TECHNOLOGY PROGRAM RECOMMENDATIONS Final Report
May 1972 245 p refs
(Contract NAS1-10703)
(NASA-CR-112093) Avail: NTIS HC $14.25 CSCL 01B

The benefits of the application of advanced technology to future transport aircraft were investigated. The noise reduction goals established by the CARD (Civil Aviation Research and Development) study for the 1981-1985 time period can be satisfied. Reduced terminal area and airway congestion can result from use of advanced on-board systems and operating procedures. The use of advanced structural design concepts can result in greatly reduced gross weight and improved operating economics. The full potential of these benefits can be realized in a 1985 airplane by implementing a research and development program that is funded to an average level of approximately $55 million per year over a ten year period. Author

N72-26008*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASPECTS OF INVESTIGATING STOL NOISE USING LARGE SCALE WIND TUNNEL MODELS
Michael D. Falarski, David G. Koenig, and Paul T. Soderman Jun. 1972 35 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.
(NASA-TM-X-62164) Avail: NTIS HC $3.75 CSCL 01B

The applicability of the NASA Ames 40- by 80-ft wind tunnel for acoustic research on STOL concepts has been investigated. The acoustic characteristics of the wind tunnel test section has been studied with calibrated acoustic sources. Acoustic characteristics of several large-scale STOL models have been studied both in the free-field and wind tunnel acoustic environments. The results indicate that the acoustic characteristics of large-scale STOL models can be measured in the wind tunnel if the test section acoustic environment and model acoustic similitude are taken into consideration. The reverberant field of the test section must be determined with an acoustically similar noise source. Directional microphone and extrapolation of near-field data to far-field are some of the techniques being explored as possible solutions to the directivity loss in a reverberant field. The model sound pressure levels must be of sufficient magnitude to be discernable from the wind tunnel background noise. Author

N72-26009*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC TRANSPORT STUDY, SUMMARY
Louis J. Williams May 1972 46 p refs
(NASA-TM-X-62156) Avail: NTIS HC $4.50 CSCL 01B

The effects of possible increases in cruise speed over present-day transport aircraft were investigated. Increased cruise speed is desirable not only because of a possible competitive market advantage, but also because of the resulting increase in aircraft productivity. Aircraft designed to cruise at Mach numbers greater than those of present-day transports but less than those which produce a sonic boom on the ground were studied. The purpose of the study was three-fold: (1) to compare, on an equal basis, the performance and economics of advanced commercial transport aircraft designed to cruise at Mach numbers 0.90, 0.98, and 1.15; (2) to determine the sensitive technical areas affecting the performance and economics of the aircraft; and (3) to assess the impact of advanced technology, particularly the supercritical wing and advanced composite materials on the performance and economics of the aircraft. Author

N72-26010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FEASIBILITY STUDY OF A BIDIRECTIONAL JET FLAP DEVICE FOR APPLICATION TO HELICOPTER ROTOR BLADES. PHASE 2: LIFT CONTROLLER DEVELOPMENT
Raymond E. Rose, Tom M. Wynn, Gary A. Smith, and Glen L. Merrill Apr. 1972 111 p refs Prepared by Honeywell, Inc., St. Paul, Minn. and Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.
(Contract NAS2-4389)
(NASA-TM-X-62152) Avail: NTIS HC $7.75 CSCL 01B

A bidirectional jet flap device called the variable deflection thruster (VDT) has been investigated for possible application to helicopter rotors. This investigation included the development and testing of a fluidic lift control system for the VDT-blade model making use of the test result that VDT-blade lift can be sensed from the differential pressure at midchord. This study

constitutes a long-range program to develop blown control techniques for stabilizing the higher harmonic modes of helicopter rotors. Wind tunnel tests were conducted using a three-sectioned, two-dimensional VDT-blade model having individually controlled VDT jet flaps in each section. Steady-state tests were conducted without the fluidic lift controller (open loop) for both full-span blowing and for the model center section blowing only. Steady-state tests were conducted with the center section blowing only using the fluidic lift controller (close-loop) to control the lift on the model center section. Dynamic tests were conducted using the complete model with the VDT jet in the model center section oscillating at various frequencies and also using the model center section alone on a single endplate to obtain finite-aspect-ratio effects. Fair agreement was obtained between theory and experimental results. Author

N72-26011# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
SPECIAL STUDY: EMERGENCY LANDING TECHNIQUES IN SMALL FIXED-WING AIRCRAFT
Gerald M. Bruggink 5 Apr. 1972 14 p refs
(NTSB-AAS-72-3) Avail: NTIS HC $3.00

Techniques to increase survivability and reduce injuries in forced and precautionary landings in small fixed-wing aircraft are presented. The study stresses the importance of reducing the main injury-producing factor, deceleration forces, and how to use the aircraft and terrain for this purpose. It describes emergency landing techniques for various flight and terrain conditions.
Author

N72-26012# Aeronautical Research Labs., Melbourne (Australia).
RESONANCE TESTS ON A JINDIVIK MK. 3B AIRCRAFT
C. M. Bailey Nov. 1971 30 p
(ARL/SM-371) Avail: NTIS HC $3.50

Resonance tests have been made on a Jindivik mark 3B target aircraft fitted with mark 7 wing tip pods. Multipoint excitation was employed with the use of four electromagnetic vibrators. The natural frequencies and modal shapes of four major wing modes, under each of two loading conditions, in the frequency range up to 40 hertz were measured. Author

N72-26013# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: TRANSINTERNATIONAL AIRLINES CORPORATION FERRY FLIGHT 863, DOUGLAS DC-8-63F, N4863T, JF KENNEDY INTERNATIONAL AIRPORT, NEW YORK
8 Sep. 1972 37 p
(NTSB-AAR-71-12) Avail: NTIS HC $4.00

A DC-8-63F, crashed during takeoff at John F. Kennedy International Airport, New York, September 8, 1970. Approximately 1,500 feet after starting takeoff, the aircraft rotated to a nose-high attitude. After 2,800 feet of takeoff roll, the aircraft became airborne and continued to rotate slowly to an attitude of approximately 60 deg to 90 deg above the horizontal, at an altitude estimated to have been between 300 and 500 feet above the ground. The aircraft rolled about 20 deg to the right, rolled back to the left to an approximate vertical angle of bank, and fell to the ground in that attitude. The aircraft was destroyed by impact and postimpact fire. Eleven crewmembers, the only occupants of the aircraft, died in the accident. The probable cause of this accident was a loss of pitch control caused by the entrapment of a pointed, asphalt-covered object between the leading edge of the right elevator and the right horizontal spar web access door in the aft part of the stabilizer. The restriction to elevator movement, caused by a highly unusual and unknown condition, was not detected by the crew in time to reject the takeoff successfully. Author

N72-26014*# General Electric Co., Lynn, Mass. Aircraft Engine Group.
DESIGN OF A TF34 TURBOFAN MIXER FOR REDUCTION OF FLAP IMPINGEMENT NOISE Final Report
A. Chamay, D. P. Edkins, R. B. Mishler, and W. S. Clapper
2 Feb. 1972 131 p refs
(Contract NAS3-14330)
(NASA-CR-120916) Avail: NTIS HC $8.75 CSCL 21E

This portion of the TF-34 turbofan quiet engine studies has been devoted to the selection and design of a special mixer exhaust nozzle system to reduce the maximum 150 m (500 foot) sideline noise generated by the impingement of four engine exhausts on a STOL wing flap system to less than 92 PNdB. The design concept selected consists of a 12-lobe internal mixer and a 12-lobe external mixer mounted in series. The internal mixer reduces maximum exhaust velocities by mixing the fan and turbine streams. The external mixer is designed to reduce the velocity of the exhaust stream striking the wing flap surfaces. A ground test version of this concept has been designed to be installed and tested on an acoustically treated TF-34 engine nacelle, with flexibility to simulate a flight version of this concept which has also been defined. Estimated noise levels are 2 PNdB below the objective at approach and 2 PNdB above the objective at takeoff, with an uncertainty band of +3, -2 PNdB. Author

N72-26015# National Transportation Safety Board, Washington, D.C.
SPECIAL STUDY: PASSENGER SURVIVAL IN TURBOJET DITCHINGS (A CRITICAL CASE REVIEW)
5 Apr. 1972 32 p
(NTSB-AAS-72-2) Avail: NTIS HC $3.75

The conditions and circumstances which determined the outcome of the ditching of a DC-9 aircraft in regard to the survival and nonsurvival of the occupants was investigated. It was found that the passengers were prepared inadequately for the ditching due to a combination of factors including insufficient preparation time, inadequate briefings, insufficient training and the lack of proper crew coordination. It was estimated that decelerative forces were in the order of 8 to 12 g's, causing unrestrained occupants to be thrown forward, inducing seat failures and spinal injuries. The cause of seats, seatbelt, and galley equipment failures were analyzed. It was estimated that the aircraft remained afloat for 5 to 6 minutes. The fact that a life raft inflated inside the aircraft was attributed to impingement of the raft package by the galley structure, forcing the crewmembers out of the aircraft. Leadership of the crew while awaiting rescue and an inflated emergency escape slide minimized further loss of life. Recommendations were advanced dealing with increased training for crewmembers, better passenger communication techniques, increased strength requirements for seats, seatbelts, and galley equipment and the development of slide raft combinations and lifevest design. Twenty references are included. Author

N72-26016*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC TRANSPORT STUDY: STRUCTURES AND AERODYNAMICS
Mark D. Ardema and Louis J. Williams Jun. 1972 84 p
(NASA-TM-X-62157) Avail: NTIS HC $6.25 CSCL 01B

The structural and aerodynamic aspects of a general study of advanced transonic transports are presented. Aircraft designed to cruise at Mach numbers of 0.90, 0.98, and 1.15 were comparatively analyzed. The wings of all three aircraft employ supercritical sections, and the two aircraft with the highest cruise Mach numbers also employ fuselage area ruling. Structural/aerodynamic characteristics and interactions are investigated both parametrically and with the aid of an automated configuration optimization program. The effects of replacing conventional aluminum airframe structure by advanced filamentary composite (carbon/epoxy) structure receive particular attention. The methods employed in the structural/aerodynamic analysis are discussed. Author

N72-26017*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

GROUND AND FLIGHT TEST METHODS FOR DETERMINING LIMIT CYCLE AND STRUCTURAL RESONANCE CHARACTERISTICS OF AIRCRAFT STABILITY AUGMENTATION SYSTEMS

Weneth D. Painter and George J. Sitterle Washington Jun. 1972 20 p refs

(NASA-TN-D-6867; H-682) Avail: NTIS HC $3.00 CSCL 01B

Performance criteria and test techniques are applied to stability augmentation systems (SAS) during ground testing to predict objectionable limit cycles and preclude structural resonance during flight. Factors that give rise to these problems, means of suppressing their effects, trade-offs to be considered, and ground test methods that have been developed are discussed. SAS performance predicted on the basis of these tests is compared with flight data obtained from three lifting body vehicles and the X-15 research airplane. Limit cycle and structural resonance test criteria, based upon ground and flight experience and data, were successfully applied to these vehicles. The criteria used were: The limit cycle amplitude (SAS gain multiplied by peak-to-peak angular rate) shall not exceed ∩ 5 deg for the highest product of control power and SAS gain that will be used in flight; the maximum in-flight SAS gain should never exceed 50 percent of the value at which a structural resonance can be sustained during ground test. Author

N72-26018# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: EASTERN AIR LINES, INCORPORATED MCDONNELL DOUGLAS DC-9-31 N8943E, AND A CESSNA MODEL 206, N2110F, RALEIGH-DURHAM AIRPORT, RALEIGH, NORTH CAROLINA, 4 DECEMBER 1971

5 Apr. 1972 15 p refs

(NTSB-AAR-72-13) Avail: NTIS HC $3.00

On December 4, 1971, a Douglas DC-9-31, on a regularly scheduled flight from Miami, Florida, to Washington, D. C., with en route stops at Raleigh, North Carolina, and Norfolk, Virginia, and a Cessna 206, collided in midair. The collision occurred between the outer marker and the threshold of Runway 5 of the Raleigh-Durham Airport at Raleigh, North Carolina. Both aircraft were in communication with and under the control of the Raleigh-Durham Tower local controller. The DC-9 overtook the Cessna and descended on top of that aircraft. The tower local controller had cleared the DC-9 to land. Previous to this clearance, he had advised the Cessna pilot that Runway 5 was the active runway and to report on a 3-mile final approach for possible straight-in landing. The probable cause of this accident was the inadequacy of air traffic control facilities and services in the Raleigh-Durham terminal area. The relative flightpaths of the two aircraft and the configurations physically limited each flightcrew's ability to see and avoid the other aircraft. Author

N72-26019# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: CHICAGO AND SOUTHERN AIRLINES, INCORPORATED, BEECH E18S (ATECO WESTWIND 2) N51CS, PEORIA, ILLINOIS, 21 OCTOBER 1971

19 Apr. 1972 28 p refs

(NTSB-AAR-72-15) Avail: NTIS HC $3.50

Chicago & Southern Airlines, Inc., Flight 804 of October 21, 1971, crashed while executing an instrument approach to the Greater Peoria Airport, Peoria, Illinois. All of the 16 persons on board received fatal injuries. The aircraft made initial contact with powerlines which cross the midpoint of the instrument final approach course, approximately 2 miles west of Runway 12 of the Greater Peoria Airport. The aircraft thereafter contacted the ground, bounced and slid into the base of a large hedgewood tree 152 feet from the point of initial wire contact along a wreckage path of 050 deg magnetic. An intense fire ensued which almost completely destroyed the cockpit and cabin area of the fuselage. The probable cause of this accident was that the pilot knowingly descended below the minimum descent altitude in an attempt to complete the approach by means of visual reference to ground objects. Because of minimal visibility and low clouds in the approach zone, the aircraft was operated at an altitude too low to provide clearance over the powerlines. Author

N72-26020# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

AIRCRAFT ACCIDENT REPORT: PAN AMERICAN WORLD AIRWAYS, INCORPORATED BOEING 747-121, N739PA NEAR NANTUCKET, MASSACHUSETTS, 4 NOVEMBER 1970

3 May 1972 19 p

(NTSB-AAR-72-14) Avail: NTIS HC $3.00

On November 4, 1970, a Pan American World Airways, Inc., Boeing 747-121, on a scheduled flight from John F. Kennedy International Airport, New York, to Orly Airport, Paris, France, encountered moderate to briefly severe turbulence at 27,000 feet as it passed Nantucket, Massachusetts. During the encounter which lasted approximately 4 minutes 10 seconds, 21 passengers and two stewardesses sustained injuries which ranged from minor to serious. The seatbelt sign was on at the time of the encounter and had been on since takeoff. Shortly after the turbulence encounter, the flight returned to John F. Kennedy International Airport, New York. The probable cause of this accident was the entry of the aircraft into an area of moderate to briefly severe turbulence associated with convective activity while numerous occupants were unsecured by seatbelts, even though the seatbelt sign was lighted. Author

N72-26021*# General Dynamics/Pomona, Calif. Electro Dynamic Div.

THEORETICAL PREDICTION OF INTERFERENCE LOADING ON AIRCRAFT STORES. PART 1: SUBSONIC SPEEDS

F. DanFernandes Jun. 1972 91 p refs

(Contract NAS1-10374)

(NASA-CR-112065-1) Avail: NTIS HC $6.75 CSCL 01B

A method is developed for theoretically predicting the loading on pylon-mounted stores in subsonic compressible flow. Linear theory is used, without two-dimensional or slender body assumptions, to predict the flow field produced by the aircraft wing, nose, inlet, and pylons. The interference loading is integrated over the store length by considering the local crossflow, its axial and radial derivatives, and buoyancy. Store moment calculations under an F-4 aircraft at Mach 8 are compared to wind tunnel data. The method is computerized, and program user information is included. Author

N72-26022*# General Dynamics/Pomona, Calif. Electrodynamic Div.

THEORETICAL PREDICTION OF INTERFERENCE LOADING ON AIRCRAFT STORES. PART 2: SUPERSONIC SPEEDS

F. DanFernandes Jun. 1972 95 p refs

(Contract NAS1-10374)

(NASA-CR-112065-2) Avail: NTIS HC $6.75 CSCL 01B

A method is developed for theoretically predicting the loading on pylon-mounted stores in supersonic flow. Linear theory is used, without two dimensional or slender body assumptions, to predict the flow field produced by the aircraft wing, nose, inlet, and pylons. Aircraft shock wave locations are predicted, and their effect on the flow field is included through a transformation of the aircraft geometry. The interference loading is integrated over the store length by considering the local crossflow, its axial and radial derivatives, and buoyancy. Store moment calculations under an F-4 aircraft at Mach 1.2 are compared to wind tunnel data. The method is computerized, and program user information is included. Author

N72-26023*# General Dynamics/Pomona, Calif. Electro Dynamic Div.

THEORETICAL PREDICTION OF INTERFERENCE LOADING ON AIRCRAFT STORES. PART 3: PROGRAMMER'S MANUAL

F. DanFernandes Jun. 1972 114 p
(Contract NAS1-10374)
(NASA-CR-112065-3) Avail: NTIS HC $7.75 CSCL 01B

A FORTRAN program is described for predicting interference loading on aircraft stores. An analysis of the program is presented from a programmer's point of view, including program organization, subroutine explanations, and FORTRAN variable definitions. This information is intended for use in any program modification, extension, or troubleshooting efforts. This manual is supplementary to the separately documented program theory and user information. Author

N72-26024*# Lockheed-California Co., Burbank.
STUDY OF AIRCRAFT IN INTRAURBAN TRANSPORTATION SYSTEMS
E. G. Stout Washington NASA Mar. 1972 156 p refs
(Contract NAS2-5989)
(NASA-CR-1991) Avail: NTIS HC $3.00 CSCL 01B

A systems analysis was conducted to define the technical economic and operational characteristics of an aircraft transportation system for short-range intracity commuter operations. The analysis was for 1975 and 1985 in the seven county, Detroit, Michigan area. STOL and VTOL aircraft were studied in sizes from 40 to 120 passengers. The preferred vehicle for the Detroit area was the deflected slipstream STOL. Since the study was parametric in nature, it is applicable to generalization, and it was concluded that a feasible intraurban air transportation system could be developed in many viable situations. Author

N72-26025*# Boeing Co., Philadelphia, Pa. Vertol Div.
A COMPARISON OF OPTIMAL AND NOISE-ABATEMENT TRAJECTORIES OF A TILT-ROTOR AIRCRAFT
F. H. Schmitz, W. Z. Stepniewski, J. Gibs, and W. Z. Hinterkeuser Washington NASA May 1972 165 p refs Sponsored in part by Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.
(Contract NAS2-5025)
(NASA-CR-2034) Avail: NTIS HC $3.00 CSCL 01B

The potential benefits of flight path control to optimize performance and/or reduce the noise of a tilt-rotor aircraft operating in the takeoff and landing phases of flight are investigated. A theoretical performance-acoustic model is developed and then mathematically flown to yield representative takeoff and landing profiles. Minimum-time and minimum-fuel trajectories are compared to proposed noise-abatement profiles to assess the reductions in annoyance possible through flight path control. Significant reductions are feasible if a nearly vertical-takeoff flight profile is flown near the landing site; however, the time expended and fuel consumed increase. Author

N72-26026# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
APPROXIMATE CALCULATION OF CANOPY SHAPE, FORCES AND STRESSES OF A FLAT CIRCULAR PARACHUTE IN STEADY DESCENT
Christos Saliaris 9 Dec. 1971 96 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-98) Avail: NTIS HC $7.00; DFVLR Porz: 19,50 DM

The relations between pressure distribution, canopy shape, and stresses in lines and fabric are derived for the steady descent of a flat circular parachute. In contrast to previous investigations both circumferential and meridian stresses are taken into consideration. Thus, six first-order differential equations and eight algebraic relations are obtained. Using a measured pressure distribution these equations are solved for the drag, the stresses, and the shape. The calculations include extended parameter variations. A comparison with other results shows satisfactory agreement. Author (ESRO)

N72-26027# Ultrasystems, Inc., Newport Beach, Calif.
AIRCRAFT RELIABILITY AND MAINTAINABILITY SITUATION (ARMS) Final Report
John P. Convey, Jr. and Stanley Cohen Sep. 1971 101 p refs
(Contract DAAJ02-71-C-0007; DA Proj. 1F1-62205-A-119)
(AD-738536; USAAMRDL-TR-71-43) Avail: NTIS CSCL 01/3

The report describes the intermediate logic flow diagrams for a computerized simulation model of U. S. Army aircraft operations. The primary objective of the model is to provide a tool for timely and realistic evaluation of system reliability and maintainability. Also, an objective of the model is the calculation of the operational availability of the aircraft being simulated. The acronym ARMS (Aircraft Reliability and Maintainability Simulation) is given to the model developed in the report. The logic flows are structured to be consistent, where feasible, with the Navy's current VALUE IV (Validated Aircraft Logistics Utilization Evaluation) model. Consistency with VALUE IV is desired so that its programming may be utilized directly, to the maximum possible extent, when the ARMS program is written. It is recommended that the Army proceed with the programming and implementation of ARMS as soon as practicable. Author (GRA)

N72-26028# Naval Aerospace Medical Research Lab., Pensacola, Fla.
MAJOR ORIENTATION ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1968: ACCIDENT FACTORS
W. Carroll Hixson, Jorma I. Niven, and Emil Spezia 29 Oct. 1971 40 p refs
(AD-738808; NAMRL-1147;
USAARL-MF12.524.005-5016BX1J9) Avail: NTIS CSCL 01/2

The report is the second in a longitudinal series of reports dealing with the pilot disorientation/vertigo problem in Regular Army UH-1 helicopter operations. Individual case history data extracted from the USABAAR master aircraft accident files are presented on 52 major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1968. Summary data listings involving a variety of operational and pilot-related accident factors are presented for each of the cases. The listings are arranged to distinguish between those factors and events present before takeoff; i.e., the initial conditions associated with a given accident, and those which occurred or were manifested during the actual airborne phase of the accident. GRA

N72-26029# Army Aviation Systems Command, St. Louis, Mo.
TWO METHODS OF PREDICTION OF HOVERING PERFORMANCE
Harold Y. H. Law Feb. 1972 80 p refs
(AD-738531; USAAVSCOM-TR-72-4; ADS-TN-69-1) Avail: NTIS CSCL 01/2

The report presents two methods of prediction on the hovering performance of single-rotor helicopters. A generalized equation was formulated by the use of numerical and empirical techniques from flight test data for the prediction of hovering performance. This generalized equation leads to two methods of prediction: the Generalized Method and the Two-Point Method. Both of these methods of prediction are simple and easy to apply, and require only limited flight data information to predict the entire range of hovering performance. The accuracy of these methods falls within 5% of the flight data. Specific working examples and procedures are given. GRA

N72-26030# Naval Aerospace Recovery Facility, El Centro, Calif. AERO Structures Dept.
STUDY OF CH-53A HELICOPTER FLIGHT LOAD PARAMETERS Final Report
Ralph E. Vining 15 Sep. 1971 58 p refs
(AD-739332; NADC-ST-7112) Avail: NTIS CSCL 01/3

A flight loads survey was performed on four CH-53A helicopters to determine whether design limits were being exceeded under actual operating conditions in the field. The

survey obtained a total of 133.40 hours of valid flight data in 1968 - 1969. By means of recording oscillographs, analog records were obtained for airspeed, altitude, outside air temperature, normal acceleration, rotary wing RPM, cruise guide indication, engine torque, and landing/take-off indication. The report presents a reduction of these data in the form of histograms, graphs and tables. GRA

N72-26037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTEGRATED ENGINE-GENERATOR CONCEPT FOR AIRCRAFT ELECTRIC SECONDARY POWER
Richard R. Secunde, Robert P. Macosko, and David S. Repas Washington Jun. 1972 20 p refs
(NASA-TM-X-2579; E-6804) Avail: NTIS HC $3.00 CSCL 10A

The integrated engine-generator concept of locating an electric generator inside an aircraft turbojet or turbofan engine concentric with, and driven by, one of the main engine shafts is discussed. When properly rated, the generator can serve as an engine starter as well as a generator of electric power. The electric power conversion equipment and generator controls are conveniently located in the aircraft. Preliminary layouts of generators in a large engine together with their physical sizes and weights indicate that this concept is a technically feasible approach to aircraft secondary power. Author

N72-26041# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS DC STARTER GENERATOR Final Report, Jun. 1966 - Aug. 1970
Vytautas F. Janonis Jan. 1971 262 p refs
(Contract AF 33(615)-3625; AF Proj. 8128)
(AD-738707; TR-132; AFAPL-TR-71-20) Avail: NTIS CSCL 10/2

The report covers work performed on the design and development of a Brushless dc Starter Generator System and its testing. The unit was built and tested as a dc power generator and aircraft engine starter. In the generating mode the unit produced 200 amperes at 28-30 VDC within plus or minus 0.5 V regulation. The unit was tested over the full speed range of 7700-12,000 rpm utilizing blast air cooling per MIL-G-6162(2). In the engine starting mode the unit was tested only at half rated conditions and 22 lb ft with starting torque at 385 amp input current. GRA

N72-26137# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
PENNSYLVANIA-PRINCETON ARMY AVIONICS RESEARCH PROGRAM. RADAR SYSTEMS TASK Final Technical Report
Raymond S. Berkowitz Feb. 1972 24 p refs
(Contract DA-28-043-AMC-02411(E); DA Proj. 1H1-62202-A-219)
(AD-738596; Rept-72-18; ECOM-02411-27) Avail: NTIS CSCL 17/9

The general objective was to determine the applicability and feasibility of airborne radar systems and related equipments for Army helicopter use. The work was divided into three subtasks: Multi-purpose Radar Studies; Specialized Radar Data Processing Techniques; and Laser Radar Applications. GRA

N72-26208# *Imperial Coll. of Science and Technology, London* (England). Dept. of Aeronautics.
TWO MORE WIND TUNNELS DRIVEN BY AEROFOIL-TYPE CENTRIFUGAL BLOWERS
P. Bradshaw Apr. 1972 16 p refs
(IC-Aero-72-10) Avail: NTIS HC $3.00

Design and operation of low turbulence wind tunnels driven by aerofoil-type centrifugal blowers at entries are reported. Each of the tunnels has a straight sided wide angle diffuser after the blower with two screens in order to refract the air flow into the expansion. The tunnels have been used for a wide variety of experiments and their performance has been satisfactory. G.G.

N72-26210# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE ELECTROFLUID DYNAMIC AUGMENTED WIND TUNNEL
Frank L. Wattendorf and Elmer G. Johnson 18 Jul. 1972 9 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Nov. 1972
Avail: NTIS HC $3.00

A new technique for producing high enthalpy flows for flight simulation in wind tunnels is reported. The unique concept examined envolves the addition of enthalpy to the gas flow by electrofluid dynamic (EFD) energy conversion which increases the flow velocity at essentially constant static pressure and temperature. Author

N72-26213# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Experimentelle Aerodynamik.
EXTENSION OF THE BRUNSWICK SUPERSONIC WIND TUNNEL FOR TRANSONIC PROFILE MEASUREMENTS [DER AUSBAU DES BRAUNSCHWEIGER UEBERSCHALL-WINDKANALS FUER TRANSSONISCHE PROFILMESSUNGEN]
Fred Thomas and Gerhard Kausche 1972 29 p refs In GERMAN; ENGLISH summary
(DLR-MITT-72-02) Avail: NTIS HC $3.50; DFVLR, Porz-Wahn: 9 DM

Arguments and technical proposals are presented for the extension of an existing supersonic wind tunnel to accomodate transonic profile measurements. It is pointed out that transonic wing aerodynamics are of special importance for the development of the next generation of airplanes and helicopters. It is shown that modification of the supersonic wind tunnel at the Institute of Aerodynamics at Braunschweig is technically and economically feasible. Author (ESRO)

N72-26214# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
FEASIBILITY OF USING MEMBRANE-ENVELOPED SOIL LAYERS AS PAVEMENT ELEMENTS FOR MULTIPLE WHEEL HEAVY GEAR LOADS Final Report, Jun. - Aug. 1970
Cecil D. Burns, William N. Brabston, and Robert W. Grau Feb. 1972 66 p refs
(AD-738839; AEWES-Misc-Paper-S-72-6) Avail: NTIS CSCL 13/2

The investigation reported herein was conducted to (a) determine the feasibility of using membrane-enveloped soil layers (MESL) as structural elements in flexible pavements and (b) investigate the performance of MESL construction under multiple-wheel heavy gear load (MWHGL) traffic. A test section was constructed within the existing MWHGL test section at the U. S. Army Engineer Waterways Experiment Station utilizing the existing 4-CBR clay subgrade. The performance of the test items under traffic showed that the concept of utilizing MESL's as structural elements in pavement construction is feasible.
Author (GRA)

N72-26215# *ARO, Inc., Arnold Air Force Station, Tenn.*
A THEORETICAL AND EXPERIMENTAL STUDY OF A JET STRETCHER DIFFUSER SYSTEM Final Report, 1 Jul. 1970 - 30 Jun. 1971
R. C. Bauer, E. H. Matkins, and R. L. Barebo AEDC Mar. 1972 45 p refs
(Contract F40600-72-C-0003; AF Proj. 3012; ARO Proj. RU5102)
(AD-738646; ARO-ETF-TR-71-246; AEDC-TR-72-246) Avail: NTIS CSCL 14/2

A theoretical and experimental study of the steady-state performance of a jet stretcher diffuser system is presented. The steady-state starting conditions are determined by limits imposed by the nozzle exit boundary layer, the blockage area, and the jet stretcher ambient pressure level. Analytical techniques are presented for estimating the starting boundary conditions related to either the nozzle exit boundary layer limit or the jet stretcher ambient pressure level limit. Limited experimental results for a small scale system are presented. Author (GRA)

N72-26217 Washington Univ., Seattle.
THE NUMERICAL CALCULATION OF PLANE STEADY TRANSONIC FLOWS PAST THIN LIFTING AIRFOILS Ph.D. Thesis
James Allan Krupp 1971 131 p
Avail: Univ. Microfilms Order No. 71-28434

Numerical solutions of the transonic potential equation for flow past lifting airfoils with free stream Mach number less than unity are presented. The work is based on the method of Murman and Cole (1970). Modifications to the basic finite difference equations are discussed which yield improved resolution of weak shock waves and greater accuracy near the sonic line. The proper treatment of boundary conditions and the Kutta condition are discussed in detail. Extensive computations for four airfoils are presented and the results are compared with theory and experiment where applicable. Dissert. Abstr.

N72-26227*# Vanderbilt Univ., Nashville, Tenn. Dept. of Mechanical Engineering.
A STUDY OF JET IMPINGEMENT ON CURVED SURFACES FOLLOWED BY OBLIQUE INTRODUCTION INTO A FREESTREAM FLOW Annual Status Report, 1 Feb. 1971 - 31 Jan. 1972
John W. Tatom, Norman M. Schnurr, John W. Williamson, and John H. Dunlap 29 Mar. 1972 148 p refs
(Grant NGR-43-002-034)
(NASA-CR-127121; AR-2) Avail: NTIS HC $9.50 CSCL 20D

An experimental investigation of the temperature and velocity fields generated by a two-dimensional transverse jet was conducted. An approximate analysis of a deflected radial plane jet was developed. An analytical model of aircraft ingestion was extended to include computation of the inlet flow field. An investigation of the use of flaps as thrust reversers was initiated. Analyses of the impingement of a round incompressible and a round compressible jet on a arbitrary axisymmetric surface were completed. A computer study of the effects on performance of thrust reverser geometry was completed and the results compared with existing data. An experimental investigation of three-dimensional jet impingement on nonplane surfaces was also initiated. Author

N72-26233*# Scientific Translation Service, Santa Barbara, Calif.
AIR VORTEX WAKES AND THEIR CAUSE
Washington NASA Jun. 1972 29 p refs Transl. into ENGLISH of Luftwirbelschleppen und Was Dahinter Steckt West Ger., Verband Deut. Flugleiter E. V., 1971 24 p
(Contract NASw-2035)
(NASA-TT-F-14286) Avail: NTIS HC $3.50 CSCL 20D

The dangers of air vortex wakes caused by jumbo jets such as the B-747 to air traffic are discussed. The effects of these wakes on other aircraft is described and safety measures are presented. Author

N72-26239*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SURVEY OF NASA LANGLEY STUDIES ON HIGH-SPEED TRANSITION AND THE QUIET TUNNEL
Ivan E. Beckwith and Mitchel H. Bertram Washington Jul. 1972 67 p refs
(NASA-TM-X-2566; L-8311) Avail: NTIS HC $3.00 CSCL 20D

A quantitative experimental and theoretical assessment of the role of wind-tunnel disturbances in the boundary-layer transition process at hypersonic speeds is presented. The various approaches and recent results for the development of a low-noise-level tunnel are presented. A statistical parametric study of transition data with a large computer is shown for cones in free flight, ballistic ranges, and wind tunnels at essentially zero angle of attack. New transition results for slender cones at small angle of attack are also given, as are studies of transition at high angle of attack, which are compared with various correlation attempts. Included are results which indicate that hypersonic transition in the outer part of the boundary layer precedes the manifestation of transition at the wall. Author

N72-26241# National Aeronautical Establishment, Ottawa (Ontario). Low Speed Aerodynamics Section.
THE TRAILING VORTEX WAKE AND DOWNWASH BEHIND A QUASI-TWO-DIMENSIONAL EXTERNAL FLOW JET FLAP
R. H. Wickens Nov. 1971 31 p refs
(LTR-LA-85) Avail: NTIS HC $3.75

The results are presented for flow traverses downwind of a quasi-two-dimensional externally flown flap. Since it was apparent that the flow behind the wing was composed of both propulsive and vortical components, it was decided to perform the flow survey with a five-hole probe, so as to achieve as complete a description as possible of the flow field. Author

N72-26251# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
REVIEW OF MIT RESEARCH ON AIRFOIL DYNAMICS STALL 1964 - 1971
Norman D. Ham Sep. 1971 33 p refs
(Contract DA-31-124-ARO(D)-247)
(AD-738610; ASRL-TR-130-3; AROD-4846:13-E) Avail: NTIS CSCL 20/4

Research on the dynamic stall of airfoils and helicopter blades is described, beginning with wind tunnel tests and helicopter flight tests which led to the current research. Flutter criteria, tests of two-dimensional airfoils undergoing large transient motions, and a partial theory of airfoil dynamic stall are presented. The application of the two-dimensional results to the loading and motion of rotor blades due to stall is described. Unsteady boundary layer analyses and tests, and their relationship to the development of a complete flow separation model, to airfoil design, and to blade-vortex interaction effects are summarized. GRA

N72-26287# Institut d'Aeronomie Spatiale de Belgique, Brussels.
THE PRODUCTION OF NITRIC OXIDE IN THE STRATOSPHERE BY OXIDATIONS OF NITROUS OXIDE
M. Nicolet and W. Peetermans 1972 38 p refs
(Rept-101) Avail: NTIS HC $4.00

The reaction of the electronically excited oxygen atom O(1D) with nitrous oxide, suggested as a natural source of nitric oxide in the stratosphere, may lead to a production of the order of (1 + or - 0.5) X 10 to the 8th power NO molecules/sq cm sec. The predictability of a reliable estimate of the NO production in the stratosphere depends on the exact determination of the variable flux from the troposphere of N2O molecules (of the order of (1 + or - 0.5) X 10 to the 9th power molecules/sq cm sec). In situ sources of stratospheric N2O seem to be negligible and the introduction of nitrogen oxides by upward transport from the troposphere and of nitric oxide by downward transport from the mesosphere requires adequate conditions at the tropopause and stratopause. An assumed operation of 500 SST aircraft in the stratosphere would lead to an artificial emission of nitric oxide molecules of the same order of magnitude as the natural production from nitrous oxide. Author

N72-26341# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
REPORT ON THE SECOND MEETING OF THE DGLR-SCIENTIFIC COMMITTEE OF THE GERMAN AEROSPACE

SOCIETY [BERICHT UBER DIE 2 SITZUNG DES DGLR-FACHAUSSCHUSSES VERSUCHSWESEN DER STROEMUNGSMECHANIK]
Feb. 1972 169 p refs In GERMAN; partly in ENGLISH Meeting held in Bremen, 6 Apr. 1971
(DLR-Mitt-72-06) Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

Wind tunnel balances with strain gage systems for measurements of quasi-stationary aerodynamic force coefficients in wind tunnels are reported.

N72-26342# Hamburger Flugzeugbau G.m.b.H. (West Germany).
SUBSONIC WIND TUNNEL BALANCES WITH DMS SYSTEMS [UNTERSCHALLWINDKANALWAAGEN MIT DMS-SYSTEMEN]
F. Waesche and A. Vasel *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 7-24 In GERMAN
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

Construction and properties of mechanical and electrical wind tunnel balances with strain gages are considered. Performance tests of these balances in subsonic wind tunnels show that their accuracies are determined mainly by the precision classification of the instrument and its connected amplifiers. It is shown that strain gages with inductive systems require a minimum in measuring time but that mechanical balances provide more precision in measurements.
Transl. by G.G.

N72-26343# Eidgenossisches Flugzeugwerk, Emmen (Switzerland).
THE DEVELOPMENT OF A DMS BALANCES SERIES FOR SIX COMPONENT MEASUREMENTS OF MODELS OR MODEL PARTS IN SUBSONIC WIND TUNNELS [DIE ENTWICKLUNG EINER DMS-WAAGENREIHE FUER 6-KOMPONENTENMESSUNGEN AN MODELLEN ODER MODELLTEILEN IN UNTERSCHALLWINDKANAELEN]
B. Baeriswyl *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 25-42 refs In GERMAN
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

A six component strain gage balance is reported for determining the interferences forces of two aircrafts during surveillance flights, and for measuring exterior loads and moments in order to determine acceptable loads for aircraft side suspension.
Transl. by G.G.

N72-26344# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik Forschungszentrum.
EXTERNAL STAIN GAUGE BALANCES FOR THREE COMPONENT MEASUREMENTS IN SUBSONIC WIND TUNNEL [EXTERNE DEHNUNGSMESSSTREIFENWAGEN FUER DREIKOMPONENTENKRAFTMESSUNGEN IM UEBERSCHALLWINDKANAL]
G. Kausche *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 43-69 refs In GERMAN
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

An external strain gage balance for measuring three components on supersonic wind tunnel models is reported. Adjustment of the various measuring elements for tangential-, normal force-, and pitch moment-loads improves measuring precision and interference behavior but does not eliminate nonlinear interference properties. Some aerodynamic example measurements are included.
Transl. by G.G.

N72-26345# Aircraft Research Association, Ltd., Bedford (England).
WIND TUNNEL BALANCE STRAIN GAUGING TECHNIQUES
A. Pendleton *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 71-83
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

For static measurements using internal sting balances and control surface balances, temperature compensated foil gages encapsulated in phenolic glass are used exclusively. For dynamic measurements the same gauges are used if the signals are large enough, otherwise encapsulated semiconductor gauges are applied. The use of four active strain gauges wired in a bridge circuit has the following advantages: (1) the signal output is four times greater: (2) the effects of temperature are largely cancelled; (3) the effect of variation in intergauge wiring resistance due to temperature is minimized; and (4) interactions of other loads and moments are also minimized.
Author

N72-26346# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
FACILITY CONNECTED ERROR EFFECTS UP TO 0.1 PERCENT IN WIND TUNNEL BALANCES WITH STRAIN GAUGE SYSTEMS [ANLAGENBEDINGTE STOEREINFLUESSE BIS IN DEN BEREICH VON 0,1 PERCENT BEI WINDKANALWAAGEN MIT DEHNUNGSMESSSTREIFENSYSTEMEN]
P. J. Weber *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 85-101 refs In GERMAN
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

Thermal and mechanical effects of wind tunnels produce balance measurement errors. Interpretation of apparent strain values as functions of error effects for data storage and correction combines multiple temperature effects into one systematic error analysis.
Transl. by G.G.

N72-26347# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
WIND TUNNEL TESTS TO DETERMINE THE INSTATIONARY AERODYNAMIC DERIVATIVES ON A MODEL OF A TWIN BRIDGE
J. W. G. vanNunen, A. J. Persoon, and H. Tijdeman *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 103-128 refs
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

Measurements were carried out on a model of a twin-bridge to determine the instationary aerodynamic loads needed to perform stability calculations. The measuring procedure, based on an inertia compensated balance system, has been described and to demonstrate the applicability thereof, some results are presented and discussed.
Author

N72-26348# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
DERIVATION MEASUREMENTS IN SUPERSONIC WIND TUNNELS BY FREE OSCILLATION METHOD [DERIVATIVAMESSUNGEN NACH DER METHODE DER FREIEN SCHWINGUNGEN IM UEBERSCHALLWINDKANAL]
N. Treinies *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 129-151 ref In GERMAN
Avail: NTIS HC $10.50; ZLDI Munich: 37,80 DM

Dynamic stability derivation measurements on aerodynamic models in supersonic wind tunnels by a freely oscillating balance system are discussed. A cross spring joint in the balance acts as linear oscillator and provides velocity proportional damping at small angles. Spring constant and damping are reproducable values in calibration trials.
Transl. by G.G.

N72-26349# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

BUFFETING MEASUREMENTS ON A WING-BODY-MODEL WITH STRAIN GAUGES AT THE WINGS [BUFFETING-MESSUNGEN AN EINEN FLUEGEL-RUMPF-MODELL MIT DEHNMESSTREIFEN AM FLUEGEL]

R. Vanino *In* DGLR Rept. on the 2d Meeting of the DGLR-Sci. Comm. of the Ger. Aerospace Soc. Feb. 1972 p 153-178 refs In GERMAN

Avail: NTIS HC $10.50; ZLDI Munich: 37.80 DM

The buffeting behavior of four differential airfoil geometries was studied in wind tunnel tests by determining bending moment oscillations at the wing-body roots through a strain gage. Analyses of dynamic gage signals indicated that a thin, slightly pointed wing is aerodynamically superior to a thicker, strongly pointed airfoil under similar buffeting conditions.

Transl. by G.G.

N72-26358# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

VISUALIZATION OF AERODYNAMIC FLOWS IN COMPRESSORS BY HOLOGRAPHIC INTERFEROMETRY Thesis - Paris Univ., 20 Dec. 1971 [VISUALISATION D'ECOULEMENTS AERODYNAMIQUES DANS LES COMPRESSEURS PAR INTERFEROMETRIE HOLOGRAPHIQUE]

Jean-Marie Caussignac 1972 41 p refs In FRENCH; ENGLISH summary

(ONERA-NT-190) Avail: NTIS HC $4.25

The advantages of holography over other visualization methods and its disadvantages are presented. Only a retrodiffusion holographic set-up is necessary, as the turbomachine hub is opaque. The blade-carrying hub is used as the diffusing surface. The difficulty in using such a method is that the experimental conditions are severe. During the run, the hub vibrates and heats. During processing, these deformations entail spurious fringes often difficult to interpret. A preliminary study of the influence of various fundamental diffuser displacements is described, and some examples are presented of the interferograms obtained in wind tunnel. Author (ESRO)

N72-26360# California Univ., Richmond. Inst. of Transportation and Traffic Engineering.

HEAD UP DISPLAY STUDY *Final Report*

Don D. Horning, D. M. Finch, Karl Mellander, and Alvah Miller May 1971 167 p refs

(AD-738591; FAA-RD-71-60) Avail: NTIS CSCL 01/4

The study objectives were to investigate effects of a Head-Up Display on a pilot's ability to see runway lights in fog. Methods of evaluation of the Head-Up Display concept under low visibility conditions were developed. Various physical parameters were measured. Luminance of the Head-Up Display, cockpit interior, and external scent were measured with a Pritchard Telephotometer at 30 minute arc intervals. The 'scene' was examined for glare sources and analyzed for the adaptation level which could be expected by a pilot. Under normal operating conditions with the visibility range 1200 ft, day or night, no glare sources were identified and adaptation levels were reasonable. It was concluded from these objective measurements that the Head-Up Display unit tested would not adversely affect pilot's ability to see runway lights in fog. Author (GRA)

N72-26363# Naval Air Test Center, Patuxent River, Md.

A STUDY OF AIRPLANE TOUCHDOWN DATA MEASURING DEVICES USED DURING CARRIER SUITABILITY STRUCTURAL TESTS

C. P. Senn 14 Mar. 1972 24 p refs

(AD-738811; NATC-FT-TM-1-72) Avail: NTIS CSCL 14/5

The report contains the results of a statistical study of the reading accuracy of the Photo-Sonics 35mm - 4M camera. The reading accuracy limits of the Photo-Sonics camera must be increased (a decrease in accuracy) above those stated for the Cameraflex. However, this should not imply that the Photo-Sonics camera is less accurate than the Cameraflex. The opposite of this is the case. Additionally, the improvement in the reading accuracy of the Photo-Sonics camera coverage is supported by the data showing the reduction in the sink speed standard deviation from 0.34 fps for the Cameraflex to 0.27 fps for the Photo-Sonics camera. Author (GRA)

N72-26382*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

TEXTILE MECHANICAL ELEMENTS IN AEROSPACE VEHICLE PARACHUTE SYSTEMS

Matts J. Lindgren and Kenneth E. French *In* NASA. Ames Res. Center 6th Aerospace Mech. Symp. Jun. 1972 p 27-32 refs

Avail: NTIS HC $3.00 CSCL 11D

Materials, design considerations, and design details for textile mechanical elements used in aerospace vehicle parachute systems are briefly reviewed. Friction burns are noted as a major *cause of parachute system failures. The friction burn hazard can* be minimized by designing for predeployment and deployment sequence control with textile mechanical restraints. Two basic restraint designs (restraint loops and line ties) are discussed and various applications of the designs shown. Author

N72-26409# Army Air Mobility Research and Development Lab., Fort Eustis, Va.

WIRE-BRAIDED HOSE CHAFING TESTS Final Report

Donald R. Artis, Jr. Jan. 1972 77 p refs

(DA Proj. 1F1-62205-A-119)

(AD-738842; USAAMRDL-TR-72-1) Avail: NTIS CSCL 13/11

The report presents the results of a series of tests conducted to determine the chafing characteristics of wire-braided hoses in an Army helicopter vibration environment. The tests were conducted by vibrating wire-braided hoses against one another until they failed or reached the predetermined termination test time. Failure was defined as a loss of hydraulic fluid through a worn or punctured lining at the point of contact. Once a mean time between failure was established for the unprotected (no chafe guard) hoses, various chafing protection schemes and materials were examined for their effectiveness.

Author (GRA)

N72-26471# Air Force Systems Command, Wright-Patterson AFB, Ohio. *Foreign Technology Div.*

INFLUENCE OF TEST TIME AND CONTACT STRESSES ON ANTIWEAR PROPERTIES OF JET FUELS UNDER ROLLING FRICTION

A. F. Aksenov and A. A. Litvinov 30 Dec. 1971 10 p refs Transl. into ENGLISH from Samoletostr. Tekh. Vozdush. Flota (USSR), no. 17, 1970 p 130-133

(AF Proj. 7343)

(AD-738883; FTD-HT-23-1235-71) Avail: NTIS CSCL 11/4

An experiment investigation of the influence of various factors on the wear of jet fuels (T-1, TS-1, T-7, and T-7 with antiwear additions) was conducted using the magnitude of wear and the increment in fuel temperature as criteria for evaluating the antiwear properties of the fuels. Particular attention was given to the influence of contact stresses, the rate of rolling friction, and time. It is shown that these factors can have a substantial influence on the quantitative and qualitative relationships between friction and wear. This indicates that the antiwear properties of such fuels should be studied in the laboratory for a wide range of external effects. Author (GRA)

N72-26472# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.

CORROSION RESISTANCE OF FASTENER COATINGS *Progress Report*

Stanley R. Brown 11 Jan. 1972 41 p refs

(AD-738805; NADC-MA-7150) Avail: NTIS CSCL 11/3

Coating materials are needed to replace electrodeposited cadmium on steel fasteners for use in high performance aircraft. A study was made to compare corrosion resistance of ten

experimental coatings, mostly aluminum-rich types, with cadmium. Several experimental coatings provided high resistance to 5% NaCl salt fog and NaCl-SO2 salt fog exposure tests. Paint adhesion was excellent on all fastener coatings with an epoxy primer/polyurethane topcoat system. Cadmium and the other fastener materials examined in this study varied widely in coating thickness on different fastener surface areas.
Author (GRA)

N72-26475*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF TRANSFORMATION EQUATIONS AND EQUATIONS OF MOTION USED IN FREE FLIGHT AND WIND TUNNEL DATA REDUCTION AND ANALYSIS
Thomas G. Gainer and Sherwood Hoffman 1972 127 p refs
(NASA-SP-3070) Avail: NTIS HC $3.00 CSCL 12A

Basic formulations for developing coordinate transformations and motion equations used with free-flight and wind-tunnel data reduction are presented. The general forms presented include axes transformations that enable transfer back and forth between any of the five axes systems that are encountered in aerodynamic analysis. Equations of motion are presented that enable calculation of motions anywhere in the vicinity of the earth. A bibliography of publications on methods of analyzing flight data is included.
F.O.S.

N72-26516*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIGATION FOR SPACE SHUTTLE APPROACH AND LANDING USING AN INERTIAL NAVIGATION SYSTEM AUGMENTED BY DATA FROM A PRECISION RANGING SYSTEM OR A MICROWAVE SCAN BEAM LANDING GUIDANCE SYSTEM
L. A. McGee, G. L. Smith, D. M. Hegarty, R. B. Merrick, T. M. Carson, and S. F. Schmidt (Anal. Mech. Assoc., Mountain View, Calif.) Dec. 1970 41 p refs
(NASA-TM-X-62123) Avail: NTIS HC $3.75 CSCL 17G

A preliminary study has been made of the navigation performance which might be achieved for the high cross-range space shuttle orbiter during final approach and landing by using an optimally augmented inertial navigation system. Computed navigation accuracies are presented for an on-board inertial navigation system augmented (by means of an optimal filter algorithm) with data from two different ground navigation aids; a precision ranging system and a microwave scanning beam landing guidance system. These results show that augmentation with either type of ground navigation aid is capable of providing a navigation performance at touchdown which should be adequate for the space shuttle. In addition, adequate navigation performance for space shuttle landing is obtainable from the precision ranging system even with a complete dropout of precision range measurements as much as 100 seconds before touchdown.
Author

N72-26520# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
DIRECTION FINDING OF EMERGENCY RADIO BUOYS BY AIRCRAFT
M. Raab and H.-J. Zetzmann 3 Jan. 1972 93 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-110) Avail: NTIS HC $6.75, DFVLR Porz-Wahn: 29,40 DM

The characteristics of low power radio buoys operating at 2182kHz for search and rescue operations are discussed. The requirements of aircraft direction finders or radio compasses for taking bearings to the buoys is described. The minimum field strength for bearing is presented. Flight tests have demonstrated that the required ranges can be accomplished by accommodating aircraft installations in the form of modified and improved equipment.
Author

N72-26522# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF ERRORS OF AN INERTIAL NAVIGATION SYSTEM CONSTRUCTED ON THE BASIS OF A GYRO HORIZON
V. A. Karakashev and S. Ia. Rozhetskii 1972 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), v. 15, no. 4, 1972 p 76-81
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A numerical analysis of the errors of an inertial navigation system constructed on the basis of a gyro horizon is presented. Dependences are obtained for the errors of the system in relation to the instrumental errors of the directional gyroscope and the gyro horizon. Other sources of error are the moments due to gravitational and inertial forces, harmful moments due to the unbalance of the gyrosphere and gyroscopes, the imperfection of the spring unit, and convection fluxes of the sustaining fluid. Mathematical models are included to explain the theoretical aspects.
Author

N72-26523# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
A TIME-FREQUENCY, HIGH PERFORMANCE COLLISION AVOIDANCE SYSTEM
Roger Gouillou 1972 7 p refs Presented at Ann. Meeting of Inst. of Navigation, West Point, N. Y., 27-29 Jun. 1972
(ONERA-TP-1091) Avail: NTIS HC $3.00

The characteristics of collision avoidance systems used for air traffic control are discussed. A modification of the message format is recommended. Lengthening the pulse from 200 to 800 microseconds is recommended in order to improve the velocity measurement precision. An automatic receiver gain is proposed to reduce the influence of multipaths and make ground synchronization possible. Other advantages of the new format are smaller power requirement and simplified equipment.
Author

N72-26524# *Little (Arthur D.), Inc., Cambridge, Mass.*
CONTINUING STUDIES OF AIR TRAFFIC CONTROL SYSTEM CAPACITY, 1970-1971 Interim Report, Oct. 1970 - Oct. 1971
G. Raisbeck, J. L. Everett, and B. O. Koopman Jan. 1972 30 p refs
(Contract DOT-FA 70WA-2141)
(FAA-RD-72-2) Avail: NTIS HC $3.50

An analysis of air traffic control systems capacity to determine technical and operational factors is presented. The subjects discussed are: (1) a concept of capacity, (2) a measure of safety, (3) analytical tools from the theory of queues, (4) analysis of system functions, (5) description of system parameters, and (6) applications to current air traffic control problems.
Author

N72-26526# Federal Aviation Administration, Washington, D.C. Air Traffic Service.
SIMULATION OF TERMINAL CONTROL CORRIDOR, BOSTON, MASSACHUSETTS Final Report, Nov. 1970 - Sep. 1971
Daniel J. Enright and Edwin H. Price Sep. 1971 57 p refs
(AD-739130; FAA-AT-71-1) Avail: NTIS CSCL 17/7

The purpose of the project was to demonstrate to the aviation industry the effectiveness and feasibility of the terminal control corridor concept in comparison with actual traffic, the terminal control area concept and modifications to the industry developed control corridor concept.
Author (GRA)

N72-26527# International Business Machines Corp., Owego, N.Y. Electronics Systems Center.
RANGE-ONLY MULTIPLE AIRCRAFT NAVIGATION SYSTEM (ROMANS) Final Report
Phillip D. Danker, Charles W. Witt, and H. H. Christensen Griffiss AFB, N. Y. RADC Feb. 1972 141 p refs
(Contract F30602-71-C-0027)
(AD-738696; IBM-71-A21-044; RADC-TR-72-22) Avail: NTIS CSCL 17/7

The report describes the system design and flight test evaluation of a Range-Only Multiple Aircraft Navigation System (ROMANS) deployed at Griffiss AFB, Rome N.Y. The ROMANS system consists of a command station, two remote (Beacon) stations, an aircraft station with steering meter capability and an aircraft station which was used on the ground during the test program. In operation, radio pulses initiated at the command station are transmitted to the aircraft both directly and via the remote stations. Distance measurements derived from these pulses are used in the command station computer to determine aircraft position. The system has hardware provision for accepting aircraft altitude data, if available, for use under conditions of poor geometry. Author (GRA)

N72-26545*# Martin Marietta Corp., Denver, Colo.
INSULATION SYSTEMS FOR LIQUID METHANE FUEL TANKS FOR SUPERSONIC CRUISE AIRCRAFT Final Report
H. F. Brady and D. DelDuca Jun. 1972 199 p
(Contract NAS3-12425)
(NASA-CR-120930; MCR-72-42) Avail: NTIS HC $12.00 CSCL 20L

Two insulation systems for tanks containing liquid methane in supersonic cruise-type aircraft were designed and tested after an extensive materials investigation. One system is an external insulation and the other is an internal wet-type insulation system. Tank volume was maximized by making the tank shape approach a rectangular parallelopiped. One tank was designed to use the external insulation and the other tank to use the internal insulation. Performance of the external insulation system was evaluated on a full-scale tank under the temperature environment of -320 F to 700 F and ambient pressures of ground-level atmospheric to 1 psia. Problems with installing the internal insulation on the test tank prevented full-scale evaluation of performance; however, small-scale testing verified thermal conductivity, temperature capability, and installed density.
Author

N72-26556# Aeronautical Research Council (England).
PAPERS ON NOVEL AERODYNAMIC NOISE SOURCE MECHANISMS AT LOW JET SPEEDS
May 1972 71 p refs Supersedes ARC-32925
(ARC-CP-1195) Avail: NTIS HC $5.75; HMSO £1.13; PHI $4.90

Studies relating to aerodynamic noise sources and the calculation of their sound fields for subsonic jet speeds are presented.

N72-26687*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BASIC TURBINE CONCEPTS
Arthur J. Glassman *In its* Turbine Design and Appl., Vol. 1 1972 p 21-67 refs
Avail: NTIS; SOD $0.60 CSCL 21E

Turbine geometric, flow, energy transfer, efficiency, and performance characteristics are considered by the use of definitions, diagrams, and dimensionless parameters. Emphasis is placed on the determination of the fluid velocity as it passes from one blade row to the next. The general methods for constructing velocity diagrams and relating them to the work and flow capacity of the turbine are discussed. D.L.G.

N72-26688*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VELOCITY DIAGRAMS
Warren J. Whitney and Warner L. Stewart *In its* Turbine Design and Appl., Vol. 1 1972 p 69-99 refs
Avail: NTIS; SOD $0.60 CSCL 21E

The selection and design of velocity diagrams for axial flow turbines are considered. Application is treated in two parts which includes: (1) mean-section diagrams, and (2) radial variation of diagrams. In the first part, the velocity diagrams occurring at the mean section are assumed to represent the average conditions encountered by the turbine. The different types of diagrams, their relation to stage efficiency, and their selection when staging is required are discussed. In the second part, it is shown that in certain cases the mean-section diagrams may or may not represent the average flow conditions for the entire blade span. In the case of relatively low hub- to tip-radius ratios, substantial variations in the velocity diagrams are encountered. The radial variations in flow conditions and their effect on the velocity diagrams are considered. D.L.G.

N72-26689*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE-STAGE EXPERIMENTAL EVALUATION OF TANDEM-AIRFOIL ROTOR AND STATOR BLADING FOR COMPRESSORS. PART 1: ANALYSIS AND DESIGN OF STAGES A, B, AND C
J. A. Brent, J. G. Cheatham, and A. W. Nilsen Jun. 1972 118 p refs
(Contract NAS3-11158)
(NASA-CR-120803; PWA-FR-4667-Pt-1) Avail: NTIS HC $8.00 CSCL 21E

A conventional rotor and stator, two dual-airfoil tandem rotors, and one dual-airfoil tandem stator were designed. The two tandem rotors were each designed with different percentages of the overall lift produced by the front airfoil. Velocity diagrams and blade leading and trailing edge metal angles selected for the conventional rotor and stator blading were used in the design of the tandem blading. Rotor inlet hub/tip ratio was 0.8. Design values of rotor tip velocity and stage pressure ratio were 757 ft/sec and 1.30, respectively. Author

N72-26690*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE-STAGE EXPERIMENTAL EVALUATION OF TANDEM-AIRFOIL ROTOR AND STATOR BLADING FOR COMPRESSORS. PART 2: DATA AND PERFORMANCE FOR STAGE A
J. A. Brent Jul. 1972 120 p refs
(Contract NAS3-11158)
(NASA-CR-120804; PWA-FR-4719) Avail: NTIS HC $8.00 CSCL 21E

Stage A, comprised of a conventional rotor and stator, was designed and tested to establish a performance baseline for comparison with the results of subsequent tests planned for two tandem-blade stages. The rotor had an inlet hub/tip ratio of 0.8 and a design tip velocity of 757 ft/sec. At design equivalent rotor speed, rotor A achieved a maximum adiabatic efficiency of 85.1 percent at a pressure ratio of 1.29. The stage maximum adiabatic efficiency was 78.6 percent at a pressure ratio of 1.27.
Author

N72-26691*# General Electric Co., Lynn, Mass. Aircraft Engine Group.
TF34 TURBOFAN QUIET ENGINE STUDY Final Report
D. P. Edkins, R. Hirschkron, and R. Lee [1971] 99 p ref
(Contract NAS3-14338)
(NASA-CR-120914) Avail: NTIS HC $7.00 CSCL 21E

A study is presented of high bypass turbofan engines in heavily sound-suppressed nacelles based on the TF-34 engine. The four-engine noise objective was 95 PNdB at four locations typical of takeoff and landing. Three engines were studied; these had fan pressure ratios, bypass ratios and fan tip speeds respectively of 1.48/6.5/404m/s (1327 ft/s),1.25/13/305 (1000), 1.25/13/366 (1200). The bypass 13 engines had a variable pitch fan, direct- and gear-driven. Noise suppressive treatment was identified which met the 95 PNdB objective except for sideline liftoff at 6.5 bypass, full power, which was 2 PNdB noisier; at 90% power, 95 PNdB was achieved. Author

N72-26692*# General Electric Co., Lynn, Mass. Aircraft Engine Group.

ACOUSTICALLY TREATED GROUND TEST NACELLE FOR THE GENERAL ELECTRIC TF34 TURBOFAN Final Report
D. P. Edkins 31 Jan. 1972 66 p
(Contract NAS3-14338)
(NASA-CR-120915) Avail: NTIS HC $5.50 CSCL 21E

A description is given of the ground test quiet nacelle for the TF34 engine. The suppression treatment consists of cylindrical splitters in the inlet and fan exhaust ducts plus duct wall treatment and core exhaust wall treatment. Aerodynamic design analysis of the inlet and exhaust ducts and overall engine performance with pressure losses from the acoustic treatment is included. The objectives of the test program are to obtain noise data for a heavily suppressed high bypass turbofan with various arrangements of exhaust systems and acoustic treatment, and to provide a basis for the power plants of the Quiet Experimental STOL Aircraft (Questol). Author

N72-26693*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EVALUATION OF RANGE AND DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, TASK 2 Final Report
K. R. Bilwakesh, C. C. Koch, and D. C. Prince Sep. 1971 224 p refs
(Contract NAS3-11157)
(NASA-CR-72880; GE-R71AEG195) Avail: NTIS HC $13.25 CSCL 21E

A 0.5 hub/tip radius ratio compressor stage consisting of a 1500 ft/sec tip speed rotor, a variable camber inlet guide vane and a variable stagger stator was designed and tested with undistorted inlet flow, flow with tip radial distortion and flow with 90 deg, one-per-rev, circumferential distortion. At the design speed and design IGV and stator setting the design stage pressure ratio was achieved at a weight flow within 1% of the design flow. The rotor met its principal objective of achieving higher efficiencies at speeds above 1450 ft/sec than those achieved by a 1400 ft/sec design tip speed rotor tested under the same contract. Analytical results on rotor tip shock structure, deviation angle and part-span shroud losses at different operating conditions are presented. The variable geometry blading enabled efficient operation with adequate stall margin at the design condition and at 70% speed. Closing the inlet guide vanes of 40 deg changed the speed-versus-weight flow relationship along the stall line and thus provided the flexibility of operation at off-design conditions. A stage-matching analysis shows that the variable geometry IGV's can be used effectively to match a hypothetical second stage to the Task 2 Stage at off-design speeds with undistorted inlet flow. Author

N72-26695*# General Electric Co., Cincinnati, Ohio. Aircraft Gas Turbine Div.
EXPERIMENTAL QUIET ENGINE PROGRAM AERODYNAMIC PERFORMANCE OF FAN A
R. G. Giffin, D. E. Parker, and L. W. Dunbar May 1971 112 p refs
(Contract NAS3-12430)
(NASA-CR-120858) Avail: NTIS HC $7.75 CSCL 21E

The aerodynamic component test results are presented of fan A, one of two high-bypass-ratio, 1160 feet per second single-stage fans, which was designed and tested as part of the NASA Experimental Quiet Engine Program. This fan was designed to deliver a bypass pressure ratio of 1.50 with an adiabatic efficiency of 86.5% at a total fan flow of 950 lb/sec. It was tested with and without inlet flow distortion. A bypass total-pressure ratio of 1.52 and an adiabatic efficiency of 88.3% at a total fan flow of 962 lb/sec were actually achieved. An operating margin of 12.4% was demonstrated at design speed. Author

N72-26815 Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION BULLETIN, NO. 42. PART 1: INVITED PAPERS, SPECIFICATIONS, MECHANICAL IMPEDANCE, TRANSPORTATION AND PACKAGING Conference Proceedings
Jan. 1972 257 p refs Presented at 42d Symp. on Shock and Vibration, Key West, Fla., 2-4 Nov. 1971 5 Vol.
(AD-739574; Bull-42-Pt-1) Avail: Shock and Vibration Information Center, Naval Research Labs., Washington, D. C: HC $40.00 per set CSCL 20/11

Conference papers on shock and vibration are presented that deal with the related areas of standards and specifications, measurement and application of mechanical impedance, and transportation and packaging.

N72-26817 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
SURVEY OF VIBRATION TEST PROCEDURES IN USE BY THE AIR FORCE
Wayne B. Yarcho *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 42, Pt. 1 Jan. 1972 p 11-17 ref
Avail: Shock and Vibration Information Center, Naval Research Labs., Washington, D. C.: HC $40.00 per set

A survey was conducted of specifications and standards containing vibration test procedures in use by the Air Force, to assess progress toward the establishment and maintenance of uniform procurement guidelines. A representative sample of hardware specifications selected from the DOD Specification Index was examined to establish the direction and extent of use of vibration tests offered in the various test specifications and standards. A number of documents presenting vibration test methods were reviewed to determine what procedures are available for application to hardware items. Conclusions relative to the current status of vibration testing methods are presented. Author

N72-26828 Sandia Labs., Albuquerque, N.Mex.
THE DYNAMIC ENVIRONMENT OF SELECTED MILITARY HELICOPTERS
Mark B. Gens *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 42, Pt. 1 Jan. 1972 p 153-161 refs Supported by AEC
Avail: Shock and Vibration Information Center, Naval Research Labs., Washington, D. C.: HC $40.00 per set

A study was conducted to determine the dynamic input to cargo from the floor of the cargo space in the OH-6, UH-1, CH-46, and CH-47 helicopters. The instrumentation, test procedures, data reduction processes, and results are discussed. The vibration regime for helicopters is shown to consist of a base of Gaussian random excitation with superimposed decaying sinusoids which are associated with rotor activity. Author

N72-26876 Honeywell, Inc., Hopkins, Minn. Government and Aeronautical Products Div.
THE EFFECT OF THE FIN-OPENING SHOCK ENVIRONMENT ON GUIDED MODULAR DISPENSER WEAPONS
K. D. Denton and K. A. Herzing *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 42, Pt. 3 Jan. 1972 p 159-165 refs
Avail: Shock and Vibration Information Center, Naval Research Labs., Washington, D. C: HC $40.00 per set

Recent laboratory studies of a first-generation aircraft modular dispenser weapon have shown that modularity, while increasing the efficiency and effectiveness of the inventory, may result in subjecting weapon components to significant self-generated system operational environments for which the component was not originally designed or was not expected to experience in its normal manufacture-to-target logistic flow. For example, the shock environment produced by tailfin opening of a weapon in free flight was found to be a significant factor that should be considered when designing and developing future modular weapon systems employing folded fins. The results of the fin-opening shock study are presented and the fin-opening shock environment levels are shown to be higher than those allowed by conventional MIL-STD requirements. A procedure for developing a shock spectrum test criterion for modular fuze and guidance electronic components is also included. Author

N72-26904 Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION BULLETIN, NO. 42. PART 5: SHOCK, VIBRATION, STRUCTURAL ANALYSIS
Conference Proceedings
Jan. 1972 255 p refs Presented at 42d Symp. on Shock and Vibration, Key West, Fla., 2-4 Nov. 1971 5 Vol.
(AD-739578; Bull-42-Pt-5) Avail: Shock and Vibration Information Center, Naval Research Labs., Washington, D. C.: HC $40.00 per set

Shock and vibration anlaysis of structural components of ships, spacecraft, aircraft, and ordnance items is discussed.

N72-26909 Army Materials and Mechanics Research Center, Watertown, Mass.
RESPONSE OF HELICOPTER ROTOR BLADES TO RANDOM LOADS NEAR HOVER
C. Lakshmikantham and C. V. JogaRao *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., No. 42, Pt. 5 Jan. 1972 p 37-45 refs
Avail: Shock and Vibration Information Center, Naval Research Labs., Washington, D. C.: HC $40.00 per set

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

N72-26939*# Boeing Co., Seattle, Wash.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF AIRCRAFT METAL STRUCTURES REINFORCED WITH FILAMENTARY COMPOSITES. PHASE 2: STRUCTURAL FATIGUE, THERMAL CYCLING, CREEP, AND RESIDUAL STRENGTH
B. Blichfeldt and J. E. McCarty Washington NASA Jun. 1972 111 p refs
(Contract NAS1-8858)
(NASA-CR-2039; D6-60136-2) Avail: NTIS HC $3.00 CSCL 20K

Specimens representative of metal aircraft structural components reinforced with boron filamentary composites were manufactured and tested under cyclic loading, cyclic temperature, or continuously applied loading to evaluate some of the factors that affect structural integrity under cyclic conditions. Bonded, stepped joints were used throughout to provide composite-to-metal transition regions at load introduction points. Honeycomb panels with titanium or aluminum faces reinforced with unidirectional boron composite were fatigue tested at constant amplitude under completely reversed loading. Results indicated that the matrix material was the most fatigue-sensitive part of the design, with debonding initiating in the stepped joints. However, comparisons with equal weight all-metal specimens show a 10 to 50 times improved fatigue life. Fatigue crack propagation and residual strength were studied for several different stiffened panel concepts, and were found to vary considerably depending on the configuration. Composite-reinforced metal specimens were also subjected to creep and thermal cycling tests. Thermal cycling of stepped joint tensile specimens resulted in a ten percent decrease in residual strength after 4000 cycles. Author

N72-26944# National Aerospace Lab., Amsterdam (Netherlands).
STIFFNESS MATRIX FOR A TAPERED SPAR ELEMENT
J. vanderVooren 29 Apr. 1970 63 p refs Sponsored by Neth. Aircraft Develop. Board
(NLR-TR-70052-V) Avail: NTIS HC $5.25

A class of tapered spar elements is developed and tested. The effect of warpage of the cross-section under transverse shear load and the influence of varying deflection over the depth of the spar are investigated. Author (ESRO)

N72-26985# Commission of Outdoor Recreation, Richmond, Va.
HELIPORT FOR THE DISTRICT OF COLUMBIA
Washington GPO 1971 73 p refs Hearing on H.R. 9723 before Comm. on Public Works, 92d Congr., 1st Sess., 23 Sep. 1971
Avail: Subcomm. on Public Bldgs. and Grounds

The hearing concerning a heliport for the District of Columbia before the Subcommittee on Public Buildings and Grounds of the Committee for Public Works of the U.S. House of Representatives is presented. The statements of various witnesses concerning the need for increased helicopter facilities constitute the bulk of the report. The advantages of a heliport are discussed from various points of view. The economics and operating requirements of the installation are examined. P.N.F.

N72-26986# Committee on Armed Services (U. S. House).
CUBAN PLANE INCIDENT AT NEW ORLEANS
Washington GPO 3 Jan. 1972 14 p ref Report presented to the Comm. on Armed Serv., 92d Congr., 1st Sess., 3 Jan. 1972
Avail: Armed Serv. Investigating Subcomm.

A Congressional investigation into the penetration of United States Defenses by a Cuban aircraft on 26 October 1971 is reported. The investigation was initiated following the arrival of a transport aircraft on a flight from Havana, Cuba to New Orleans, Louisiana, with no detection or warning prior to arrival at the New Orleans airport. The lack of military security which made this flight possible is examined and causes for the defects in the security system are analyzed. Recommendations are made to prevent future occurrences. P.N.F.

N72-26987# Committee on Armed Services (U. S. House).
CUBAN PLANE INCIDENT AT NEW ORLEANS
Washington GPO 1972 125 p Hearings before Comm. on Armed Serv., 92d Congr., 1st Sess., 9 and 17 Nov. and 9 Dec. 1971
Avail: Armed Serv. Investigating Subcomm.

The findings of a Congressional hearing concerning an undetected flight of a Russian built AN-24 aircraft from Havana, Cuba to New Orleans, Louisiana are presented. The flight occurred on October 26, 1971 and exposed a deficiency in air traffic control and military surveillance and interception procedures. The circumstances surrounding the incident and the dereliction of the organizations involved are discussed. The verbatim testimonies of many witnesses compose the major part of the report. P.N.F.

N72-26994 Aeronautical Research Council (England).
TECHNICAL REPORT FOR THE YEAR 1958. VOLUME 2: [RESEARCH ON AIRCRAFT, BOUNDARY LAYERS, COMPRESSORS AND TURBINES, AND FLUTTER AND OSCILLATIONS]
HMSO 1971 881 p refs 3 Vol.
(SBN-11-470152-0) Copyright. Avail: HMSO £20; PHI $77.52

N72-26995 Aeronautical Research Council (England).
TECHNICAL REPORT FOR THE YEAR 1958. VOLUME 3: [RESEARCH ON GUIDED WEAPON SYSTEMS, WIND TUNNELS, VTOL, AIRCRAFT, SEAPLANES, AND RELATED AERONAUTICAL TOPICS]
HMSO 1971 1480 p refs 3 Vol.
(SBN-11-470153-9) Copyright. Avail: HMSO £18; PHI $69.77

N72-26996*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF THE APPLICABILITY OF THE

FREE-WING PRINCIPLE TO LIGHT, GENERAL AVIATION AIRCRAFT
Richard F. Porter, Ross G. Luce, and Joe H. Brown, Jr. Washington NASA Jun. 1972 120 p refs
(Contract NAS1-10174)
(NASA-CR-2046) Avail: NTIS HC $3.00 CSCL 01A

Gust-alleviation benefits for aircraft employing an unconventional wing, free to pivot about a spanwise axis forward of its aerodynamic center and subject only to aerodynamic pitching moments imposed by lift and drag forces and a trailing-edge control surface are reviewed. Author

N72-26999# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC DESIGN AND TEST RESULTS OF FRONT FANS
Shoichi Fujii, Hide Nishiwaki, and Mitsuo Gomi Jan. 1972 26 p refs
(NAL-TR-268T) Avail: NTIS HC $3.50

Full scale front fans were designed and tested with satisfactory results. The flow field in passing through the fans was estimated by means of a method called streamline-curvature technique. In the first test program the rotor blade row was without snubbers (part-span shroud) and in the second, with them. A comparison of both experimental data enabled the flow behavior and aerodynamic characteristics to be visualized under these two different inlet conditions. Author

N72-27000# National Aerospace Lab., Tokyo (Japan).
INTERFERENCE BETWEEN WING AND SURFACE OF VELOCITY DISCONTINUITY
Norio Inumaru 1971 64 p refs In JAPANESE; ENGLISH summary
(NAL-TR-254) Avail: NTIS HC $5.25

A study is made on the aerodynamic interference between a wing and the surface of velocity discontinuity in a non-uniform potential flow field. The surface of velocity discontinuity is deformed around the wing which penetrates the surface. A deformation of the surface is theoretically predicted, leading to the conclusion that a sectorial region will be formed on the wing. Formation of the sectorial region is recognized in new experiments and also in many existing experimental data. Both theoretical and experimental analyses are made on the physical roles of the sectorial region. Author

N72-27002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EFFICIENT ALGORITHM USING MATRIX METHODS TO SOLVE WIND TUNNEL FORCE-BALANCE EQUATIONS
David L. Smith Washington Aug. 1972 43 p refs
(NASA-TN-D-6860; L-8278) Avail: NTIS HC $3.00 CSCL 20D

An iterative procedure applying matrix methods to accomplish an efficient algorithm for automatic computer reduction of wind-tunnel force-balance data has been developed. Balance equations are expressed in a matrix form that is convenient for storing balance sensitivities and interaction coefficient values for online or offline batch data reduction. The convergence of the iterative values to a unique solution of this system of equations is investigated, and it is shown that for balances which satisfy the criteria discussed, this type of solution does occur. Methods for making sensitivity adjustments and initial load effect considerations in wind-tunnel applications are also discussed, and the logic for determining the convergence accuracy limits for the iterative solution is given. This more efficient data reduction program is compared with the technique presently in use at the NASA Langley Research Center, and computational times on the order of one-third or less are demonstrated by use of this new program. Author

N72-27004# Cambridge Univ. (England). Dept. of Engineering.
PRESSURE DISTRIBUTIONS AT M SUB INFINITY = 3.51 AND AT HIGH INCIDENCES ON FOUR WINGS WITH DELTA PLANFORM
R. Hillier London Aeron. Res. Council 1972 34 p refs Supersedes ARC-32828 Sponsored by Sci. Res. Council
(ARC-CP-1198) Avail: NTIS HC $3.75; HMSO 55p; PHI $2.35

Results are presented for wind tunnel tests at 3.51 M on four wings with pointed vertices and sharp leading edges. Two conical models were tested through a wide range of angles of incidence and yaw and the results clearly demonstrate the stabilizing effect of dihedral. Two simple non-conical wings were also tested and it is shown, in this case, that the pressure on the compression surfaces may be approximately deduced from an equivalent conical wing. Author (ESRO)

N72-27006 Rensselaer Polytechnic Inst., Troy, N.Y.
EFFECT OF FORWARD SPEED ON A TWO-DIMENSIONAL PERIPHERAL-JET GROUND EFFECT SUPPORT Ph.D. Thesis
George Cunkle Cooke, IV 1971 210 p
Avail: Univ. Microfilms Order No. 72-1182

A theory for the effect of forward speed on a two dimensional peripheral jet ground effect support is presented. New analytical models are proposed for the flow at the nozzle exit of the peripheral jets and the cross flow underneath the support. The analysis is carried to the point of determining upper and lower surface pressure distributions as well as lift and ideal pumping power. The theory is supported by the results of a comprehensive experimental study conducted with a two dimensional model in a moving ground wind tunnel. At low subcritical speeds the effect of forward speed was found to be adverse in the absence of upper surface lift. At high subcritical speeds performance improved such that lift power requirements at critical speeds were 20-30% below those at hover.
Dissert. Abstr.

N72-27007 Purdue Univ., Lafayette, Ind.
AN INVESTIGATION OF THE EFFECTS OF STOL AIRCRAFT OPERATING FROM CONGESTED MAJOR AIRPORTS Ph.D. Thesis
James Paul Ditz 1971 195 p
Avail: Univ. Microfilms Order No. 72-1848

Changes in aircraft congestion at major airports due to the introduction of short takeoff and landing (STOL) aircraft into the system of airlines operating from the major airport are evaluated. The STOL aircraft are assumed to operate from a STOL runway at the major airport. An approximation of the number and the schedules of conventional takeoff and landing aircraft with and without STOL aircraft in the system is obtained. An approximate transient M/D/1 queueing model is formulated to calculate aircraft delay times and imposed waiting times. The minimization of the objective function requires prior knowledge of the resulting arrival rates of aircraft at the landing and takeoff queues. Therefore, an iterative procedure is developed which modifies the input arrival rates so they converge approximately to the output rates. Dissert. Abstr.

N72-27008* National Aeronautics and Space Administration, Washington, D.C.
ENVIRONMENTAL STATEMENT FOR EARTH RESOURCES AIRCRAFT PROGRAM Draft Environmental Impact Statement
Mar. 1971 6 p
(NASA-TM-X-68550) Avail: NASA Public Document Rooms, $1.00 CSCL 01B

An environmental impact statement for the Earth Resources Aircraft program is submitted. The program objectives are summarized and the benefits are described. It is concluded that the air pollution resulting from the operation of four aircraft in the program cannot create a significant amount of environmental degradation. The adverse effects which cannot be avoided amount to the operation of the aircraft which meet the established criteria for operational aircraft. Author

N72-27009 National Lending Library for Science and Technology, Boston Spa (England).
THE DYNAMICS OF THE HIGH ATMOSPHERIC AND SUPERSONIC FLIGHT
C. Dousset and R. Joatton [1972] 11 p Transl. into ENGLISH from proceedings of French/Am. Meteorol. Soc. Joint Meeting, 1971
(NLL-M-22437-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The effects of atmospheric turbulence at high altitudes on the operation of supersonic transport aircraft is discussed. The characteristics of atmospheric turbulence under various conditions are described. Methods for advance detecting atmospheric turbulence are examined. It is concluded that the horizontal temperature gradient is the best known physical correlation which permits advance detection of clear air turbulence. The operational characteristics of the Concorde aircraft are used as examples of supersonic transport limitation under turbulent conditions. Author

N72-27010*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TERMINAL-AREA FLIGHT PROCEDURES AND ROUTE DESIGN FOR SUPERSONIC TRANSPORT NEW YORK-TRANSATLANTIC OPERATIONS
Richard H. Sawyer and Milton D. McLaughlin Washington May 1972 36 p refs
(NASA-TN-D-6801; L-8283) Avail: NTIS HC $3.00 CSCL 01B

The results of an analytical investigation of two departure and arrival transition procedures between John F. Kennedy International Airport and projected North Atlantic track systems for supersonic transport (SST) operations are presented. The procedures studied were: (1) separated departure and arrival transition routes with departures made at supersonic speeds, and (2) superimposed departure and arrival routes with departures restricted to subsonic speed until the airplane is on the track system. For both procedures, transition routes with intercept angles of 30 deg to 90 deg to both six-and four-track systems were investigated. Track spacings of 30 and 60 nautical miles were studied. Author

N72-27011# Civil Aeromedical Inst., Oklahoma City, Okla.
CRASH SURVIVAL ANALYSIS OF 16 AGRICULTURAL AIRCRAFT ACCIDENTS
J. J. Swearingen, T. F. Wallace, J. G. Blethrow, and D. E. Rowlan Apr. 1972 27 p refs
(FAA Proj. AM-A-72-PRS-37; FAA Proj. AM-A-71-PRS-37)
(FAA-AM-72-15) Avail: NTIS HC $3.50

Findings from on-the-scene investigations to evaluate the crashworthiness of the present fleet of agricultural applicator aircraft are presented. A detailed presentation of 16 crashes illustrates the fact that most of these specialized aircraft structures are well designed to protect the pilot, even in severe crashes. Most injuries and deaths of aerial applicator pilots are not attributable to failure of the cockpit structure itself, but rather to factors associated with (1) pilot restraint equipment, (2) seat failures, (3) failure of the roll-over structure, and (4) a lack of head impact attenuators at the top of the instrument panel. Author

N72-27012*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE GENERATED BY STOL CORE-JET THRUST REVERSERS
James R. Stone and Orlando A. Gutierrez 1972 17 p refs Presented at Aircraft Design, Flight Test, and Operations Meeting, Los Angeles, 7-9 Aug. 1972; sponsored by AIAA
(NASA-TM-X-68082; E-6975) Avail: NTIS HC $3.00 CSCL 01B

An experimental investigation on the noise generated by target-type thrust reversers is discussed. The experimental data are normalized and scaled up to sizes suitable for reversing the core jets of a 100,000 lb augmentor-wing-type STOL airplane. The scaling calculations yield perceived noise levels well above the 95-PNdB design goal for both sideline and flyover at 500 ft. V-gutter and semicylindrical reversers were tested with a 5.24-cm-diameter circular nozzle, and a semicylindrical reverser was also tested with a 7.78-cm-diameter circular nozzle. The thrust reversers, in addition to being noisier than the nozzle alone, also had a more uniform directivity. The maximum overall sound pressure level and the effective sound power level both varied with sixth power of the nozzle jet velocity. Author

N72-27013*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
STATISTICAL SURVEY OF XB-70 AIRPLANE RESPONSES AND CONTROL USAGE WITH AN ILLUSTRATION OF THE APPLICATION TO HANDLING QUALITIES CRITERIA
Bruce G. Powers Washington Jul. 1972 40 p refs
(NASA-TN-D-6872; H-663) Avail: NTIS HC $3.00 CSCL 01B

The magnitude and frequency of occurrence of aircraft responses and control inputs during 27 flights of the XB-70 airplane were measured. Exceedance curves are presented for the airplane responses and control usage. A technique is presented which makes use of these exceedance curves to establish or verify handling qualities criteria. This technique can provide a means of incorporating current operational experience in handling qualities requirements for future aircraft. Author

N72-27014*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF A TF30-P-3 TURBOFAN ENGINE IN AN ALTITUDE FACILITY: AFTERBURNER PERFORMANCE AND ENGINE-AFTERBURNER OPERATING LIMITS
John E. McAulay and Mahmood Abdelwahab Washington Jul. 1972 35 p refs
(NASA-TN-D-6839; E-6833) Avail: NTIS HC $3.00 CSCL 21E

For distortion free steady state operation at the maximum (full afterburning) throttle position, the afterburner combustion efficiency decreased from 0.91 to 0.68 as engine inlet Reynolds number index was reduced from 0.80 to 0.25. Engine afterburner operational limits were obtained for transient and fixed throttle operation over a range of engine inlet distortions. At limiting conditions, time histories of pressures in the fan compressor during throttle transients between military and maximum showed the development of rotating stall in the fan hub which quickly propagated and produced complete stall in the high pressure compressor. Author

N72-27015*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC TRANSPORT STUDY: ECONOMICS
Cynthia L. Smith and Darrell E. Wilcox Washington May 1972 27 p refs
(NASA-TM-X-62159) Avail: NTIS HC $3.50 CSCL 01B

An economic analysis was performed to evaluate the impact of advanced materials, increased aerodynamic and structural efficiencies, and cruise speed on advanced transport aircraft designed for cruise Mach numbers of .90, .98, and 1.15. A detailed weight statement was generated by an aircraft synthesis computer program called TRANSYN-TST; these weights were used to estimate the cost to develop and manufacture a fleet of aircraft of each configuration. The direct and indirect operating costs were estimated for each aircraft, and an average return on investment was calculated for various operating conditions. There was very little difference between the operating economics of the aircraft designed for Mach numbers .90 and .98. The Mach number 1.15 aircraft was economically marginal in comparison but showed significant improvements with the application of carbon/epoxy structural material. However, the Mach .90 and Mach .98 aircraft are the most economically attractive vehicles in the study. Author

N72-27016# Advisory Group for Aerospace Research and Development, Paris (France).
AIRFRAME/ENGINE INTEGRATION
A. Ferri May 1972 197 p refs
(AGARD-LS-53) Avail: NTIS HC $12.00

Analytical and experimental methods for investigating interference problems in airplane design optimization are reported. Considered are inlet-airplane interference, nozzle geometry and exhaust jet-airplane interference dynamics of engine and airplane characteristics.

N72-27017 New York Univ., N.Y.
ENGINE AIRPLANE INTERFERENCE DEFINITION OF THE PROBLEM AND RELATED BASIC FLUID DYNAMIC PHENOMENA
Antonio Ferri *In* AGARD Airframe/Engine Integration May 1972 12 p refs

The lack of simulation of the engine flow introduces substantial differences between the aerodynamics of the actual airplane and of the model tested. Characteristics related to the interference between an airplane and the engine, and their effects on the calculated performance of the airplane are integrated into analog and digital simulation, where the wind tunnel or test stand provides analog data, to improve the results. G.G.

N72-27018 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
INLET/AIRPLANE INTERFERENCE AND INTEGRATION
Philip P. Antonatos, Lewis E. Surber, and Donald J. Stava *In* AGARD Airframe/Engine Integration May 1972 54 p refs

The basic technological problems and potential solutions relating to the development of inlet and airframe design criteria are discussed. Results of analytical and experimental work emphasize details of closely coupled inlet airframe concepts. Inlet flow fields generated by basic forebody and forebody/wing combinations are reviewed together with an anlysis of the effects of variations in fuselage shape, forebody camber, wing geometry and inlet position. Problems associated with boundary layer development and vortex ingestion are discussed in terms of their effect on inlet design. Attitude effects such as angle of attack and angle of yaw are reviewed. The losses due to spillage, bleed and bypass flows are analyzed as they affect vehicle performance. Criteria are reviewed to minimize such loss for the development of optimal inlet/airframe performance. Specific problems relating to the subsonic-transonic flight regime and the supersonic regime are included. Author

N72-27019 Aircraft Research Association, Ltd., Bedford (England).
EXPERIMENTAL DETERMINATION OF INLET CHARACTERISTICS AND INLET AND AIRFRAME INTERFERENCE
E. C. Carter *In* AGARD Airframe/Engine Integration May 1972 24 p refs

The following experimental methods are considered: Measurement of the interference of the inlet on the airframe, measurement of the interference of the airframe on the inlet, and measurement of the performance of the inlet/airframe combination as a whole. The use of complete aerodynamic force models and partial models is discussed including the drag use of full and half model tunnel techniques. Particular attention is given to drag. Shortcomings of the present techniques are pointed out and alternative proposals are made where possible. Author

N72-27020 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
NOZZLE/AIRFRAME INTERFERENCE AND INTEGRATION
Felix Aulehla and Kurt Loter *In* AGARD Airframe/Engine Integration May 1972 25 p refs

The main parameters involved in the interference between internal and external flow are discussed. Also considered is how these parameters in principle affect afterbody drag. Then the definition of rear end drag is given in the conventional way and also in a more relative manner approaching the physical optimum. For configurations with single and twin engines installed in the rear end of the fuselage wind tunnel test results for various nozzle concepts are presented and discussed. The geometric variations in these tests comprise boattail angle, size and location of the base, nozzle interfairings and engine spacing. Proper consideration of these geometric parameters in nozzle/airframe integration, reduces additional afterbody drag drastically in the transonic flight regime. Author

N72-27021 National Aerospace Lab., Amsterdam (Netherlands).
EXPERIMENTAL DETERMINATION OF NOZZLE CHARACTERISTICS AND NOZZLE AIRFRAME INTERFERENCE
F. Jaarsma *In* AGARD Airframe/Engine Integration May 1972 45 p refs

An outline is given under which circumstances certain jet flow and nozzle parameters should be simulated in the wind tunnel for both installed thrust and drag determination. The circumstances relate to the flight regimes, nozzle types and engine installation configurations. Next the technical requirements for the wind tunnel and the model are given and the difficulties in fulfilling these requirements are discussed. The techniques and schemes as used by the various groups in the AGARD countries are reviewed. Special attention is given to miniature turbo engine simulators. Author

N72-27022 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
DYNAMIC CHARACTERISTICS OF ENGINE INLETS
Demetrius Zonars *In* AGARD Airframe/Engine Integration May 1972 16 p refs

Inlet random pressure fluctuations and their effects on reducing the stall margin of turbojet engines are discussed. A review is accomplished of the TF-30/F-111 compatibility study over the past several years. The practicality of utilizing steady state and instantaneous distortion factors to determine inlet-engine compatibility is assessed and recent advances in inlet research configurations with associated steady state and dynamic distortions are presented. Finally, a complete random data acquisition, editing, and processing method is developed for accomplishing data analysis as an inlet diagnostic tool. Author

N72-27023 Naval Postgraduate School, Monterey, Calif.
ENGINE INTEGRATION AND THRUST/DRAG DEFINITION
Allen E. Fuhs *In* AGARD Airframe/Engine Integration May 1972 21 p refs

Various definitions relating to thrust and drag are considered. Since thrust minus drag is of primary interest, the background on drag determination is discussed. This is followed by testing techniques for full scale propulsion systems. Sources of installation losses are of considerable interest. Several different methods have evolved to account for various terms in a drag/thrust determination. Bookkeeping of forces and momentum flux is described. Any aircraft development is controlled by schedules and fixed resources. Influence of these constraints on engine-airframe integration is discussed. Some special integration problems, e.g., engine bleed air, are considered. Author

N72-27024*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMPLIFIED METHODS FOR INTERPRETING THE EFFECT OF TRANSFER-FUNCTION ZEROS ON THE TRANSIENT RESPONSE OF AIRCRAFT
Reiner Onken Washington Jul. 1972 44 p refs

(NASA-TM-X-2585; A-4180) Avail: NTIS HC $3.00 CSCL 01B

Two simple methods are outlined for evaluating the effect of transfer-function zeros on the system time response. The pole effects can also be evaluated. These methods are useful for simplified analysis or creating design criteria in terms of desirable regions of pole-zero locations. The type of transfer function studied is limited to those linear systems. Corresponding to ordinary longitudinal or lateral aircraft transfer functions, the denominator polynomial is of fourth order and the numerator of third order at most. With the longitudinal motion of the aircraft as an example, the methods are used in the evaluation of optimal regulator control with respect to a particular performance index structure. Author

N72-27025# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

AIRCRAFT ACCIDENT REPORT: AMERICAN AIRLINES, INCORPORATED, BOEING 707-323, N7595A AND A LINDEN FLIGHT SERVICE, INCORPORATED, CESSNA 150, N60942 OVER EDISON, NEW JERSEY, 9 JANUARY 1971

10 May 1972 17 p

(NTSB-AAR-72-16) Avail: NTIS HC $3.00

An aircraft accident involving the collision between a Boeing 707 and a Cessna 150 on 9 January, 1971 near Edison, New Jersey is reported. The probable cause of the accident was the inability of the crews of both aircraft to see and avoid each other while operating in a system which permits VFR aircraft to operate up to 3,000 feet on random headings and altitudes in a congested area under conditions of reduced visibility. Other factors were the deviation of the air carrier aircraft from its clearance altitude and conducting student flight training in a congested control area under marginal flight visibility conditions. Author

N72-27026# National Aerospace Lab., Tokyo (Japan).

AN ANALYTICAL METHOD TO PREDICT HEIGHT-VELOCITY DIAGRAM AND CRITICAL DECISION POINT OF ROTORCRAFT

Mesaki Komoda Aug. 1971 65 p refs In JAPANESE; ENGLISH summary

(NAL-TR-245) Avail: NTIS HC $5.25

An analytical method utilizing optimization techniques to estimate height-velocity diagram and the critical decision point of rotorcraft is proposed. It is pointed out that the control inputs of the pilot to the system equations describing rotorcraft dynamics are obtained as the solution of an adequately stated optimization problem, in which the final rotor rpm is maximized, or equivalently, the height loss is minimized or maximized. It is also shown that the degree of optimality of controls can be evaluated by means of impulsive response function associated with the optimal trajectories thus obtained. In order to show the applicability of this approach, sample calculations are presented for high hover point, knee point and for low hover point of height-velocity boundary, as well as for a partial power climb and a rejected take-off from critical decision point. State equations which are linearized with respect to acceleration factors at G.G. are used for simplicity. A comparison with FAA flight test data as to the high hover point is included. Author

N72-27027# National Aerospace Lab., Tokyo (Japan).

OVERALL GROUND EXPERIMENTS ON FLYING TEST BED FOR VTOL AIRCRAFT AT NATIONAL AEROSPACE LABORATORY

Naoto Takizawa, Yoshikazu Tanabe, Akiyoshi Shibuya, Toshio Ogawa, Hirotoshi Fujieda, Tadao Kai, Hiroshi Nishimura, Koichi Ono, and Yoshio Goto Feb. 1972 93 p refs In JAPANESE; ENGLISH summary

(NAL-TR-276) Avail: NTIS HC $6.75

The overall ground experiments on the flying test bed which has been developed for the purpose of studying the problems associated with hovering, vertical take-off and landing of VTOL aircraft are described. The experiments were made on the complete assembly but without engines and fuel, and consisted of three items; (1) the functional performance of several subsystems, (2) the capability of the attitude control, and (3) the vibration characteristics of the framework. The subsystems tested were the air turbine system connected with the electrical and hydraulic systems, the bleed air distribution system, the attitude control system, the airborne instrumentation system, and the redundant back-up system. The attitude control experiments made with varying amounts of artificial damping and stabilization showed that their optimum ranges in pitch and roll were revealed independently. In the vibration tests, the measurements covered natural frequencies, modes, damping ratios and phases of vibration of the framework. Author

N72-27028# National Aerospace Lab., Tokyo (Japan).

ON THE AERODYNAMIC DAMPING MOMENT IN PITCH OF A RIGID HELICOPTER ROTOR IN HOVERING

Kingo Takasawa Nov. 1971 82 p refs In JAPANESE; ENGLISH summary

(NAL-TR-256) Avail: NTIS HC $6.25

The aerodynamic damping moment in pitch (ADMP) was measured with a hovering model helicopter rotor. Three kinds of model blades with different rigidity were tried. A flow visualization study was performed for the purpose of determining the relative position between the blade and the vortices in steady hovering state. Using the Rayleigh-Ritz method, the ADMP of the perfectly rigid rotor was determined from the above-mentioned experimental data. A quasi-steady theory is devised. The model based on this theory takes into account: (1) the steady lift loss due to the finite span effect, (2) the steady lift loss attributable to the downwash induced by the returning wake, and (3) the lift variation due to the change of relative position between the blade and the trailing vortices in the returning wake. Author

N72-27029*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FORWARD FLIGHT EFFECTS ON MIXER NOZZLE DESIGN AND NOISE CONSIDERATIONS FOR STOL EXTERNALLY BLOWN FLAP SYSTEMS

U. vonGlahn, N. Sekas, D. Groesbeck, and R. G. Huff 1972 14 p refs Presented at the 4th Aircraft Design Flight Test and Oper. Meeting, Los Angeles, 7-9 Aug. 1972; sponsored by AIAA

(NASA-TM-X-68102; E-7028) Avail: NTIS HC $3.00 CSCL 01B

Experimental data of the peak axial-velocity decay in a moving airstream are presented for several types of nozzles. The nozzles include a six-tube mixer nozzle of a type considered for reduction of jet-flap interaction noise for externally-blown-flap STOL aircraft. The effect of secondary flow on the core flow velocity decay of a bypass nozzle is also discussed. Tentative correlation equations are suggested for the configurations evaluated. Recommendations for minimizing forward velocity effects on velocity decay and jet-flap interaction noise are made. Author

N72-27030*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY NOISE TESTS OF THE ENGINE-OVER-THE-WING CONCEPT. 2: 10 DEG - 20 DEG FLAP POSITION

Meyer Reshotko, William A. Olsen, and Robert G. Dorsch Jun. 1972 39 p refs

(NASA-TM-X-68104; E-7038) Avail: NTIS HC $4.00 CSCL 01B

Preliminary acoustic tests of the engine-over-the-wing concept as a method for reducing the aerodynamic noise created by conventional and short takeoff aircraft are discussed. Tests were conducted with a small wing section model having two flaps which can be set for either the landing or takeoff positions. Data was acquired with the flaps set at 10 degrees and 20 degrees for takeoff and 30 and 60 degrees for landing. The engine exhaust was simulated by an air jet from a convergent nozzle. Far field noise data are presented for nominal pressure

ratios of 1.25, 1.4 and 1.7 for both the flyover and sideline modes. Author

N72-27031*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF WIND TUNNEL AND FLYOVER NOISE MEASUREMENTS OF THE YOV-10A STOL AIRCRAFT
Adolph Atencio, Jr. and Paul T. Soderman Jun. 1972 28 p refs Sponsored in part by Army Air Mobility Res. and Develop. Lab.
(NASA-TM-X-62166) Avail: NTIS HC $3.50 CSCL 01B

The YOV-10A Research Aircraft was flown to obtain flyover noise data that could be compared to noise data measured in the 40- by 80- foot wind tunnel at NASA Ames Research Center. The flyover noise measurements were made during the early morning hours on runway 32L at Moffett Field, California. A number of passes were made at 50 ft altitude in level flight with an airplane configuration closely matching that tested in the wind tunnel. Two passes were selected as prime and were designated for full data reduction. The YOV-10A was flown over a microphone field geometrically similar to the microphone array set up in the wind tunnel. An acoustic center was chosen as a matching point for the data. Data from the wind tunnel and flyover were reduced and appropiate corrections were applied to compare the data. Results show that wind tunnel and flight test acoustic data agreed closely. Author

N72-27032*# Systems Technology, Inc., Hawthorne, Calif.
EXPERIMENTAL MEASUREMENTS OF MOTION CUE EFFECTS ON STOL APPROACH TASKS
Robert F. Ringland and Robert L. Stapleford Apr. 1972 120 p refs
(Contract NAS2-6433)
(NASA-CR-114458; TR-1014-2) Avail: NTIS HC $8.00 CSCL 01B

An experimental program to investigate the effects of motion cues on STOL approach is presented. The simulator used was the Six-Degrees-of-Freedom Motion Simulator (S.01) at Ames Research Center of NASA which has ±2.7 m travel longitudinally and laterally and ±2.5 m travel vertically. Three major experiments, characterized as tracking tasks, were conducted under fixed and moving base conditions: (1) A simulated IFR approach of the Augmentor Wing Jet STOL Research Aircraft (AWJSRA), (2) a simulated VFR task with the same aircraft, and (3) a single-axis task having only linear acceleration as the motion cue. Tracking performance was measured in terms of the variances of several motion variables, pilot vehicle describing functions, and pilot commentary. Author

N72-27033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF DESIGN CONSIDERATIONS FOR AIRPLANE SPIN-RECOVERY PARACHUTE SYSTEMS
Sanger M. Burk, Jr. Washington Aug. 1972 55 p refs
(NASA-TN-D-6866; L-8219) Avail: NTIS HC $3.00 CSCL 01B

A compilation of design considerations applicable to spin-recovery parachute systems for military airplanes has been made so that the information will be readily available to persons responsible for the design of such systems. This information was obtained from a study of available documents and from discussions with persons in both government and industry experienced in parachute technology, full-scale and model spin testing, and related systems. Author

N72-27034# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
THE INFLUENCE OF A DISPLAY ON THE HUMAN TRANSFER FUNCTION MEASURED BY MEANS OF AN ADAPTIVE ANALOG PILOT [DER EINFLUSS EIN ER VORANZEIGE AUF DAS MENSCHLICHE UEBERTRAGUNGSVERHALTEN GEMESSEN MIT HILFE EINES ADAPTIVEN ANALOG-PILOTEN]
Dieter Dey Oct. 1971 100 p refs In GERMAN Sponsored by Landesamt fuer Forsch. Nordrhein-Westfalen and Fraunhofer-Ges.
(Rept-64) Avail: NTIS HC $7.00

A model for man transfer function is used to improve the anthropotechnical control system by introducing advanced information, assuming the possibility to describe the man transfer function. A survey is presented of present knowledge of man as part of a control circuit and the control capacity of pilots, assuming the possibility to describe the mean transfer function. An application oriented model is used. This model and a model adaptation process are used for the first time in closed circuit. Advantages and disadvantages of continuous adaptation are evaluated and the results, power density spectra calculated by a Fourier transformation, are discussed. The experimental technique presented was applied to two tested persons, one of which had the benefit of the advanced information signals. Statistical analysis of the results show that advanced information increases the pilot's performance and decreases the response time. In addition it was noted that noise was eliminated in the man-machine system. ESRO

N72-27035# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
STATISTICAL ANALYSIS OF MISSION PROFILE PARAMETERS OF TRANSPORT AIRCRAFT [STATISTISCHE AUSWERTUNG VON PARAMETERN FUER EINSATZPROFILE VON TRANSPORTFLUGZEUGEN]
O. Buxbaum and P. Reinhold Jul. 1971 45 p refs In GERMAN Sponsored by Bundesmin. der Verteidigung
(TB-88) Avail: NTIS HC $4.25

The cumulative frequency distributions of mission-profile parameters of different types of transport airplanes are shown: flight-time, airplane take-off weight, airplane landing weight, and fuel weights during take-off and landing. Results are presented for jet-powered short, medium, and long range airplanes flown in passenger and cargo service and it is shown that they can be used for the design of other, similar airplanes. ESRO

N72-27036# Naval Air Development Center, Johnsville, Pa.
ARRESTED LANDING FATIGUE TEST OF MODEL C-2A AIRPLANE Final Report
Edward F. Kautz 30 Jun. 1971 42 p refs
(AD-739331; NADC-ST-7111) Avail: NTIS CSCL 01/3

A laboratory fatigue test was performed on a C-2A airframe to determine whether the airframe could sustain the effects of 3000 arrested landings. A total of 6000 arrested landing cycles were applied to the airframe during the test with no structural failures. With a test scatter factor of 2, the 6000 test cycles are equivalent to 3000 service arrested landings. Author (GRA)

N72-27037# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
AIRCRAFT STRUCTURAL ELECTRICAL BONDING AND GROUNDING INCLUDING LIGHTNING EFFECTS AND ELECTROSTATIC CHARGE BUILDUP ON MISSILES AND SPACE VEHICLES Interim Report
Feb. 1972 20 p refs
(Contract DSA900-72-C-1182)
(AD-739356; EPIC-IR-74-Rev) Avail: NTIS CSCL 01/2

Over 130 references are provided on static electrification, grounding, electrical bonding and lightning protection. Bonding and grounding of electronic equipment are discussed.
Author (GRA)

N72-27038# Naval Air Development Center, Johnsville, Pa. Vehicle Technology Dept.
FLIGHT LOADS DATA FROM LAMPS HH-2D HELICOPTERS DV/98 OPERATIONS Final Report

David J. Rhoads 18 Feb. 1972 73 p ref
(AD-738452; NADC-72022-VT) Avail: NTIS CSCL 01/3

6A flight loads study was performed on two LAMPS HH-2D helicopters during DV/98 operations to define the flight profiles for the aircraft during fleet operations. The study was made to supplement engineering data for the structural evaluation of the H-2 helicopter used in the LAMPS program. Author (GRA)

N72-27039# Northrop Corp., Hawthorne, Calif. Aircraft Div.
VALIDATION OF THE FLYING QUALITIES REQUIREMENTS OF MIL-F-8785B (ASG) Final Report
Robert N. Kandalaft Sep. 1971 442 p refs
(Contract F33615-71-C-1065; AF Proj. 8219)
(AD-738625; NOR-71-127; AFFDL-TR-71-134) Avail: NTIS CSCL 01/1

A study was conducted to validate the 1969 military specification MIL-F-8785B(ASG), "Flying Qualities of Piloted Airplanes," by performing a detailed comparison of its requirements with the known characteristics of the Northrop F-5 fighter and pilot comments on them. The comparison was based primarily on existing flight test data supplemented by analytical data. Validations or discrepancies are noted, resolutions are attempted if necessary, and recommendations are given. Recommendations are also made for experimental and analytical investigations beyond the scope of this study which will further validate and update the requirements. GRA

N72-27040# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A GRAPHITE HORIZONTAL STABILIZER Semiannual Interim Technical Report, 1 May - 31 Oct. 1971
George M. Lehman Feb. 1972 234 p refs
(Contract N00156-70-C-1321)
(AD-738900; MDC-J5317; IR-4) Avail: NTIS CSCL 01/3

The structural weights, stress-analysis results, and *manufacturing methods are summarized for an A4 aircraft* horizontal stabilizer utilizing Narmco 5206 graphite-epoxy laminates in the primary structure. The actual weight of the first unit produced was 178 pounds, a weight reduction of 30% in comparison to the equivalent metal structure. The finished structure weight was comprised of approximately 62 percent graphite-epoxy, 11 percent fiberglass-epoxy, 10, 8, and 5 percent, respectively of aluminum, steel, and titanium alloys (including attachments), and 4 percent adhesive and epoxy fillets. Results of a discrete element stress-analysis are presented for the three critical load conditions on the stabilizer.
Author (GRA)

N72-27041# Directorate of Aerospace Safety, Norton AFB, Calif.
USAF BIRD STRIKE SUMMARY Statistical Report, 1 Jan. - 31 Dec. 1971
31 Dec. 1971 23 p refs
(AD-739464) Avail: NTIS CSCL 01/2

The document is a statistical report of USAF aircraft damaged by collisions with birds during 1971. There were 383 such occurrences which were 23 more than in 1970. In fact, there were more bird strikes in 1971 than during any previous year. Two of these collisions resulted in major accidents. Two crew members were killed in one of these accidents while in the other, two crew members successfully ejected. As in 1970, windscreen/canopy penetrations continue to be the greatest hazard to aircrews. As has been the case in previous years, a substantial number of birds were ingested by engines. Twenty-six percent of the strikes directly involved engines. Author (GRA)

N72-27042# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
FOG DISSIPATION TECHNIQUES FOR EMERGENCY USE
David H. Dickson and James R. Oden Jan. 1972 43 p refs
(DA Proj. 1T0-62111-A-126)
(AD-739487; ECOM-5420) Avail: NTIS CSCL 01/2

The report documents the lesson plan for a short course of instruction in fog dissipation by helicopter, prepared at the request of the U. S. Army Aviation School, Ft. Rucker, Alabama.
GRA

N72-27043# Texas A&M Univ., College Station. Dept. of *Industrial Engineering.*
CRITERIA FOR EVALUATING THE APPLICABILITY OF COMPOSITE MATERIAL SHAFTS TO HELICOPTER DRIVE SYSTEMS M.S. Thesis
Victor W. Welner May 1971 42 p refs Sponsored by Army
(AD-739429) Avail: NTIS CSCL 01/3

The report develops criteria for determining the suitability of applying composite materials to helicopter synchronizing drive shafts. A discussion of composite materials and power transmission shafting is given. The factors involved in making an economic decision are vonsidered and suggestion for their evaluation is made. Author (GRA)

N72-27044# Dynamic Science, Phoenix, Ariz.
A SURVEY OF NAVAL AIRCRAFT CRASH ENVIRONMENTS WITH EMPHASIS ON STRUCTURAL RESPONSE
John J. Glancy and Stanley P. Desjardins Dec. 1971 89 p refs
(Contract N00014-71-C-0318)
(AD-739370; Rept-1500-71-43) Avail: NTIS CSCL 01/2

The report contains the results of research in survival aspects of Naval aircraft crashes. The study was made to identify areas for needed improvement in structural design. A literature study, documented crash data, and firsthand data obtained in interviews with Naval personnel and in visits to Naval facilities established a data base which was used to identify the Naval aircraft crash environment and crash survival problems. The study indicated that the Naval Aircraft Accident *Report form should include requests for specific impact variables.* It also noted Naval helicopters as a productive area for crashworthiness improvement. GRA

N72-27045# Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.
A THREE-AXIS FLUIDIC STABILITY AUGMENTATION SYSTEM Final Technical Report, 15 Nov. 1968 - 28 Oct. 1970
Harvey D. Ogren Oct. 1971 300 p refs
(Contracts DAAJ02-68-C-0039; DAAJ02-69-C-0036; DA Proj. 1F1-62203-A-141)
(AD-739559; GAPD-21192-FR; USAAMRDL-TR-71-30) Avail: NTIS CSCL 01/3

The report covers the analysis, design, fabrication and laboratory tests of a three-axis hydrofluidic stability augmentation system for a UH-1-type helicopter. The design goal was to improve the handling qualities of the aircraft, without stabilizer bar, in the speed range of 60 to 120 knots. The control problem was analyzed and a system defined through use of analog computer simulation techniques. The defined system was mechanized into three separate controller packages, one for each axis. The system was subjected to temperature and vibration flightworthiness tests. The final tests conducted were closed-loop performance checks using an analog computer to simulate the aircraft dynamics. GRA

N72-27047# Hamilton Standard, Windsor Locks, Conn.
ADVANCED TECHNOLOGY V/STOL PROPELLER RETENTION SYSTEM INVESTIGATION Final Report
Edward M. Varholak Jan. 1972 72 p refs
(Contract DAAJ02-70-C-0030; DA Proj. 1G1-62203-D-144)
(AD-739555; USAAMRDL-TR-71-39) Avail: NTIS CSCL 01/3

The objective of this program was to investigate the feasibility of employing a BORSIC/Aluminum composite structure for a propeller blade retention for an advanced-technology,

2000-shp, V/STOL propeller system. This was accomplished by the design of a one-half scale composite retention system, the fabrication of three test elements, and the fatigue test of this system, which is compatible with the 33LF propeller.
Author (GRA)

N72-27048# Naval Air Systems Command, Washington, D.C. Airframe Div.
AIRCRAFT CABIN AIR LEAKAGE RATE, MAXIMUM ALLOWABLE: DERIVATION OF
Norman N. Rubin Jul. 1972 12 p refs
(AD-739687; Rept-530-72-01) Avail: NTIS CSCL 01/3
The report describes an attempt to derive a standard formula for allowable cabin leakage that could be applicable to all military aircraft types. GRA

N72-27049# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: ALOHA AIRLINES, INCORPORATED VICKERS VISCOUNT MODEL 745D, N7415 HONOLULU INTERNATIONAL AIRPORT, HONOLULU, HAWAII, 8 AUGUST 1971
29 Dec. 1971 15 p
(PB-207902; NTSB-AAR-72-2; FILE-1-0013) Avail: NTIS HC $3.00 CSCL 01B
Aloha Airlines, Inc., Vickers Viscount 745D, N7415 was operating as Flight 845 between Hilo and Honolulu, Hawaii. After landing at Honolulu and during taxi to the terminal, smoke was detected coming from below the passenger cabin floor. The aircraft was stopped on the taxiway, the engines were shut down and all passengers and crewmembers evacuated without incident. The fire was extinguished by airport emergency equipment. The Board determined that the probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery, which resulted in the absorption of an increasing amount of heat energy over an unknown period of time, and progressed to a state of thermal runaway.
Author (GRA)

N72-27050# Hydrospace Research Corp., San Diego, Calif.
MEASUREMENT AND ANALYSIS OF NOISE FROM FOUR AIRCRAFT IN LEVEL FLIGHT (727, KC-135, 707-320B AND DC-9) Final Report, May - Sep. 1971
Carole S. Tanner Sep. 1971 59 p refs
(Contract DOT-FA71WA-2555)
(AD-739870; HRC-TR-S-209; FAA-RD-71-83) Avail: NTIS CSCL 20/1
Measurements of noise from aircraft level flyovers are presented in the form of effective perceived noise level (EPNL) as a function of slant range at the closest point of approach. Four aircraft were investigated (727, KC-135, 707-320B, and DC-9) and the effort involved acquisition of acoustical, meteorological, aircraft tracking, and aircraft operational data. Microphones were located four feet above the ground in an array normal to the flight track. Author (GRA)

N72-27052# United Aircraft Corp., East Hartford, Conn.
AN INVESTIGATION OF THE QUANTITATIVE APPLICABILITY OF MODEL HELICOPTER ROTOR WAKE PATTERNS OBTAINED FROM A WATER TUNNEL Final Report
Anton J. Landgrebe and Elton D. Bellinger Fort Eustis, Va. AAMRDL Dec. 1971 142 p refs
(Contract DAAJ02-70-C-009; DA Proj. 1F1-62204-A-142)
(AD-739946; UARL-K910917-23; USAAMRDL-TR-71-69) Avail: NTIS CSCL 20/4
An analytical investigation was conducted to evaluate quantitative applications of available model rotor tip vortex patterns from a water tunnel. This evaluation consisted of reducing selected photographic wake data to coordinate form, and comparing the resulting wake geometries with both theoretical results and available experimental data taken in air. Additionally, the study included an examination of the sensitivity of water tunnel wake geometry to the water tunnel test parameters which did not duplicate full-scale rotor values and the applicability of a water tunnel wake geometry to determine the airloads of a full-scale rotor. Finally, the possibility of developing simplified wake documentation and generalization procedures and improved water tunnel test techniques was assessed. Author (GRA)

N72-27069# Boeing Co., Philadelphia, Pa. Vertol Div.
SECONDARY POWER SYSTEM STUDY FOR ADVANCED ROTARY WING AIRCRAFT Final Report
John Karpis, Louis J. Levine, Richard D. Semple, and Raymond G. Smith Nov. 1971 215 p refs
(Contract DAAJ02-70-C-0046)
(AD-739480; D210-10273-1; USAAMRDL-TR-71-52) Avail: NTIS CSCL 10/2
The report describes the results of a study to determine three optimum secondary power systems (SPS) for advanced rotary-wing aircraft, using three different levels of technology, and to recommend research and development required to achieve technological advancements in SPS components that can provide significant improvements for future aircraft.
Author (GRA)

N72-27101 Stanford Research Inst., Menlo Park, Calif.
TRIGGERED LIGHTNING AND SOME UNSUSPECTED LIGHTNING HAZARDS
Edward T. Pierce *In* ONR Naval Res. Rev., Vol. 25, No. 3 Mar. 1972 p 14-33
Instances of lightning initiated by man's activities are considered. These include the triggering of lightning by high-rise buildings and other tall structures; by rockets trailing wires; by the column of water thrown up by a depth-charge; by the large Apollo 12 rocket; by aircraft; and by thermonuclear explosions. All the incidents occur when the ambient electric field is some 10,000 volts per meter, and the voltage discontinuity between the conductor initiating the lightning and the adjacent atmosphere is about a million volts. It is pointed out that solid-state devices and microcircuitry, computers, plastics, and electrically composite materials, are all quite vulnerable to the effects of lightining. These components are being increasingly used in aircraft construction and operation. Also, as aircraft become bigger and faster they have a greater propensity to trigger lightning. Therefore it is concluded that the lightning hazard to aircraft operation is increasing. Author

N72-27271*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPARATUS FOR APPLYING SIMULATED G-FORCES TO AN ARM OF AN AIRCRAFT SIMULATOR PILOT Patent Application
Billy R. Ashworth and John R. Merrill, IV, inventors (to NASA) Filed 9 Jun. 1972 9 p
(NASA-Case-LAR-10550-1; US-Patent-Appl-SN-261183) Avail: NTIS HC $3.00 CSCL 14B
A device to be used with an aircraft simulator to apply positive and negative g-forces to the pilot's arm is described. An arm harness fits around the pilot's arm that he uses to operate the throttle. The device allows the harness to track intentional arm movements, without exerting any restraining forces, and at the same time applies g-forces through the harness to the pilot's arm that are computed by the aircraft simulator computer.
NASA

N72-27272*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL MODEL AND METHOD Patent Application
Charlie M. Jackson, Jr. and Dallas G. Summerfield, inventors (to NASA) Filed 19 Jun. 1972 9 p
(NASA-Case-LAR-10812-1; US-Patent-Appl-SN-263815) Avail: NTIS HC $3.00 CSCL 14B

A method for designing a wind tunnel model airfoil with integrally formed pressure measurement orifices is described. Diverse length small diameter tubes are clamped in fixed spaced relationship by clamps to form an array. The tubes are placed with an equal length of each tube extending from one side of the airfoil, and uneven lengths extending from the other side. The even length tubes are at the base of the constructed airfoil while the uneven lengths extend to varying distances within the airfoil toward the leading edge. The airfoils are formed by casting a solidifiable material so as to completely encase the uneven portion of the tubes. After finishing and polishing the airfoil, an X-ray photo is taken to precisely locate the individual tubes. The X-ray is then used as a template to drill transverse holes to intersect perpendicularaly with the tubes. Holes are positioned at the points on the airfoil where pressure measurements are desired during wind tunnel test, and connected to conventional pressure measurement instrumentation. F.O.S.

N72-27278# Naval Aerospace Recovery Facility, El Centro, Calif. Crew Systems Dept.
PILOT CONTROLLED DYNAMIC SPIN SIMULATION OF THE F-4 PHANTOM JET ON THE HUMAN CENTRIFUGE Final Report
Emma Fessenden, Robert A. Hall, and Richard J. Crosbie 22 Nov. 1971 99 p refs
(AD-739326; NADC-CS-7111) Avail: NTIS CSCL 01/3

A successful dynamic spin simulation was completed on the human centrifuge which includes a realistic (dynamic) control stick feel system, and a dynamic out-the-windshield display system. The simulator has an actual F-4 cockpit with dynamic flight instruments and was operated by pilots through a closed loop computer simulation of the aerodynamics of the F-4. The evaluation of the simulator by knowledgeable pilots has given insight into the value of the constituents of a spin simulator. A combination of three modes of motion and the presence and absence of a dynamic closed loop visual display constituted the major variants for analysis. The methods used for the simulation of aerodynamic equations, the centrifuge drive, the instrument drive and the feel system are detailed in the report. A comprehensive study was made of the parameters generated in the spin for the significance of motion and the visual display on the pilots actions. Author (GRA)

N72-27279# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Flight research Dept.
DEVELOPMENT, DESIGN AND FABRICATION OF THE TOTAL IN-FLIGHT SIMULATOR (TIFS) Final Technical Report, Feb. 1967 - Oct. 1970
P. A. Reynolds, J. C. Seal, and G. J. Fabian Aug. 1971 237 p refs
(Contract F33615-67-C-1157; AF Proj. 6848)
(AD-739230; AFFDL-TR-71-77) Avail: NTIS CSCL 01/3

The TIFS research airplane, the most advanced in-flight simulation vehicle yet developed, was designed to provide total in-flight simulation. This capability depends on two basic features of the aircraft. First is the addition of an evaluation cockpit which is entirely separate from the normal airplane's safety pilots' cockpit. Second is the control by a variable stability system of not only the moments about all three axes, but also the forces acting along the three axes. The report describes the TIFS airplane through the completion of functional flight tests in October 1970. The subjects treated are structures, electronics, hydraulics, aerodynamics, flutter, and model following. Author (GRA)

N72-27280# Department of Transportation, Washington, D.C.
NATIONAL TRANSPORTATION PLANNING MANUAL (1970 - 1990). MANUAL D: AIRPORTS AND OTHER INTERCITY TERMINALS
Apr. 1971 118 p refs
(PB-207529; OMB-04-S71002) Avail: NTIS HC $3.00 CSCL 13F

The manual is the fourth in a series prepared by the U.S. Department of Transportation for conducting the 1972 national transportation needs study. Three general types of information are concerned: a transportation needs summary, capital improvement program summaries, and individual airport information. GRA

N72-27284# Federal Aviation Agency, Washington, D.C. Airports Service.
PARK FALLS MUNICIPAL AIRPORT, PRICE COUNTY, PARK FALLS, WISCONSIN Final Environmental Impact Statement.
10 Apr. 1972 38 p Supersedes PB-204025-D
(PB-204025-F; ELR-4187) Avail: NTIS HC $3.00 CSCL 13B

The report describes the proposal to construct a paved 75 x 3200 ft runway with marking; construct a paved 30 x 130 ft taxiway with marking; construct a paved 100 x 200 ft apron with tie downs; construct a 24 x 1225 ft private entrance road; install low intensity lighting system. The adverse impacts are clearing of 8.8 acres of trees. Author (GRA)

N72-27286 Michigan State Univ., East Lansing.
TWO-DIMENSIONAL POTENTIAL FLOW AND BOUNDARY LAYER ANALYSIS OF THE AIRFOIL OF A STOL WING PROPULSION SYSTEM Ph.D. Thesis
James Arthur Albers 1971 151 p
Avail: Univ. Microfilms Order No. 71-31148

The calculated pressure distributions for a particular externally blown flap configuration indicated that the minimum pressure point is near the leading edge (less than 2 percent of chord) of the airfoil with severe adverse pressure gradients at high angles of attack (near 20deg). The results of the boundary layer analysis indicated that the predicted turbulent separation point moved forward from the trailing edge as the angle of attack was increased. Trailing edge separation for the thick wing (t/c= 0.15) propulsion system combination considered was verified by experimental data. Dissert. Abstr.

N72-27290*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE COOLANT FLOW CHARACTERISTICS IN COOLED TURBINE AIRFOILS
W. P. Damerow, J. P. Murtaugh, and F. Burggraf Jun. 1972 71 p refs
(Contract NAS3-13499)
(NASA-CR-120883; GE-R72AEG165) Avail: NTIS HC $5.75 CSCL 20D

The flow characteristics of turbine airfoil cooling system components were experimentally investigated. Flow models representative of leading edge impingement, impingement with crossflow (midchord cooling), pin fins, feeder supply tube, and a composite model of a complete airfoil flow system were tested. Test conditions were set by varying pressure level to cover the Mach number and Reynolds number range of interest in advanced turbine applications. Selected geometrical variations were studied on each component model to determine these effects. Results of these tests were correlated and compared with data available in the literature. Orifice flow was correlated in terms of discharge coefficients. For the leading edge model this was found to be a weak function of hole Mach number and orifice-to-impinged wall spacing. In the impingement with crossflow tests, the discharge coefficient was found to be constant and thus independent of orifice Mach number, Reynolds number, crossflow rate, and impingement geometry. Crossflow channel pressure drop showed reasonable agreement with a simple one-dimensional momentum balance. Feeder tube orifice discharge coefficients correlated as a function of orifice Mach number and the ratio of the orifice-to-approach velocity heads. Pin fin data was correlated in terms of equivalent friction factor, which was found to be a function of Reynolds number and pin spacing but independent of pin height in the range tested. Author

N72-27317# National Aerospace Lab., Tokyo (Japan).
A DESCRIPTION OF THE IDEAS UNDERLYING A COMPUTER PROGRAM FOR PREDICTING THE AEROFOIL PRESSURE DISTRIBUTIONS IN SUBCRITICAL VISCOUS FLOW
Masao Ebihara, Youji Ishida, and Tokio Okonogi Nov. 1971 18 p refs In JAPANESE; ENGLISH summary
(NAL-TR-248) Avail: NTIS HC $3.00

The calculation is based on a compressibility correction formula and on the boundary layer camber model to account for viscous effects. The process by which the modification is effected is explained and the limitation of the boundary layer camber model is discussed. Comparison of the computed results with available experimental data indicates that the method gives results with an accuracy sufficient for most practical applications. Author

N72-27332# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Final Technical Report, Jun. - Sep. 1970
A COMPUTERIZED PROCEDURE TO OBTAIN THE COORDINATES AND SECTION CHARACTERISTICS OF NACA DESIGNATED AIRFOILS
Don W. Kinsey and Douglas L. Bowers Nov. 1971 79 p refs (AF Proj. 1366)
(AD-738623; AFFDL-TR-71-87) Avail: NTIS CSCL 20/4

The report describes the technical and analytical aspects of a computer program written to give airfoil coordinates, incompressible inviscid section characteristics and two-dimensional drag-rise Mach numbers for a large number of NACA airfoils from a simple one card input. The computer program is a combination of two separate programs. One program gives the airfoil surface coordinates with only the NACA airfoil designation as input, and the other program uses the surface coordinates to predict incompressible, inviscid pressure distribution from which the section characteristics and drag-rise Mach number are determined. The capabilities and accuracies of the computer program are described. GRA

N72-27426# Aeronautical Research Labs., Melbourne (Australia).
TRANSONIC WIND TUNNEL TESTS OF A DUAL SYSTEM (VANES, PRESSURE TAPS) GUST PROBE AND A PITOT-STATIC PROBE MOUNTED SIDE BY SIDE
G. F. Forsyth Jan. 1972 59 p refs
(ARL/A-Note-334) Avail: NTIS HC $5.00

A dual system gust measuring probe has been tested in the transonic wind tunnel primarily to provide a calibration at Mach numbers between 0.4 and 0.9 and at incidence and yaw angles in the range plus or minus 5 deg. The probe consisted of a bluff body with extended tube type pressure tappings and two lifting vanes mounted 6 in. from the probe head. The test results show the gust probe produces pilot instrument errors similar to those for a previous probe without the vanes. The Chaffois probe produced a small effect on the gust probe pressures but no effect on the vanes. Both differential pressures and vane loads were satisfactory in this range, the vanes being more linear but showing more offset due to the asymmetric mounting. Effect of the vanes on differential pressures was significant but predictable. The gust probe static pressure was always too high but comparable with previous results. Author

N72-27428# National Aerospace Lab., Tokyo (Japan).
FLUIDIC TURBINE INLET GAS TEMPERATURE SENSOR
Kenji Nishio, Masanori Endo, and Atsukazu Endo 1972 29 p In JAPANESE; ENGLISH summary
(NAL-TR-265) Avail: NTIS HC $3.50

The development of fluidic turbine inlet gas temperature sensors is discussed. The sensors have two outstanding features: (1) the output port is smaller than the main nozzle in cross section, and (2) the feedback path cross section area increases and remains constant up to the control port. These features produce a temperature sensor with high resolution, low noise, and large amplitude output signal. Performance test results and mathematical models are included to define the performance of the sensors. Author

N72-27472# Saab Aircraft Co., Linkoping (Sweden).
A PHOTOGRAMMETRIC THREE-POINT METHOD FOR ANALYSING THE MOTION OF MOVING OBJECTS
Kaare Moen 1972 37 p refs
(SAAB-TN-68) Avail: NTIS HC $4.00

Three of the six independent quantities necessary to describe the position of the camera in space have been chosen to specify the position of the optical center (focus) and the other *three to specify the attitude angles (Euler angles). The attitude* angles of the camera are determined by means of iterative angle computations with subsequent film coordinate transformation until convergence is achieved. Using the transformed film coordinates, the focal length of the camera lens and the positional coordinates of the points on the ground, the position of camera is computed in relation to the origin of the ground-based system in which the attitude angles were computed. As this system is usually an auxiliary system, further transformations are required in order to obtain the positional coordinates and attitude angles of the camera in the desired system. Knowing the positional coordinates of the camera and the mounting angles in the aircraft reference system it is then possible to compute the attitude angles of the aircraft and the position of its mean center of gravity. These quantities, which are instantaneous values for the time at which the frame was exposed, are evaluated for all the frames of interest. Using the camera frame rate, the instantaneous values are joined together into functions of time. The final phase of the motion analysis consists of digital low-pass filtering and differentiation and transformation to give the angles of attack and sideslip, heading angle, flight path angle and translational and angular velocities of the aircraft. Author (ESRO)

N72-27584# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
MECHANISM OF FATIGUE ENHANCEMENT IN SELECTED HIGH STRENGTH ALUMINUM ALLOYS Progress Report
Ronald E. Trabocco 10 Dec. 1971 29 p refs
(AD-738450; NADC-MA-7171) Avail: NTIS CSCL 11/6

The initial phase of an investigation concerned with the mechanism of fatigue enhancement in selected high strength/weight aluminum alloys was completed. Data indicate that in both X7080-T7 and X 7050, aluminum alloys fatigue enhancement is related to unique microstructures. In the case of the X7080 Al alloy it is the presence of aligned light etching regions and in the X 7050 alloy, it is the directional proliferation of precipitates predominately at grain boundaries. Author (GRA)

N72-27638 National Lending Library for Science and Technology, Boston Spa (England).
METEOROLOGICAL ASSISTANCE FOR THE CONCORDE TRIAL FLIGHTS
Henri Robert Cazale [1972] 17 p refs Transl. into ENGLISH from the publ. "French/American Meteorological Societies' Joint Meeting" Paris, 1971 p 1-19
(NLL-M-22439-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Eng.: 2 NLL photocopy coupons

The weather predictions for the Concorde test flights are discussed for the prototype and first subsonic flights in the lower atmospheric layers, the subsonic and transonic flights at altitudes between 500 and 200 mb, and the supersonic flights reaching to 100 mb and at a speed of Mach 2. The problems of predicting clear air turbulence and of predicting temperatures at 100 mb and 70 mb with sufficient fine detail and accuracy are described. The general conclusion is that meteorological help has

N72-27672 National Lending Library for Science and Technology, Boston Spa (England).
ON THE DETERMINATION OF ROUTES WITH MINIMUM FLIGHT TIME AT SST FLIGHT ALTITUDES
J. Bessemoulin [1972] 12 p Transl. into ENGLISH from "French/American Meteorological Societies' Joint Meeting" Paris, 1971 p 1-9
(NLL-M-22436-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A method for determining the optimal routes for supersonic transport aircraft is discussed. It was determined that the wind has a reduced effect on aircraft travelling at supersonic speed. The primary consideration is the effect of atmospheric temperature. Atmospheric temperature limits the speed at which the aircraft can operate due to the effect on power output from the engines and aerodynamic heating of the aircraft skin. An analysis of the temperature field at supersonic transport aircraft altitudes is required to attain savings in time of flight and fuel consumption. P.N.F.

N72-27679*# Stanford Univ., Calif. Center for Systems Research.
GUIDANCE AND CONTROL OF FLIGHT VEHICLES Annual Progress Report
J. V. Breakwell, A. E. Bryson, Jr., and G. F. Franklin Dec. 1971 18 p refs
(Grant NGL-05-020-007)
(NASA-CR-127268) Avail: NTIS HC $3.00 CSCL 17G

Progress reports on guidance and attitude control mechanisms of different flight vehicles are presented. The vehicles considered include orbiting spacecraft, supersonic aircraft, and general aviation aircraft. Data also cover orbital transfer using low thrust, automatic landing logic for aircraft, optimal and three dimensional turns for supersonic aircraft, and orbital rendezvous. E.H.W.

N72-27694# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TEST AND EVALUATION OF CATEGORY 3 ILS GROUND GUIDANCE EQUIPMENT "STAN-37 LOCALIZER TESTS AT NAFEC ON R/W-4" Interim Report, Feb. 1969 - May 1970
Henry W. Kasper May 1972 122 p
(FAA Proj. 320-111-01X)
(FAA-RD-72-50; FAA-NA-72-14) Avail: NTIS HC $8.25

A STAN-37 localizer (85-foot aperture) was installed and subjected to various tests. These included conformance to ICAO Annex 10 Category 3 ILS specifications, system performance, system and monitor stability and monitor operation under degraded system performance. It was concluded that the system characteristics met ICAO specifications, and that monitor executive action occurs as required when faults are present. System availability sufficient for Category 3 operation should be established during an evaluation under operational conditional conditions. Author

N72-27700# National Aviation Facilities Experimental Center, Atlantic City, N.J.
INTENSITY CONTROL OF FLASHERS Final Report, Apr. 1970 - Mar. 1972
Bernard Weinstein Jun. 1972 55 p
(FAA-RD-72-54; FAA-NA-72-36) Avail: NTIS HC $4.75

Intensity control of condenser discharge lights with a three-step intensity control was tested. The flashers were used in a runway alignment indicator light system as part of a medium intensity approach light system with sequenced flashers (MALSR) during both day and night and over a wide range of visibility conditions. A voltage sensing circuit, intended to operate the intensity controlled MALSR from the control tower using current changes in the runway lighting circuit, was also tested. One intensity controlled MALSR system 2400 ft long and another 3000 ft long were flight tested. The results indicate the following: (1) The voltage sensing circuit provided satisfactory operation of the MALSR from the control tower. (2) The intensity controlled MALSR operated satisfactorily and adequately supported flight operations. (3) Compatible intensity levels between the MALSR and the runway lights were obtained to provide a satisfactory intensity balance. (4) The operations of condenser discharge lights during night VFR and IFR conditions were not distracting and did not subject pilots to annoying glare. Author

N72-27701*# Magnavox Co., Silver Spring, Md. Advanced Systems Analysis Office.
MULTIPATH/RFI/MODULATION STUDY FOR DRSS-RFI PROBLEM: VOICE CODING AND INTELLIGIBILITY TESTING FOR A SATELLITE-BASED AIR TRAFFIC CONTROL SYSTEM Final Report, May 1970 - Apr. 1971
J. N. Birch and Norman Getzin Apr. 1971 576 p refs
(Contract NAS5-20168)
(NASA-CR-122432; ASAO-PR20020-2) Avail: NTIS HC $31.00 CSCL 17G

Analog and digital voice coding techniques for application to an L-band satellite-basedair traffic control (ATC) system for over ocean deployment are examined. In addition to performance, the techniques are compared on the basis of cost, size, weight, power consumption, availability, reliability, and multiplexing features. Candidate systems are chosen on the bases of minimum required RF bandwidth and received carrier-to-noise density ratios. A detailed survey of automated and nonautomated intelligibility testing methods and devices is presented and comparisons given. Subjective evaluation of speech system by preference tests is considered. Conclusion and recommendations are developed regarding the selection of the voice system. Likewise, conclusions and recommendations are developed for the appropriate use of intelligibility tests, speech quality measurements, and preference tests with the framework of the proposed ATC system. Author

N72-27702# National Aviation Facilities Experimental Center, Atlantic City, N.J.
SIMULATION STUDY OF DIAMOND RUNWAY MARKS FOR AIRCRAFT APPROACH GUIDANCE Interim Report, Oct. 1970 - Mar. 1972
Thomas E. Zurinskas Jun. 1972 16 p refs
(FAA Proj. 072-324-12X)
(FAA-NA-72-57) Avail: NTIS HC $3.00

A simulation study was made to determine a pilot's ability to establish a specific glide path angle by perceiving the apparent squareness of an oblong diamond mark on a runway. Twenty subjects were asked to say when they perceived squareness of the diamond marks. The subject's task was to adjust a movable simulated runway, which sloped upward or downward from level, changing the perspective of the marks until the first diamond mark in the runway centerline appeared to be square. The median viewing angle of each subject's judgements was his score. Two diamond centerlines of different dimensions were simulated: (1) one with diamonds 10 feet wide by 75 feet long, and (2) another with diamonds 10 feet wide by 150 feet long. The range of the scores was approximately 3 deg for the 10/75 diamonds, and approximately 6 deg for the 10/150 diamonds. In general, the results of this study do not support the hypothesis that the perception of squareness of a diamond runway marking is a sufficiently accurate technique for establishing a suitable glide path angle. Author

N72-27703*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPARATUS FOR AIDING A PILOT IN AVOIDING A MIDAIR COLLISION BETWEEN AIRCRAFT Patent Application
James H. Schrader and Richard H. Couch, inventors (to NASA) Filed 7 Apr. 1972 29 p
(NASA-Case-LAR-10717-1; US-Patent-Appl-SN-242028) Avail: NTIS HC $3.50 CSCL 17G

A system for aiding a pilot in avoiding a midair collision between aircraft is described. The system consists of a protected aircraft equipped with a transmitter, transponder, receiver, and data processor. The intruding aircraft is similarly equipped. The signal from the most hazardous intruding aircraft is received by the protected aircraft and applied to the data processor. The data processor determines the closing velocity of the aircraft, the range between aircraft, altitude difference, and time to possible collision. The timeliness of the warning information makes it possible to avoid midair collisions. NASA

N72-27705# Joint Publications Research Service, Arlington, Va.
THE "EYES" OF AN AIRPORT
V. Kulikov 11 Jul. 1972 5 p Transl. into ENGLISH from Radio (Moscowi, no. 5, 1972 p 15-16
(JPRS-56463) Avail: NTIS HC $3.00

A description of an air traffic control radar system in use in U.S.S.R. is presented. The specifications of the radar are identified and its performance parameters are discussed. The radar has 53 percent solid state and only 1.6 percent vacuum tube components in its circuitry. The radar also is equipped with an interrogator, which by means of a responder in the aircraft, transmits data concerning the altitude of the aircraft, aircraft identification, and fuel remaining in aircraft tanks. Author

N72-27706*# Genoa Univ. (Italy).
TWO EXAMPLES OF APPLICATIONS OF KALMAN FILTERING TO INTEGRATED SYSTEMS OF NAVIGATION [DUE ESEMPI DI APPLICAZIONI DEL FILTRO DI KALMAN AD EQUIPAGGIAMENTI INTEGRATI DI NAVIGAZIONE]
Aldino Ferraro and Aleramo L. Lucifredi Dec. 1970 18 p refs In ITALIAN Submitted for publication Sponsored jointly by ESRO and NASA
(NASA-CR-127253; IIR-70-LF-157) Avail: NTIS HC $3.00 CSCL 17G

Two applications of optimal stochastic filters to navigation systems are described. The first is an air navigation system consisting of an inertial device (INS) and a Loran, plus an altimeter. The second is an application to a system of submarine navigation consisting of an inertial device (SINS) and an Omega plus a depth sensor. ESRO

N72-27707# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
ESRO-ATC BALLOON-AIRCRAFT SATELLITE SIMULATION EXPERIMENT 1971. VOL. 2: MULTIPATH ANALYSIS (MATHEMATICAL) FROM ANALOGUE MAGNETIC RECORDINGS GENERATED IN EXPERIMENTED FLIGHTS DURING ATC CAMPAIGN, 1971 Final Report
Peter Horn Mar. 1972 131 p refs
(Contract ESTEC-1458-71-CG)
Avail: NTIS HC $8.75

As part of the development of a European aeronautical satellite, a mathematical multipath analysis from analog magnetic recordings generated in experimental flights is presented. The satellite is simulated by a balloon. Experimental multipath phenomena were investigated in the light of theoretical predictions. The study was restricted to pure CW signals, and data processing by fast Fourier transformation was covered in addition. Data are presented in graphical form. ESRO

N72-27708# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.
THE QUASI-VISUAL FLIGHT: A NEW NAVIGATION CONCEPT [DER QUASI-SICHTFLUG: EIN NEUES KONZEPT DER FLUGFUEHRUNG]
Joachim Wernicke Sep. 1971 37 p refs In GERMAN
(Rept-62) Avail: NTIS HC $4.00

An air navigation system is described which uses the concept of interferometric measurements of signals received from microwave radio beacons on the ground and in other aircraft similarly equipped. The position of the aircraft as well as that of aircraft in the vicinity are shown on a display device. The pilot can thus initiate a collision avoidance maneuver. The advantages of such a system over present day air traffic control are stressed, especially freedom from fixed predetermined air routes and much shorter security margins. Costs of such a system are estimated and compared with those of present air traffic control in Germany. ESRO

N72-27709# Airborne Instruments Lab., Deer Park, N.Y.
EVALUATION OF THE 1968 FAA/DOD BEACON FLIGHT TEST IN NEW YORK Final Report
Richard L. Lella Sep. 1970 199 p
(Contract DOT-FA70WA-2267)
(AD-738680; AIL-9206-1; FAA-RD-70-60) Avail: NTIS CSCL 17/7

The study examines beacon test data taken by FAA/DOD during a 4-hour flight over the New York area. The object was to develop methods of processing the data and to extract information characterizing the performance of the beacon system. Parameters used to evaluate performance include scan reliability, probability of a missed report, classification of misses according to cause, code errors, spurious target reports, and range azimuth accuracy estimation. For data available on magnetic tape, computer programs were developed to tabulate beacon malfunctions. Techniques were developed to estimate the probable cause of a malfunction. Author (GRA)

N72-27710# Little (Arthur D.), Inc., Cambridge, Mass.
ILLUSTRATIVE APPLICATIONS OF AIR TRAFFIC CONTROL SYSTEM CAPACITY STUDY METHODOLOGY Interim Report, Nov. 1970 - Sep. 1971
G. Raisbeck, J. L. Everett, and B. O. Koopman Nov. 1971 46 p refs
(Contract DOT-FA70WA-2141)
(AD-738892; FAA-RD-71-113) Avail: NTIS CSCL 17/7

The long-range objective of this program is to develop tools and techniques to define, measure, and predict the capacity of an air traffic control system, which can then be used in analytical studies in support of long-range plans, management decisions, and system performance evaluations. The method of approach in this contract provides for testing and refining these tools by using them in typical current problems. This report illustrates the application of these tools to five typical current problems: The origins of delays in aviation operations; Insensitivity of queue parameters to server statistics; Operational measurements in the terminal control area; Structuring cost-benefit methodology for ATC capacity improvement measures; and Establishing practical safety goals in air traffic control. GRA

N72-27713# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
ADVANCED CARRIER-BASED AIR TRAFFIC CONTROL Technical Report, 15 Mar. - 14 Dec. 1971
Nelson R. Zagalsky, Keith L. Curtner, and Robert P. Irons Mar. 1972 90 p refs
(Contract N00014-71-C-0265; NR Proj. 215-188)
(AD-739713; F2027-IR1) Avail: NTIS CSCL 17/7

A carrier-based air traffic control system which features enroute trajectory optimization and a computer-aided marshal reassignment procedure is described. The development of the trajectory optimization procedure is followed by a description of a computer simulation to be used as a design tool and for the demonstration of concept feasibility. The simulation model features an F4 mathematical model and an interactive controller's display console. Author (GRA)

N72-27737*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME CONTRIBUTIONS TO ENERGETICS BY THE LEWIS RESEARCH CENTER AND A REVIEW OF THEIR POTENTIAL NON-AEROSPACE APPLICATIONS
Robert W. Graham and Martin U. Gutstein 1972 11 p refs Proposed for presentation at Conf. on the Impact of Aerospace Technol. on Soc. in the 70's, Anaheim, Calif., 10-13 Sep. 1972; sponsored by Am. Soc. of Mech. Eng.
(NASA-TM-X-68092; E-6958) Avail: NTIS HC $3.00 CSCL 20L

The primary technology areas are aerospace propulsion, power and materials. As examples in these technologies, the programs in the fields of cryogenics and liquid metals are reviewed and potential non-aerospace applications for the results of these programs are discussed. These include such possibilities

as: hydrogen as a non-polluting industrial fuel; more efficient central power stations; and powerplants for advanced ground transportation. Author

N72-27811# National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.
TECHNICAL EVALUATION REPORT ON PROPULSION AND ENERGETICS PANEL 37TH MEETING ON AIRCRAFT FUELS, LUBRICANTS, AND FIRE SAFETY
R. B. Whyte and L. Gardner Paris AGARD May 1972 9 p refs
(AGARD-AR-44) Avail: NTIS HC $3.00

The discussions which took place at a meeting on aircraft fuels, lubricants, and fire safety are presented. The subjects discussed are: (1) fuels production, analysis and testing, (2) fuel handling, (3) lubricants, and (4) fire safety research. It was concluded that from an operational aspect the fuels and lubricants used for aircraft engines are satisfactory up to at least Mach 2.2. It was recommended that additional developments be undertaken to provide refueling systems capable of dealing with larger volumes of fuel at higher rates of flow than exist in present equipment. Author

N72-27814* National Aeronautics and Space Administration, Washington, D.C.
ENVIRONMENTAL IMPACT STATEMENT QUIET ENGINE PROGRAM Draft Environmental Impact Statement
Feb. 1971 5 p
(NASA-TM-X-68545) Avail: NASA Public Document Rooms, $1.00 CSCL 21E

The quiet engine program is described, including technology demonstration, noise level determination, and acoustic and aerodynamic data acquisition. Unavoidable adverse environmental effects are reviewed. The relationship between the local short term uses of the environment and the maintenance of long term productivity is also investigated. J.A.M.

N72-27816*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIENCE WITH LOW COST JET ENGINES
Robert L. Cummings 1972 20 p Presented at Natl. Business Aircraft Meeting, Wichita, Kansas, 15-17 Mar. 1972; sponsored by Soc. of Automotive Engr.
(NASA-TM-X-68085; E-6985) Avail: NTIS HC $3.00 CSCL 21E

A summary is given of the results of a NASA program for reducing the cost of turbojet and turbofan engines. The design, construction, and testing of a simple turbojet, designed for use in missiles, is described. Low cost axial stage fabrication, the design of a fan jet engine suitable for propulsion of light aircraft, and application of such engines to provide higher flight speeds, are discussed. Author

N72-27817*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTED UPWASH ANGLES AT ENGINE INLETS FOR STOL AIRCRAFT
James A. Albers Washington Jul. 1972 16 p refs
(NASA-TM-X-2593; E-6901) Avail: NTIS HC $3.00 CSCL 20D

Upwash angles were predicted for a STOL lifting system by using a two-dimensional potential flow analysis. Upwash angles are presented for distances ahead of the wing leading edge of 50, 75, and 100 percent of wing chord. The upwash angle was determined to be insenitive to the vertical location of the engine inlet. For a wide range of takeoff and landing conditions, the upwash angle was found to be a function of the total two-dimensional lift coefficient. Upwash angles, along with typical flow fields, are presented for a range of total two-dimensional lift coefficients from 2 to 12. Three-dimensional effects were considered in estimating upwash angles for an unswept-wing externally blown flap aircraft. For this STOL configuration, effective upwash angles during takeoff, approach, and waveoff conditions were found to be 22 deg, 26 deg, and 36 deg, respectively. Author

N72-27818*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EVALUATION OF RANGE AND DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES. TASK 2: PERFORMANCE OF A 1500-FOOT-PER-SECOND TIP SPEED TRANSONIC FAN STAGE WITH VARIABLE GEOMETRY INLET GUIDE VANES AND STATOR Final Report
K. R. Bilwakesh, C. C. Koch, and D. C. Prince Jun. 1972 224 p refs
(Contract NAS3-11157)
(NASA-CR-72880; R71AEG195) Avail: NTIS HC $13.25 CSCL 21E

A 0.5 hub/tip radius ratio compressor stage consisting of a 1500 ft/sec tip speed rotor, a variable camber inlet guide vane and a variable stagger stator was designed and tested with undistorted inlet flow, flow with tip radial distortion, and flow with 90 degrees, one-per-rev, circumferential distortion. At the design speed and design IGV and stator setting the design stage pressure ratio was achieved at a weight within 1% of the design flow. Analytical results on rotor tip shock structure, deviation angle and part-span shroud losses at different operating conditions are presented. The variable geometry blading enabled efficient operation with adequate stall margin at the design condition and at 70% speed. Closing the inlet guide vanes to 40 degrees changed the speed-versus-weight flow relationship along the stall line and thus provided the flexibility of operation at off-design conditions. Inlet flow distortion caused considerable losses in peak efficiency, efficiency on a constant throttle line through design pressure ratio at design speed, stall pressure ratio, and stall margin at the 0 degrees IGV setting and high rotative speeds. The use of the 40 degrees inlet guide vane setting enabled partial recovery of the stall margin over the standard constant throttle line. Author

N72-27820*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VARIABLY POSITIONED GUIDE VANES FOR AERODYNAMIC CHOKING Patent Application
David Chestnutt, inventor (to NASA) Filed 27 Jun. 1972 13 p
(NASA-Case-LAR-10642-1; US-Patent-Appl-SN-266820) Avail: NTIS HC $3.00 CSCL 21E

Turbine inlet guide vanes which may be variable positioned to provide aerodynamic choking are described. The choked condition is obtained by pivoting selected guide vanes about their own axes. The invention provides a means of obtaining aerodynamic choking without encountering the losses caused by other choking devices. NASA

N72-27822# National Aerospace Lab., Tokyo (Japan).
AN INVESTIGATION OF A HIGH SPEED AXIAL-FLOW TURBINE. 2: A SINGLE STAGE TURBINE
Tadao Torisaki, Mitsuo Morita, Hiroyuki Nouse, Shizuo Sekine, and Shigeo Inoue Feb. 1972 24 p refs In JAPANESE; ENGLISH summary
(NAL-TR-273) Avail: NTIS HC $3.25

The results of cold air tests of a single stage, axial-flow turbine are reported. A conventional profile, T-6, was used both for nozzle and rotor blade profiles. The tests were carried out over the expansion ratio based on turbine inlet and outlet total pressure ranging from 1.1 to 2.0 and the rotor blade-speed parameter ranging from 30 percent to 110 percent of the design value. Relatively high overall performance was achieved over the range of the blade to gas speed ratio from 0.4 to 0.5. Spanwise distribution of the expansion ratio, the stage enthalpy drop and the adiabatic efficiency were made clear from the turbine inlet, the nozzle exit and the rotor blade exit surveys. These results are compared with the previous test results obtained from the

annular nozzle cascade test, and the effects of the rotor blade row on the upstream flow coming through the nozzle blade row are discussed. The result of an off-design overall performance calculation is also presented. Author

N72-27955# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
CRACK PROPAGATION IN A FULL-SCALE WING STRUCTURE UNDER RANDOM FLIGHT-SIMULATION LOADING
J. Schijve and P. DeRijk Apr. 1971 54 p refs Sponsored by Neth. Aircraft Develop. Board (NIV)
(NLR-TR-71043-U) Avail: NTIS HC $4.75

Flight simulation tests carried out on a wing of the Fokker F-28 Fellowship under cyclic gust loading are reported on. Truncation of infrequently occurring high-amplitude gust cycles to a lower level considerably accelerated crack growth. A 25 percent increase of the design stress level induces about 2.5 times faster crack growth. The application of fail-safe loads (100 percent limit load) drastically delayed subsequent crack growth.
Author (ESRO)

N72-27968# Tennessee Univ., Tullahoma. Space Inst.
POLLUTANT PRODUCTION IN A SIMULATED TURBOJET AFTERBURNER. PART 1: EXPERIMENTAL AND THEORETICAL STUDY Final Report, 1 Nov. 1970 - 31 Jul. 1971
LLoyd W. Crawford, Arthur A. Mason, and James M. Lents Feb. 1972 140 p refs
(Contract F33615-71-C-1125; AF Proj. 3066)
(AD-739176; AFAPL-TR-71-66-Pt-1) Avail: NTIS CSCL 21/2

An experimental and theoretical study has been made of the history of the pollutants carbon monoxide (CO), unburned hydrocarbons (HC) and nitrogen oxides (NO(x)) in a turbojet afterburner. Experimental traverses at several axial stations were performed in a simulated afterburner in which exhaust from a J-47 combustor can, operated at medium power, was mixed with fuel spray. Experiments were carried out both in a non-bypass and in a bypass configuration (secondary air was mixed with primary exhaust). The theoretical analysis consisted of a computer program for reacting flow with turbulent mixing. Infrared measurements of NO in the combustion tunnel were attempted. Indications were obtained of NO at the 5.3 micron band, but quantitative measurements were not obtained.
Author (GRA)

N72-27969# Tennessee Univ., Tullahoma. Space Inst.
POLLUTANT PRODUCTION IN A SIMULATED TURBOJET AFTERBURNER. PART 2: COMPUTER PROGRAM FOR CALCULATION OF POLLUTANT HISTORY IN AFTERBURNING TURBOJET ENGINES Final Report, 1 Nov. 1970 - 31 Jul. 1971
LLoyd W. Crawford, Arthur A. Mason, and James M. Lents Feb. 1972 70 p refs
(Contract F33615-71-C-1125; AF Proj. 3066)
(AD-739177; AFAPL-TR-71-66-Pt-2) Avail: NTIS CSCL 21/2

The users manual was prepared to provide the means of estimating air pollution concentrations in the exhaust gases from afterburning turbojet engines. Author (GRA)

N72-27988# Army Foreign Science and Technology Center, Charlottesville, Va.
ANTIAIRCRAFT DEFENSE HERALD, NUMBER 8, AUGUST 1971
3 Jan. 1972 176 p refs Transl. into ENGLISH of Vestn. Protivovozdushnoy Oborony (Moscow), no. 8, Aug. 1971
(AD-739229; FSTC-HT-23-1238-72; ACSI-K-0856) Avail: NTIS CSCL 15/3

Articles are presented on a new five year plan, group cohesion, interceptors, all-weather operations, flight safety, scientific and technical personnel, decision making, combat training, human engineering, test methods, electronic equipment, teaching aids, and guidance. GRA

N72-27990# Army Foreign Science and Technology Center, Charlottesville, Va.
ANTIAIRCRAFT DEFENSE HERALD, NUMBER 7, JULY 1971
3 Jan. 1972 192 p refs Transl. into ENGLISH from Vestn. Protivovozdushnoi Oborony (Moscow), no. 7, 1971
(AD-739973; FSTC-HT-23-1240-72) Avail: NTIS CSCL 15/3

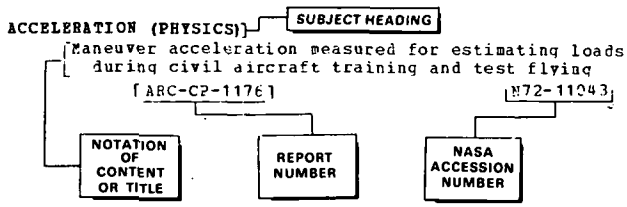
Contents: Military training; Aircraft stability; Psychometrics; Combat machinery life; Targets; Radar and radio; Photographing; Airfield maintenance. GRA

N72-27991# Army Foreign Science and Technology Center, Charlottesville, Va.
ANTIAIRCRAFT DEFENSE HERALD, NUMBER 10, OCTOBER 1971
23 Feb. 1972 176 p Transl. into ENGLISH from Vestn. Protivovozdushnoi Oborony (Moscow), no. 10, Oct. 1971
(AD-739974; FSTC-HT-23-1601-72) Avail: NTIS CSCL 15/3

Contents: Military discipline; Communism; Antiaircraft defense; Rocketry; Military training; Aircraft engine maintenance; Radar equipment; Communication systems repair; Image recognition; Zionism. GRA

SUBJECT INDEX

Typical Subject Index Listing



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[AD-738900] N72-27040

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PERSONAL AUTHOR INDEX

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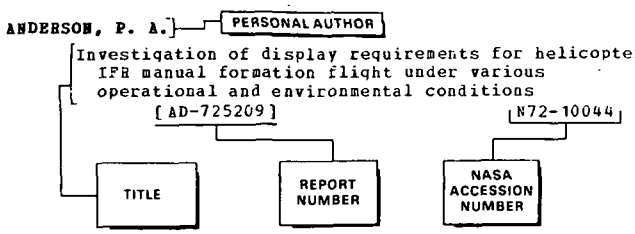

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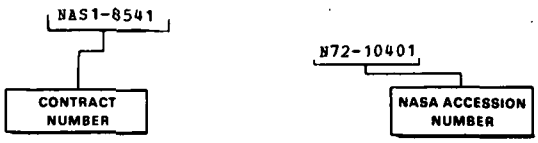

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1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037 (23)		

4. Title and Subtitle	5. Report Date
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	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
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9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546	11. Contract or Grant No.
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15. Supplementary Notes

16. Abstract

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