

# BIBLIOGRAPHY OF NASA PUBLISHED REPORTS ON GENERAL AVIATION, 1975 TO 1981

(1981 EDITION)

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**BIBLIOGRAPHY OF  
NASA PUBLISHED REPORTS  
ON GENERAL AVIATION,  
1975 TO 1981**

**(1981 EDITION)**

**NASA**  
National Aeronautics and  
Space Administration

NASA Headquarters  
Washington, DC 20546

**OAST**  
Office of Aeronautics  
and Space Technology



## FOREWORD

This bibliography lists 478 documents generated by the NASA aeronautics program during the period 1975 through the first quarter of 1981, which relate to general aviation or which are judged to be of specific interest to those involved in general aviation. General aviation in this context includes all heavier-than-air fixed wing aircraft exclusive of military types and those used for commercial air transport. An exception is the recent inclusion of commuter transport aircraft types within the general aviation category.

NASA publications included in this bibliography are:

- o Conference Publications (CP)
- o Reference Publications (RP)
- o Technical Memorandums (TM, TMX)
- o Technical Notes (TN)
- o Technical Papers (TP)
- o Contractor Reports (CR)

In addition, papers and articles on NASA general aviation programs published by technical societies (AIAA, SAE, etc.) are included, as well as those listed in NASA's Scientific and Technical Aerospace Reports (STAR) Journal. Author and subject indexes are also provided to facilitate use of the bibliography.

This bibliography was compiled and edited by Dr. Raymond E. Rose, Program Manager, General Aviation Office, NASA Headquarters, Washington, D. C. He expresses his appreciation to Mr. Philip F. Eckert, Manager, Reference and Retrieval Department, and Ms. June Silvester, Reference Analyst, both of the NASA Scientific and Technical Information (NSTI) Facility for help in compiling the report bibliography and author and subject indexes, and to Mr. John H. Wilson, Jr., Information Systems Specialist, NSTI Branch, for his special assistance in developing the bibliography.



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## NASA'S GENERAL AVIATION RESEARCH AND TECHNOLOGY PROGRAM

Over the years, much of the NASA and the predecessor NACA research in aeronautics has had wide applicability to general aviation even though largely focussed on other aircraft types and applications. In addition, from time to time and particularly within the last decade, NASA has allocated a portion of its research resources to technical opportunities and needs specifically applicable to general aviation aircraft and their operation. This research has been focussed on the broad objectives of improved safety, greater energy efficiency, increased utility and productivity, and environmental compatibility. To accomplish these broad objectives, the program has aimed at obtaining greater understanding of the basic phenomena and processes involved in the design and operation of general aviation aircraft, through obtaining useful physical data from laboratory and flight research, and developing useful theories, analysis and design methods.

Resources allocated annually to general aviation needs and applications in the last decade have ranged from about 2 to 5 percent of the NASA aeronautics funding and manpower budgets. In Fiscal Year 1981, approximately \$8.5 million has been allocated specifically to commuter and general aviation research and technology, and it is estimated that approximately another \$2 million devoted to aeronautics fundamentals and/or to other specific air vehicle types is also applicable to commuter and general aviation.

NASA's commuter and general aviation programs are conducted by the Langley Research Center, Hampton, Virginia, and the Lewis Research Center, Cleveland, Ohio, with the support of the Ames Research Center, Moffett Field, California, and the Wallops Flight Center, Wallops Island, Virginia. Approximately 40 percent of the general aviation program is conducted in-house at NASA Centers by Civil Service employees (researchers, engineers, technicians and other support staff) and support service contractors using NASA facilities. Approximately 60 percent of the program is conducted by industry and universities under research contracts and grants from the NASA Centers, and is monitored and managed by NASA Center personnel.

The commuter and general aviation program encompasses all the aeronautical disciplines. Current research emphases are as follows:

- o Aerodynamics and Flight Dynamics
  - Stall/spin avoidance and/or alleviation
  - Airfoil and wing technology
  - Drag reduction techniques
  - Improved configurations for efficiency, handling qualities, ride qualities, aerodynamic integration
  
- o Propulsion
  - Propellers: increased efficiency, reduced noise
  - Engines: combustion and heat transfer, advanced engines (increased fuel efficiency, reduced weight and cost, lower emissions, improved controls and operation)
  
- o Structures and Materials
  - Crash dynamics, energy absorbing and load limiting structures
  - Low cost composites
  
- o Avionics and Human Factors
  - Improved sensors, displays, navigation concepts
  - Single pilot IFR system improvements
  
- o Agricultural Aerial Applications
  - Wake prediction and modification for improved uniformity, accuracy, productivity, and safety
  - Improved liquid and solid material dispersal systems

- o Icing
  - Fundamentals of ice formation and accretion
  - Anti-icing and deicing system concepts
- o Interior Noise Reduction
  - Source and transmission
  - Noise reduction design technology

Current year program objectives are described in the Research and Technology Objectives and Plans (RTOP) Summary (NASA-TM-82189, Accession No. N81-19959).



## NASA BIBLIOGRAPHY OF GENERAL AVIATION REPORTS

This is the second publication of a NASA bibliography of general aviation reports and covers the period from 1975 to early 1981. The first publication covered the period from 1966 to 1975. This bibliography contains abstracts of published works as primarily obtained from the NASA/RECON (Remote Console for the bibliographical retrieval data base system) reporting system. The abstracts are preceded by a listing of document numbers and titles according to report category. General aviation reports in publication are not listed (this could include some reports from late 1980) and will appear in the next general aviation bibliography publication.

Most of the published reports cited are available in either hard copy or microfiche through the National Technical Information Service (NTIS), Springfield, VA 22151; the Government Printing Office (GPO), Washington, D.C. 20402; or the Technical Information Service, AIAA Inc., 750 3rd Ave., New York, N.Y. 10017, (212) 867-8300. In particular, reports containing the letter "N", in the Accession No., such as 78N31874, can be obtained from NTIS, while reports containing the letter, "A", in the Accession No. (77A17069) are more readily obtained from the Technical Information Service, AIAA Inc. Please refer to the Accession No. when requesting publications.

### Notations

The following notations are used in the report title listings and bibliography:

ABS	Abstract
AUTH	Author(s)
IAA	International Aerospace Abstracts (refers to IAA Journal produced for NASA by the AIAA, issued on the 1st and 15th of each month)
MAJS	Major subject
MINS	Minor subject
RPT#	Report number
STAR	Scientific and Technical Aerospace Reports (refers to NASA's STAR Journal* publication, issued on the 8th and 23rd of each month)
UTTL	Unclassified report title

- 78AXXXXX Report accession number. The number, "78", or a corresponding number, refers to the calendar year in which the report was entered into the NASA/RECON reporting system. The letter, "A", indicates that the report is published in the IAA Journal. The remaining five digits complete the accession number.
- 79NXXXXX Report accession number. The letter, "N", indicates that the report is published in NASA's STAR publication. (In many cases the letter "N" or "A" in the accession number is interchanged with the calendar year number, such as N79-XXXXX.)
- 80/11/21 Example of an official report publication date - year/month/day

\* The NASA STAR Journal is a journal of abstracts and is a major component of a comprehensive NASA information system covering aeronautics, space and supporting disciplines. The STAR is issued on the 8th and 23rd of each month and announces current publications of the following types:

- o NASA, NASA contractor, and NASA grantee reports
- o Reports issued by other U.S. Government agencies, domestic and foreign institutions, universities, and private firms
- o Translations in report form
- o NASA-owned patents and patent applications
- o Dissertations and theses

A separate section of information on aerospace-related on-going research projects is also included in STAR. Cumulative index volumes of STAR are published semiannually and annually.

### Use of Bibliography

This bibliography is presented in four sections: Section 1, Title Listings by Report Category; Section 2, Report Abstracts; Section 3, Subject Index Listing; and Section 4, Personal Author Index.

Section 1, Title Listings by Report Category, contains the report titles grouped according to the category of the report - CP, TM, etc. The titles are presented by report number in increasing

numerical sequence and, in general, are grouped according to calendar year (starting with 1975, where applicable) as indicated by the report accession number. An exception to the increasing numerical sequence rule occurs with some contractor reports (CR). Because of the peculiarities of the computer system used in the NASA/RECON reporting system, the first digit of the CR report numbers are listed in increasing numerical sequence, but all CR reports having the same first digit are listed before the CR reports having a larger first digit regardless of the size of the total report number. For example, CR's such as NASA CR-132531 (starting with the digit "1") will be listed ahead of CR's starting with a higher digit, such as NASA CR-2523, regardless of the size of the report number. However, following the first digit the reports are still listed in increasing numerical sequence.

If the NASA report number or title is known and the approximate year of publication, the page containing the report abstract and other pertinent information, can be found from the report title listings. As an example, if a particular Technical Memorandum (TM) is required, one can look in the TM section of the report listings in the calendar year group indicated by the accession numbers. In some cases where the report publication date is near the end of the calendar year, it may not have been entered into the NASA/RECON reporting system until the following calendar year and would, therefore, appear in that year's grouping as indicated by accession number.

In the case of AIAA, SAE and other papers, the papers are grouped according to calendar year of publication, alphabetically and in increasing numerical sequence.

Section 2, Report Abstracts, contains a definition of the various report categories -- CP, TM, CR, etc.; and in addition to information given in Section 1, presents the report author(s), major and minor subjects discussed in the report, and report abstracts.

Section 3, Subject Index Listing, can be used to locate reports dealing with a particular subject. The report numbers and the accession numbers for a particular subject are listed in the subject index on the left and right hand sides of the subject columns, respectively. The report numbers can then be used to find the report abstracts, etc., by using Section 1, Title Listings by Report Category, as previously explained.

Section 4, Personal Author Index, can be used to locate reports written by a particular author. The report numbers listed can be used to find the report abstracts as explained above.



SECTION 1

TITLE LISTINGS BY REPORT CATEGORY



TITLE LISTINGS BY REPORT CATEGORY

Conference and Reference Publications (CP, RP):

<u>Report Nos. and Title</u>	<u>Page No.</u>
RPT#: NASA-CP-2045-PT-2 L-12232-VOL-1-PT-2 79N19689 UTTL: Advanced technology airfoil research, volume 1, part 2 78/00/00	49
RPT#: NASA-CP-2057 E-9900 79N15961 UTTL: The rotary combustion engine: A candidate for general aviation 78/00/00	49
RPT#: NASA-CP-2046 L-12232 BON21283 UTTL: Advanced technology airfoil research, volume 2 79/00/00	49
RPT#: NASA-CP-2119 L-13503 BON19193 UTTL: Assessment of Carbon Fiber Electrical Effects 80/03/00	49
RPT#: NASA-CP-2120 BON22283 UTTL: Resource management on the flight deck 80/03/00	49
RPT#: NASA-CP-2126 E-310 BON22327 UTTL: General Aviation Propulsion 80/03/00	49
RPT#: NASA-CP-2149 E-489 B1N12978 UTTL: Impact for the 80's: Proceedings of a Conference on Selected Technology for Business and Industry 80/11/00	49
RPT#: NASA-RP-1020 79N25043 UTTL: Precision positional data of general aviation air traffic in terminal air space 78/05/00	49

Technical Memorandums (TM, TMX):

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<u>Report Nos. and Title</u>	<u>Page No.</u>	<u>Report Nos. and Title</u>	<u>Page No.</u>
RPT#: NASA-TM-X-3213 A-5863 75N18181 UTTL: Application of numerical optimization to the design of low speed airfoils 75/03/00	53	RPT#: NASA-TM-X-3445 A-6743 OR-76-1 76N33845 UTTL: NASA aviation safety reporting system 76/09/00	55
RPT#: NASA-TM-X-62398 FAA-NA-75-151 75N17340 UTTL: Flight test investigation of the vortex wake characteristics behind a Boeing 727 during two-segment and normal ILS approaches (A joint NASA/FAA report) 75/01/00	53	RPT#: NASA-TM-X-72811 76N15158 UTTL: Description of a landing site indicator (LASI) for light aircraft operation 76/01/00	55
RPT#: NASA-TM-X-72641 75N18231 UTTL: Noise reduction studies for the Cessna model 337 (0-2) airplane 75/04/00	53	RPT#: NASA-TM-X-72838 76N20940 UTTL: Prediction of light aircraft interior noise 76/04/00	55
RPT#: NASA-TM-X-72642 75N18234 UTTL: Ground noise measurements during static and flyby operations of the Cessna Q2-T turbine powered airplane 75/04/00	53	RPT#: NASA-TM-X-72839 76N21990 UTTL: Sources and characteristics of interior noise in general aviation aircraft 76/04/00	55
RPT#: NASA-TM-X-72716 75N28066 UTTL: Interior noise levels of two propeller-driven light aircraft 75/07/00	54	RPT#: NASA-TM-X-72997 76N20065 UTTL: Domestic and world trends affecting the future of aviation (1980 - 2000), appendix C 76/03/00	56
		RPT#: NASA-TM-X-72998 76N20066 UTTL: The outlook for aeronautics, 1980 - 2000: Executive summary 76/03/00	56
		RPT#: NASA-TM-X-73051 NASA-NEWS-RELEASE-76-51 76N20106 UTTL: General aviation technology program 76/03/00	56
		RPT#: NASA-TM-X-73124 FAA-RD-76-100 76N30200 UTTL: Progress toward development of civil airworthiness criteria for powered-lift aircraft 76/05/00	56

<u>Report Nos. and Title</u>	<u>Page No.</u>	<u>Report Nos. and Title</u>	<u>Page No.</u>
RPT#: NASA-TM-X-3546 A-7001 77N24076 UTTL: NASA aviation safety reporting system 77/05/00	57	RPT#: NASA-TM-X-74687 77N24010 UTTL: FY 1978 aeronautics and space technology program summary 77/03/07	58
RPT#: NASA-TM-X-72697 77N23049 UTTL: Low-speed aerodynamic characteristics of a 13-percent-thick airfoil section designed for general aviation applications 75/05/00	57	RPT#: NASA-TM-X-3561 L-11472 78N11052 UTTL: Experimental and analytical determination of characteristics affecting light aircraft landing-gear dynamics 77/11/00	59
RPT#: NASA-TM-X-73228 A-6947 77N24052 UTTL: Dynamics of ultralight aircraft: Motion in vertical gusts 77/04/00	57	RPT#: NASA-TM-73507-VOL-1 E-8916-2 78N29100 UTTL: Effect of air temperature and relative humidity at various fuel-air ratios on exhaust emissions on a per-mode basis of an AVCO Lycoming O-320 diad light aircraft engine: Volume 1: Results and plotted data 78/07/00	59
RPT#: NASA-TM-X-73229 A-6989 77N24053 UTTL: Dynamics of ultralight aircraft: Dive recovery of hang gliders 77/05/00	57	RPT#: NASA-TM-73831 78N16055 UTTL: A review of NASA's propulsion programs for aviation 79/00/00	59
RPT#: NASA-TM-X-73500 77N19058 UTTL: Emissions of an AVCO Lycoming O-320-DIAD air cooled light aircraft engine as a function of fuel-air ratio, timing, and air temperature and humidity 76/08/00	57	RPT#: NASA-TM-73884 78N17060 UTTL: General aviation energy-conservation research programs at NASA-Lewis Research Center 77/00/00	59
RPT#: NASA-TM-X-73507 E-8916-VOL-2 77N10066 UTTL: Effect of air temperature and relative humidity at various fuel-air ratios on exhaust emissions on a per-mode basis of an Avco Lycoming O-320 DIAD light aircraft engine. Volume 2: Individual data points 76/09/00	58	RPT#: NASA-TM-74055 78N13040 UTTL: A preliminary study of the performance and characteristics of a supersonic executive aircraft 77/03/00	60
RPT#: NASA-TM-X-73564 E-9008 77N23109 UTTL: NASA Quiet Clean General Aviation Turbofan (QCGAT) program status 77/00/00	58	RPT#: NASA-TM-74097 L-11695 79N13011 UTTL: Aerodynamic characteristics of airplanes at high angles of attack 77/12/00	60
RPT#: NASA-TM-X-73671 E-9190 77N26153 UTTL: Exploratory investigation of the incipient spinning characteristics of a typical light general aviation airplane 77/00/00	58	RPT#: NASA-TM-75052 78N11702 UTTL: Provisional standards of radiation safety of flight personnel and passengers in air transport of the civil aviation 77/10/00	60

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<u>Report Nos. and Title</u>	<u>Page No.</u>	<u>Report Nos. and Title</u>	<u>Page No.</u>
RPT#: NASA-1M-75323 PAPER-77-027 78N32054 UTTL: Profile design for an advanced-technology airfoil for general aviation aircraft 78/08/00	60	RPT#: NASA-1M-79073 E-9890 79N16849 UTTL: New opportunities for future small civil turbine engines: Overviewing the GATE studies 79/00/00	63
RPT#: NASA-TM-78638 L-11918 78N19059 UTTL: Dynamic wind-tunnel tests of an aeromechanical gust-alleviation system using several different combinations of control surfaces 78/03/00	61	RPT#: NASA-TM-79075 E-9892 79N15958 UTTL: The gate studies: Assessing the potential of future small general aviation turbine engines 79/00/00	63
RPT#: NASA-TM-78748 78N33731 UTTL: Adaptation of time line analysis program to single pilot instrument flight research 78/08/00	61	RPT#: NASA-1M-79254 E-165 AIAA-79-1824 79N31210 UTTL: An overview of NASA research on positive displacement type general aviation engines 79/00/00	63
		RPT#: NASA-1M-80133 79N28158 UTTL: Potential applications of advanced aircraft in developing countries 79/07/00	63
RPT#: NASA-1M-X-72843 79N13000 UTTL: Effects of thickness on the aerodynamic characteristics of an initial low-speed family of airfoils for general aviation applications 76/06/00	62	RPT#: NASA-TM-80510 79N30173 UTTL: Radio-controlled model design and testing techniques for stall/spin evaluation of general-aviation aircraft 75/00/00	64
RPT#: NASA-1M-X-74018 79N24960 UTTL: Low-speed wind tunnel results for a modified 13-percent-thick airfoil 77/05/00	62		
RPT#: NASA-TM-78811 A-7920 79N32205 UTTL: Low-cost inertial navigation for moderate-g missions 79/09/00	62		
RPT#: NASA-TM-79013 E-9802 79N15051 UTTL: Preliminary QCGAT program test results 79/00/00	62		
RPT#: NASA-1M-79031 E-9820 79N12083 UTTL: NASA research on general aviation power plants 78/00/00	62		

<u>Report Nos. and Title</u>	<u>Page No.</u>	<u>Report Nos. and Title</u>	<u>Page No.</u>
RPT#: NASA-TM-75937 BON16042 UTTL: Possible markets for dirigibles 79/12/00	65	RPT#: NASA-TM-80206 L-13548 BON33384 UTTL: Analysis of general aviation single-pilot IFR incident data obtained from the NASA aviation safety reporting system 80/10/00	66
RPT#: NASA-TM-78709 L-12264 BON21294 UTTL: NASA low- and medium-speed airfoil development 79/03/00	65	RPT#: NASA-TM-80208 BON18011 UTTL: The aerial relay system: An energy-efficient solution to the airport congestion problem 80/01/00	67
RPT#: NASA-TM-80117 BON28446 UTTL: Carbon fiber counting 80/06/00	65	RPT#: NASA-TM-80235 L-13615 BON21293 UTTL: Emergency in-flight egress opening for general aviation aircraft 80/04/00	67
RPT#: NASA-TM-80163 BON10225 UTTL: Comparison of stability and control parameters for a light, single-engine, high-winged aircraft using different flight test and parameter estimation techniques 79/09/00	65	RPT#: NASA-TM-80237 L-13585 BON20227 UTTL: A spin-recovery parachute system for light general-aviation airplanes 80/04/00	67
RPT#: NASA-TM-80178 BON12732 UTTL: Single pilot scanning behavior in simulated instrument flight 79/10/00	65	RPT#: NASA-TM-81017 BON21299 UTTL: Global positioning system for general aviation: Joint FAA-NASA Seminar 78/00/00	67
RPT#: NASA-TM-80189 BON14110 UTTL: Wind-tunnel investigation of the flow correction for a model-mounted angle of attack sensor at angles of attack from -10 deg to 110 deg 79/11/00	66	RPT#: NASA-TM-81482 E-419 BON21285 UTTL: High speed turboprops for executive aircraft, potential and recent test results 80/00/00	67
RPT#: NASA-TM-80197 BON15874 UTTL: A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft 79/12/00	66	RPT#: NASA-TM-81805 BON24260 UTTL: Development of test methods for scale model simulation of aerial applications in the NASA Langley Vortex Research Facility 80/04/00	68
RPT#: NASA-TM-80203 L-13371 BON19023 UTTL: Aeroacoustic wind-tunnel tests of a light twin-boom general-aviation airplane with free or shrouded-pusher propellers 80/04/00	66	RPT#: NASA-TM-81817 BON28370 UTTL: Exploratory piloted simulator study of the effects of winglets on handling qualities of a representative agricultural airplane 80/04/00	68

Report Nos. and Title

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RPT#: NASA-TM-75823  
81N10577  
UTTL: Annoyance from light aircraft investigation carried  
out around four airports near Paris 80/04/00 69

RPT#: NASA-TM-80064  
81N13959  
UTTL: Development of a computer program data base of a  
navigation aid environment for simulated IFR flight  
and landing studies 80/11/00 69

RPT#: NASA-TM-81225 A-8311 QR-11  
81N10021  
UTTL: NASA Aviation Safety Reporting System 80/04/00 69

RPT#: NASA-TM-81260 A-8432  
81N16022  
UTTL: Human Factors of Flight-deck Automation:  
NASA/Industry Workshop 81/01/00 69

RPT#: NASA-TM-81584 E-561  
81N10067  
UTTL: Comparisons of four alternative powerplant types for  
future general aviation aircraft 80/10/00 69

RPT#: NASA-TM-81610 E-607  
81N11769  
UTTL: Core noise measurements from a small, general aviation  
turbofan engine 80/11/21 70

RPT#: NASA-TM-81666 E-686  
81N16052  
UTTL: An overview of general aviation propulsion research  
programs at NASA Lewis Research Center 81/00/00 70

RPT#: NASA-TM-81892 L-13960  
81N12012  
UTTL: Flight evaluation of the effect of winglets on  
performance and handling qualities of a single-engine  
general aviation airplane 80/12/00 70

Technical Notes (TN):

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RPT#: NASA-TN-D-7712 L-9411 75N17368 UTTL: Monte Carlo analysis of inaccuracies in estimated aircraft parameters caused by unmodeled flight instrumentation errors 75/02/00	73	RPT#: NASA-TN-D-8283 L-10878 77N11033 UTTL: Landing practices of general aviation pilots in single-engine light airplanes 76/10/00	76
RPT#: NASA-TN-D-7928 75N18169 UTTL: Pilot preference and procedures at uncontrolled airports 75/03/00	73	RPT#: NASA-TN-D-8521 L-11352 77N31072 UTTL: A comparison of the results of dynamic wind-tunnel tests with theoretical predictions for an aeromechanical gust-alleviation system for light airplanes 77/09/00	76
RPT#: NASA-TN-D-8058 L-10355 76N15083 UTTL: A review of the NASA V-G/VGH general aviation program 75/12/00	74	RPT#: NASA-TN-D-8524 L-11305 77N28094 UTTL: Aerodynamic characteristics of wing-body configuration with two advanced general aviation airfoil sections and simple flap systems 77/08/00	76
RPT#: NASA-TN-D-8179 L-10514 76N21173 UTTL: Impact dynamics research facility for full-scale aircraft crash testing 76/04/00	74		
RPT#: NASA-TN-D-8206 L-10735 76N26165 UTTL: Review of drag cleanup tests in Langley full-scale tunnel (from 1935 to 1945) applicable to current general aviation airplanes 76/06/00	74		
RPT#: NASA-TN-D-8234 L-10635 76N31134 UTTL: An analytical study and wind tunnel tests of an aeromechanical gust-alleviation system for a light airplane 76/08/00	74		
RPT#: NASA-TN-D-8236 L-10736 76N26218 UTTL: Wind-tunnel investigation of a Fowler flap and spoiler for an advanced general aviation wing 76/06/00	75		

Technical Papers (TP):

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RPT#: NASA-TP-1009 L-11227 77N33111 UTTL: Spin-tunnel investigation of the spinning characteristics of typical single-engine general aviation airplane designs. 1. Low-wing model A; Effects of tail configurations 77/09/00	79	RPT#: NASA-TP-1306 L-12291 79N20071 UTTL: Determination of stability and control parameters of a light airplane from flight data using two estimation methods 79/03/00	81
RPT#: NASA-TP-1054 E-9098 77N32432 UTTL: Effect of fin passage length on optimization of cylinder head cooling fins 77/09/00	79	RPT#: NASA-TP-1321 L-12439 79N14874 UTTL: Noise transmission through flat rectangular panels into a closed cavity 78/12/00	81
RPT#: NASA-TP-1043 L-11355 78N13071 UTTL: Effects of control inputs on the estimation of stability and control parameters of a light airplane 77/12/00	80	RPT#: NASA-TP-1324 AVRADCOM-TR-78-45 79N14018 UTTL: Low-speed aerodynamic characteristics of a 16-percent-thick variable-geometry airfoil designed for general aviation applications 78/12/00	81
RPT#: NASA-TP-1076 L-11804 78N12040 UTTL: Spin-tunnel investigation of the spinning characteristics of typical single-engine general aviation airplane designs. 2: low-wing model A; tail parachute diameter and canopy distance for emergency spin recovery 77/11/00	80		
RPT#: NASA-TP-1157 L-12008 78N20115 UTTL: Ground distance covered during airborne horizontal deceleration of an airplane 78/04/00	80		
RPT#: NASA-TP-1276 L-12197 78N31101 UTTL: Simulation and flight evaluation of a head-up landing aid for general aviation 78/09/00	80		

<u>Report Nos. and Title</u>	<u>Page No.</u>	<u>Report Nos. and Title</u>	<u>Page No.</u>
RPT#: NASA-TP-1477 L-12770 BON10512 UTTL: Light airplane crash tests at three roll angles 79/10/00	82	RPT#: NASA-TP-1498 L-12976 B1N12015 UTTL: Low-speed aerodynamic characteristics of a 13 percent thick medium speed airfoil designed for general aviation applications 79/08/00	83
RPT#: NASA-TP-1481 BON11505 UTTL: Light airplane crash tests at three pitch angles 79/11/00	82	RPT#: NASA-TP-1762 L-13946 B1N16039 UTTL: Use of constrained optimization in the conceptual design of a medium-range subsonic transport 80/12/00	83
RPT#: NASA-TP-1589 L-13143 BON13026 UTTL: Exploratory study of the effects of wing-leading-edge modifications on the stall/spin behavior of a light general aviation airplane 79/12/00	82		
RPT#: NASA-TP-1591 L-13135 BON22266 UTTL: Full-scale wind tunnel investigation of the Advanced Technology Light Twin-Engine airplane (ATLIT) 80/05/00	82		
RPT#: NASA-TP-1636 L-13054 BON25345 UTTL: Measurement of the handling characteristics of two light airplanes 80/06/00	82		
RPT#: NASA-TP-1647 L-12494 BON22358 UTTL: Description of an experimental (hydrogen peroxide) rocket system and its use in measuring aileron and rudder effectiveness of a light airplane 80/05/00	83		

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REPORT ABSTRACTS



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#### REFERENCE PUBLICATIONS (RP)

Compilations of scientific and technical data and information deemed to be of continuing reference value in particular subject areas or disciplines.



RPT#: NASA-CP-2045-PT-2 L-12232-VOL-1-PT-2  
79N19989

UTTL: Advanced technology airfoil research, volume 1, part 2  
MAJS: /\*AIRFOILS/\*WIND TUNNEL TESTS  
MINS: / AERODYNAMICS/ GENERAL AVIATION AIRCRAFT/ PROPELLERS/  
SUPERCRITICAL WINGS/ TEST FACILITIES

RPT#: NASA-CP-2067 E-9800  
79N15961

UTTL: The rotary combustion engine: A candidate for general aviation  
MAJS: /\*AIRCRAFT ENGINES/\*CONFERENCES/\*ENGINE DESIGN/\*  
GENERAL AVIATION AIRCRAFT/\*MECHANICAL DRIVES  
MINS: / AUTOMOBILE ENGINES/ ENERGY CONSERVATION/ FUEL  
CONSUMPTION/ NOISE REDUCTION/ POLLUTION CONTROL/  
TECHNOLOGICAL FORECASTING/ TECHNOLOGY TRANSFER

RPT#: NASA-CP-2046 L-12232  
80N21283

UTTL: Advanced technology airfoil research, volume 2  
MAJS: /\*AIRFOILS/\*CONFERENCES/\*TECHNOLOGY ASSESSMENT/\*  
TECHNOLOGY UTILIZATION  
MINS: / AERODYNAMIC CHARACTERISTICS/ COMPUTERIZED DESIGN/  
GENERAL AVIATION AIRCRAFT/ ROTARY WING AIRCRAFT/  
STRUCTURAL DESIGN/ SYSTEMS ENGINEERING/ TEST  
FACILITIES  
ABS: A comprehensive review of airfoil research is  
presented. The major thrust of the research is in  
three areas: development of computational aerodynamic  
codes for airfoil analysis and design, development of  
experimental facilities and test techniques, and all  
types of airfoil applications.

RPT#: NASA-CP-2119 L-13503  
80N19193

UTTL: Assessment of Carbon Fiber Electrical Effects  
MAJS: /\*AIRCRAFT ACCIDENTS/\*CARBON FIBERS/\*COMPOSITE  
MATERIALS/\*ELECTRIC EQUIPMENT/\*FIRES  
MINS: / AIRCRAFT CONSTRUCTION MATERIALS/ ATMOSPHERIC  
DIFFUSION/ CIVIL AVIATION/ ELECTRICAL FAULTS/  
ELECTRICAL INSULATION/ VULNERABILITY

RPT#: NASA-CP-2120  
80N22283

UTTL: Resource management on the flight deck  
AUTH: A/COOPER, G. E.; B/WHITE, M. D.; C/LAUBER, J. K.  
MAJS: /\*CONFERENCES/\*FLIGHT CREWS/\*FLIGHT TRAINING/\*  
PERSONNEL MANAGEMENT/\*PILOT PERFORMANCE/\*PILOT  
SELECTION  
MINS: / CIVIL AVIATION/ COMPUTER ASSISTED INSTRUCTION/  
EMERGENCIES/ FLIGHT SIMULATORS/ GROUP DYNAMICS/  
PERSONALITY TESTS/ PILOT TRAINING/ PSYCHOLOGICAL  
FACTORS/ PSYCHOLOGICAL TESTS/ PSYCHOMOTOR PERFORMANCE/  
SOCIAL FACTORS

RPT#: NASA-CP-2126 E-310  
80N22327

UTTL: General Aviation Propulsion  
MAJS: /\*AIRCRAFT ENGINES/\*AIRCRAFT NOISE/\*CONFERENCES/\*  
ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT/\*PROPULSION  
SYSTEM CONFIGURATIONS  
MINS: / AEROACOUSTICS/ AEROELASTICITY/ NOISE REDUCTION/  
PROPELLERS/ QUIET ENGINE PROGRAM/ SPARK IGNITION

RPT#: NASA-CP-2149 E-489  
81N12978

UTTL: Impact for the 80's: Proceedings of a Conference on  
Selected Technology for Business and Industry  
MAJS: /\*CONFERENCES/\*ELECTRIC HYBRID VEHICLES/\*ELECTRIC  
MOTOR VEHICLES/\*ENERGY TECHNOLOGY/\*PROPULSION SYSTEM  
PERFORMANCE  
MINS: / AUTOMOBILES/ CIVIL AVIATION/ COMMERCIAL AIRCRAFT/  
ENERGY CONVERSION/ TECHNOLOGY UTILIZATION

RPT#: NASA-RP-1020  
78N25048

UTTL: Precision positional data of general aviation air  
traffic in terminal air space  
AUTH: A/MELSON, W. E., JR.; B/PARKER, L. C.; C/NORTHAM, A.  
M.; D/SINGH, R. P.  
MAJS: /\*AIR TRAFFIC CONTROL/\*AIRPORTS/\*CIVIL AVIATION/\*RADAR  
TRACKING/\*TABLES (DATA)  
MINS: / AIRLINE OPERATIONS/ FLIGHT TIME/ RUNWAYS/ SCHEDULING  
ABS: Three dimensional radar tracks of general aviation air  
traffic at three uncontrolled airports are considered.  
Contained are data which describe the position-time  
histories, other derived parameters, and reference  
data for the approximately 1200 tracks. All  
information was correlated such that the date, time,  
flight number, and runway number match the pattern  
type, aircraft type, wind, visibility, and cloud  
conditions.



TECHNICAL MEMORANDUMS (TM, TMX)

These documents record scientific and technical findings that do not warrant broad dissemination or that cannot be given broad dissemination due to security or restricted-audience considerations. This series includes quick-release reports that typically contain preliminary data and were designated TMX until 1978, when the "X" designation was dropped.



RPT#: NASA-TM-X-3213 A-5863  
75N18181

UTTL: Application of numerical optimization to the design of low speed airfoils

AUTH: A/HICKS, R. M.; B/VANDERPLAATS, G. N.

MAJS: /\*AERODYNAMIC CONFIGURATIONS/\*AIRFOIL PROFILES/\*  
COMPUTERIZED DESIGN/\*GENERAL AVIATION AIRCRAFT

MINS: / AERODYNAMIC CHARACTERISTICS/ FLIGHT CHARACTERISTICS/  
NUMERICAL ANALYSIS/ OPTIMIZATION

ABS: A practical procedure for the optimum design of low-speed airfoils is demonstrated. The procedure uses an optimization program based on the method of feasible directions coupled with an aerodynamic analysis program that uses a relaxation solution of the inviscid, full potential equation. Results are presented for airfoils designed to have small adverse pressure gradients, high maximum lift, and low pitching moment.

RPT#: NASA-TM-X-62398 FAA-NA-75-151  
75N17340

UTTL: Flight test investigation of the vortex wake characteristics behind a Boeing 727 during two-segment and normal ILS approaches (A joint NASA/FAA report)

AUTH: A/BARBER, M. R.; B/KURKOWSKI, R. L.; C/GARODZ, L. J.;  
D/ROBINSON, G. H.; E/SMITH, H. J.; F/JACOBSEN, R. A.;  
G/STINNETT, G. W., JR.; H/MCMURTRY, T. C.;  
I/TYMCZYSZYN, J. J.; J/DEVEREAUX, R. L.

MAJS: /\*AIRCRAFT LANDING/\*BOEING 727 AIRCRAFT/\*FLIGHT  
HAZARDS/\*TURBULENT WAKES/\*VORTEX STREETS

MINS: / AIRCRAFT CONTROL/ DATA ACQUISITION/ FLOW  
VISUALIZATION/ GENERAL AVIATION AIRCRAFT

ABS: Flight tests were performed to evaluate the vortex wake characteristics of a Boeing 727 aircraft during conventional and two-segment instrument landing approaches. Smoke generators were used for vortex marking. The vortex was intentionally intercepted by a Lear jet and a Piper Comanche aircraft. The vortex location during landing approach was measured using a system of phototheodolites. The tests showed that at a given separation distance there are no readily apparent differences in the upsets resulting from deliberate vortex encounters during the two types of approaches. The effect of the aircraft configuration on the extent and severity of the vortices is discussed.

RPT#: NASA-TM-X-72641  
75N18231

UTTL: Noise reduction studies for the Cessna model 337 (0-2) airplane

AUTH: A/HILTON, D. A.; B/CONNOR, A. B.; C/DINGELDEIN, R. C.

MAJS: /\*ACOUSTIC MEASUREMENTS/\*AIRCRAFT NOISE/\*CESSNA  
AIRCRAFT/\*LIGHT AIRCRAFT/\*NOISE REDUCTION

MINS: / AERODYNAMIC CONFIGURATIONS/ ENGINE NOISE/ FLIGHT  
TESTS/ MUFFLERS/ PROPELLERS/ SOUND PROPAGATION

ABS: A study was undertaken to determine the noise reduction potential of the 0-2 airplane in order to reduce its aural detection distance. Static and flyover noise measurements were made to document the noise signature of the unmodified airplane. The results show that significant reductions in aural detection distance can be achieved by the combination of propeller geometry changes and the addition of engine exhaust mufflers. The best results were estimated for the aircraft equipped with a six-blade propeller operating at 3/4 engine speed in combination with a 3.49 cubic foot exhaust muffler installed on each engine. Detection distance for the modified aircraft is estimated to be reduced from about 4-1/4 miles to about 1-1/2 miles when the aircraft is operating at an altitude of 1,000 ft over grassy terrain. Reducing the altitude to 300 ft over a leafy jungle ground cover should reduce the aural detection distance to 0.9 miles. Reduced aural detection distances were also indicated for a modification utilizing a direct-drive six-blade propeller of reduced radius along with smaller exhaust mufflers.

RPT#: NASA-TM-X-72642  
75N18234

UTTL: Ground noise measurements during static and flyby operations of the Cessna 02-T turbine powered airplane

AUTH: A/HILTON, D. A.; B/HENDERSON, H. R.; C/LAWTON, B. W.

MAJS: /\*ACOUSTIC MEASUREMENTS/\*AIRCRAFT NOISE/\*CESSNA  
AIRCRAFT/\*ENGINE NOISE/\*GAS TURBINE ENGINES/\*LIGHT  
AIRCRAFT/\*NOISE REDUCTION

ABS: The field noise measurements on the Cessna 02-T turbine powered propeller aircraft are presented. The objective of the study was to obtain the basic noise characteristics of the aircraft during static ground runs and flyover tests, to identify the sources of the noise, and to correlate the noises with the aircraft operating conditions. The results are presented in the form of overall noise levels, radiation patterns, and frequency spectra. The noise characteristics of the turbine powered aircraft are compared with those of the reciprocating engine powered aircraft.

RPT#: NASA-TM-X-72716

75N28066

UTTL: Interior noise levels of two propeller-driven light aircraft

AUTH: A/CATHERINES, J. J.; B/MAYES, W. H.

MAJS: /\*AIRCRAFT COMPARTMENTS/\*AIRCRAFT NOISE/\*LIGHT  
AIRCRAFT/\*NOISE MEASUREMENT/\*PROPELLER DRIVE

MINS: / ACOUSTICS/ AERODYNAMIC CONFIGURATIONS/ ENGINE NOISE/  
GROUND TESTS

ABS: The relationships between aircraft operating conditions and interior noise and the degree to which ground testing can be used in lieu of flight testing for performing interior noise research were studied. The results show that the noise inside light aircraft is strongly influenced by the rotational speed of the engine and propeller. Both the overall noise and low frequency spectra levels were observed to decrease with increasing high speed rpm operations during flight. This phenomenon and its significance is not presently understood. Comparison of spectra obtained in flight with spectra obtained on the ground suggests that identification of frequency components and relative amplitude of propeller and engine noise sources may be evaluated on stationary aircraft.

RPT#: NASA-TM-X-3445 A-6743 QR-76-1  
76N33845

UTTL: NASA aviation safety reporting system  
AUTH: A/BILLINGS, C. E.; B/LAUBER, J. K.; C/FUNKHOUSER, H.  
; D/LYMAN, E. G.; E/HUFF, E. M.  
MAJS: /\*AIRCRAFT SAFETY/\*DATA BASES/\*FLIGHT HAZARDS  
MINS: / CIVIL AVIATION/ HUMAN FACTORS ENGINEERING/ SAFETY  
MANAGEMENT/ WARNING SYSTEMS  
ABS: The origins and development of the NASA Aviation  
Safety Reporting System (ASRS) are briefly reviewed.  
The results of the first quarter's activity are  
summarized and discussed. Examples are given of  
bulletins describing potential air safety hazards, and  
the disposition of these bulletins. During the first  
quarter of operation, the ASRS received 1464 reports;  
1407 provided data relevant to air safety. All reports  
are being processed for entry into the ASRS data base.  
During the reporting period, 130 alert bulletins  
describing possible problems in the aviation system  
were generated and disseminated. Responses were  
received from FAA and others regarding 108 of the  
alert bulletins. Action was being taken with respect  
to 70 of the 108 responses received. Further studies  
are planned of a number of areas, including human  
factors problems related to automation of the ground  
and airborne portions of the national aviation system.

RPT#: NASA-TM-X-72811  
76N15158

UTTL: Description of a landing site indicator (LASI) for  
light aircraft operation  
AUTH: A/FULLER, H. V.; B/OUTLAW, B. K. E.  
MAJS: /\*HEAD-UP DISPLAYS/\*LANDING AIDS/\*LIGHT AIRCRAFT  
MINS: / AIRSPEED/ ANGLE OF ATTACK/ ENVIRONMENTAL TESTS/  
PERFORMANCE TESTS/ SIDESLIP  
ABS: An experimental cockpit mounted head-up type display  
system was developed and evaluated by LaRC pilots  
during the landing phase of light aircraft operations.  
The Landing Site Indicator (LASI) system display  
consists of angle of attack, angle of sideslip, and  
indicated airspeed images superimposed on the pilot's  
view through the windshield. The information is made  
visible to the pilot by means of a partially  
reflective viewing screen which is suspended directly  
in front of the pilot's eyes. Synchro transmitters are  
operated by vanes, located at the left wing tip, which  
sense angle of attack and sideslip angle. Information  
is presented near the center of the display in the  
form of a moving index on a fixed grid. The airspeed  
is sensed by a pitot-static pressure transducer and is  
presented in numerical form at the top center of the

display.

RPT#: NASA-TM-X-72838  
76N20940

UTTL: Prediction of light aircraft interior noise  
AUTH: A/HOWLETT, J. T.; B/MORALES, D. A.  
MAJS: /\*AIRCRAFT NOISE/\*COMPUTER PROGRAMS/\*LIGHT AIRCRAFT/\*  
LOW FREQUENCIES/\*PREDICTION ANALYSIS TECHNIQUES  
MINS: / GENERAL AVIATION AIRCRAFT/ NOISE REDUCTION/  
STRUCTURAL VIBRATION  
ABS: A computerized interior noise prediction method for  
light aircraft is described. An existing analytical  
program, development for commercial jets, forms the  
basis of some modal analysis work which is described.  
The accuracy of this modal analysis technique for  
predicting low-frequency coupled acoustic-structural  
natural frequencies is discussed along with trends  
indicating the effects of varying parameters such as  
fuselage length and diameter, structural stiffness,  
and interior acoustic absorption.

RPT#: NASA-TM-X-72839  
76N21990

UTTL: Sources and characteristics of interior noise in  
general aviation aircraft  
AUTH: A/CATHERINES, J. J.; B/JHA, S. K.  
MAJS: /\*AIRCRAFT ENGINES/\*AIRCRAFT NOISE/\*GENERAL AVIATION  
AIRCRAFT/\*NOISE GENERATORS/\*PROPELLERS  
MINS: / EXHAUST GASES/ LOW FREQUENCIES/ STRUCTURAL VIBRATION  
ABS: A field study was conducted to examine the interior  
noise characteristics of a general aviation aircraft.  
The goals were to identify the major noise sources and  
their relative contribution and to establish the noise  
transmission paths and their relative importance.  
Tests were performed on an aircraft operating under  
stationary conditions on the ground. Results show that  
the interior noise level of light aircraft is  
dominated by broadband, low frequencies (below 1,000  
Hz). Both the propeller and the engine are dominant  
sources, however, the contribution from the propeller  
is significantly more than the engine at its  
fundamental blade passage frequency. The data suggest  
that the airborne path is more dominant than the  
structure-borne path in the transmission of broadband,  
low frequency noise which apparently results from the  
exhaust.

RPT#: NASA-TM-X-72997  
76N20065

UTTL: Domestic and world trends affecting the future of aviation (1980 - 2000), appendix C  
MAJS: /\*AIR DEFENSE/\*AIR TRANSPORTATION/\*CIVIL AVIATION/\*FORECASTING/\*MARKET RESEARCH  
MINS: / AIRCRAFT INDUSTRY/ ECOLOGY/ ECONOMIC FACTORS/ ENERGY TECHNOLOGY/ GOVERNMENT/INDUSTRY RELATIONS/ INTERNATIONAL RELATIONS/ SOCIAL FACTORS  
ABS: The results are presented of a study of variables affecting aviation in the United States during the last fifth of the twentieth century. A series of key trends relating to economic, social, political, technological, ecological, and environmental developments are identified and discussed with relation to their possible effects on aviation. From this analysis a series of scenarios is developed representing an array of possibilities ranging from severe economic depression and high international tension on the one hand to a world of detente which enjoys an unprecedented economic growth rate and relaxation of tensions on the other. A scenario is presented which represents the manner in which events will most probably develop and their effect on the aviation industry.

RPT#: NASA-TM-X-72998  
76N20066

UTTL: The outlook for aeronautics, 1980 - 2000: Executive summary  
MAJS: /\*AIR DEFENSE/\*AIR TRANSPORTATION/\*CIVIL AVIATION/\*FORECASTING/\*RESEARCH MANAGEMENT  
MINS: / AIRCRAFT INDUSTRY/ ECONOMIC FACTORS/ ENERGY TECHNOLOGY/ GOVERNMENT/INDUSTRY RELATIONS/ MARKET RESEARCH/ SOCIAL FACTORS  
ABS: For abstract, see N76-20062.

RPT#: NASA-TM-X-73051 NASA-NEWS-RELEASE-76-51  
76N20106

UTTL: General aviation technology program  
MAJS: /\*CIVIL AVIATION/\*GENERAL AVIATION AIRCRAFT/\*TECHNOLOGY ASSESSMENT  
MINS: / AERODYNAMIC CHARACTERISTICS/ AIRCRAFT SAFETY/ AVIONICS/ NASA PROGRAMS/ RESEARCH AND DEVELOPMENT  
ABS: The research and technology program of the civil air transportation system is reported. Research is discussed for stall/spin, crashworthiness, pilot operations, flight efficiency, propulsion, and avionics.

RPT#: NASA-TM-X-73124 FAA-RD-76-100  
76N30200

UTTL: Progress toward development of civil airworthiness criteria for powered-lift aircraft  
AUTH: A/SCOTT, B. C.; B/MARTIN, P. W.; C/HYNES, C. S.; D/BRYDER, R. B.  
MAJS: /\*AIRCRAFT CONFIGURATIONS/\*AIRCRAFT RELIABILITY/\*ANGLE OF ATTACK/\*CIVIL AVIATION/\*LIFT AUGMENTATION/\*SHORT TAKEOFF AIRCRAFT  
MINS: / COMMERCIAL AIRCRAFT/ LIFT/ THRUST VECTOR CONTROL  
ABS: The results of a joint research program directed toward development of civil airworthiness flight criteria for power lift transports are summarized. Tentative criteria are proposed for performance and handling characteristics for powered lift transport aircraft in commercial service. The aircraft considered are primarily wing supported vehicles which rely upon the propulsion system for a significant portion of lift and control. VTOL aircraft are excluded. The flight criteria treat primarily the approach and landing flight phases.

RPT#: NASA-TM-X-3546 A-7001  
77N24076

UTTL: NASA aviation safety reporting system  
MAJS: /\*AIRCRAFT SAFETY/\*CIVIL AVIATION/\*FLIGHT SAFETY  
MINS: / AIR TRAFFIC CONTROL/ DATA BASES/ SAFETY MANAGEMENT  
ABS: During the third quarter of operation of the Aviation Safety Reporting System (ASRS), 1429 reports concerning aviation safety were received from pilots, air traffic controllers, and others in the national aviation system. Details of the administration and results of the program are discussed. The design and construction of the ASRS data base are briefly presented. Altitude deviations and potential aircraft conflicts associated with misunderstood clearances were studied and the results are discussed. Summary data regarding alert bulletins, examples of alert bulletins and responses to them, and a sample of deidentified ASRS reports are provided.

RPT#: NASA-TM-X-72697  
77N23049

UTTL: Low-speed aerodynamic characteristics of a 13-percent-thick airfoil section designed for general aviation applications  
AUTH: A/MCGHEE, R. J.; B/BEASLEY, W. D.; C/SOMERS, D. M.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRFOIL PROFILES/\*GENERAL AVIATION AIRCRAFT/\*LOW SPEED  
MINS: / AERODYNAMIC COEFFICIENTS/ AIRCRAFT MODELS/ REYNOLDS NUMBER/ WIND TUNNEL STABILITY TESTS  
ABS: Wind-tunnel tests were conducted to determine the low-speed section characteristics of a 13 percent-thick airfoil designed for general aviation applications. The results were compared with NACA 12 percent-thick sections and with the 17 percent-thick NASA airfoil. The tests were conducted over a Mach number range from 0.10 to 0.35. Chord Reynolds numbers varied from about 2,000,000 to 9,000,000.

RPT#: NASA-TM-X-73228 A-6947  
77N24052

UTTL: Dynamics of ultralight aircraft: Motion in vertical gusts  
AUTH: A/JONES, R. T.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*GLIDERS/\*GUST LOADS/\*LIGHT AIRCRAFT/\*VERTICAL MOTION  
MINS: / AERODYNAMIC STABILITY/ JET AIRCRAFT/ LIFT/ WING LOADING  
ABS: Gust load calculations are extended to the range of conditions encountered by ultralight aircraft such as hang gliders. Having wing loadings of the order of 5 kg/sq m, these gliders acquire a substantial fraction

of the motion of a gust within a distance of 1 or 2 m. Comparative loads and displacements for a small powered airplane having a wing loading of 50 kg sq m and for a commercial jet with 500 kg sq m are shown.

RPT#: NASA-TM-X-73229 A-6989  
77N24053

UTTL: Dynamics of ultralight aircraft: Dive recovery of hang gliders  
AUTH: A/JONES, R. T.  
MAJS: /\*AERODYNAMIC STABILITY/\*CLIMBING FLIGHT/\*GLIDERS/\*LIFT/\*LIGHT AIRCRAFT/\*PITCH (INCLINATION)  
MINS: / AERODYNAMIC COEFFICIENTS/ LIFT DEVICES/ WING LOADING  
ABS: Longitudinal control of a hang glider by weight shift is not always adequate for recovery from a vertical dive. According to Lanchester's phugoid theory, recovery from rest to horizontal flight ought to be possible within a distance equal to three times the height of fall needed to acquire level flight velocity. A hang glider, having a wing loading of 5 kg sq m and capable of developing a lift coefficient of 1.0, should recover to horizontal flight within a vertical distance of about 12 m. The minimum recovery distance can be closely approached if the glider is equipped with a small all-moveable tail surface having sufficient upward deflection.

RPT#: NASA-TM-X-73500  
77N10058

UTTL: Emissions of an AVCO Lycoming O-320-DIAD air cooled light aircraft engine as a function of fuel-air ratio, timing, and air temperature and humidity  
AUTH: A/MENG, P. R.; B/SKOROBATCKYI, M.; C/COSGROVE, D. V.; D/KEMPKE, E. E., JR.  
MAJS: /\*AIR COOLING/\*AIRCRAFT ENGINES/\*ATMOSPHERIC TEMPERATURE/\*EXHAUST GASES/\*FUEL-AIR RATIO/\*LIGHT AIRCRAFT  
MINS: / AIR POLLUTION/ CARBON MONOXIDE/ HUMIDITY/ HYDROCARBONS/ NITROGEN OXIDES/ PISTON ENGINES  
ABS: A carbureted aircraft engine was operated over a range of test conditions to establish the exhaust levels over the EPA seven-mode emissions cycle. Baseline (full rich production limit) exhaust emissions at an induction air temperature of 59 F and near zero relative humidity were 90 percent of the EPA standard for HC, 35 percent for NOx, and 161 percent for CO. Changes in ignition timing around the standard 25 deg BTDC from 30 deg BTDC to 20 deg BTDC had little effect on the exhaust emissions. Retarding the timing to 15 deg BTDC increased both the HC and CO emissions and decreased NOx emissions. HC and CO emissions decreased as the carburetor was leaned out, while NOx emissions

increased. The EPA emission standards were marginally achieved at two leanout conditions. Variations in the quantity of cooling air flow over the engine had no effect on exhaust emissions. Temperature-humidity effects at the higher values of air temperature and relative humidity tested indicated that the HC and CO emissions increased significantly, while the NOx emissions decreased.

RPT#: NASA-TM-X-73507 E-8916-VOL-2  
77N10066

UTTL: Effect of air temperature and relative humidity at various fuel-air ratios on exhaust emissions on a per-mode basis of an Avco Lycoming O-320 DIAD light aircraft engine. Volume 2: Individual data points

AUTH: A/SKOROBATCKYI, M.; B/COSGROVE, D. V.; C/MENG, P. R.; D/KEMPKE, E. R.

MAJS: /\*AIRCRAFT ENGINES/\*CARBURETORS/\*EXHAUST GASES/\*FUEL-AIR RATIO

MINS: / AIR POLLUTION/ ATMOSPHERIC COMPOSITION/ COMBUSTION PRODUCTS/ ENGINE TESTS/ LIGHT AIRCRAFT/ TABLES (DATA)

ABS: A carbureted four cylinder air cooled O-320 DIAD Lycoming aircraft engine was tested to establish the effects of air temperature and humidity at various fuel-air ratios on the exhaust emissions on a per-mode basis. The test conditions included carburetor lean-out at air temperatures of 50, 59, 80, and 100 F at relative humidities of 0, 30, 60, and 80 percent. Temperature-humidity effects at the higher values of air temperature and relative humidity tested indicated that the HC and CO emissions increased significantly, while the NOx emissions decreased. Even at a fixed fuel-air ratio, the HC emissions increase and the NOx emissions decrease at the higher values of air temperature and humidity. Volume II contains the data taken at each of the individual test points.

RPT#: NASA-TM-X-73564 E-9008  
77N23109

UTTL: NASA Quiet Clean General Aviation Turbofan (QCGAT) program status

AUTH: A/BRESNAHAN, D. L.; B/SIEVERS, G. K.

MAJS: /\*CLEAN ENERGY/\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS/\*QUIET ENGINE PROGRAM/\*TURBOFAN ENGINES

MINS: / AIRCRAFT ENGINES/ EXHAUST GASES/ FUEL CONSUMPTION/ NOISE REDUCTION

ABS: The suitability of large engine technology to reduce noise, emissions, and fuel consumption of small turbine engines and develop new technology where required is determined. The design, fabrication, assembly, test, and delivery of the experimental engines to NASA are discussed.

RPT#: NASA-TM-X-73671 E-9190  
77N26153

UTTL: Exploratory investigation of the incipient spinning characteristics of a typical light general aviation airplane

AUTH: A/RANAUDO, R. J.

MAJS: /\*AERODYNAMIC STALLING/\*GENERAL AVIATION AIRCRAFT/\*SPIN DYNAMICS

MINS: / AIRCRAFT CONTROL/ ANGLE OF ATTACK/ ANGULAR MOMENTUM/ PITCHING MOMENTS/ YAW

ABS: The incipient spinning characteristics of general aviation airplanes were studied. Angular rates in pitch, yaw, and roll were measured through the stall during the incipient spin and throughout the recovery along with control positions, angle of attack, and angle of sideslip. The characteristic incipient spinning motion was determined from a given set of entry conditions. The sequence of recovery controls were varied at two distinct points during the incipient spin, and the effect on recovery characteristics was examined. Aerodynamic phenomena associated with flow over the aft portion of the fuselage, vertical stabilizer, and rubber are described.

RPT#: NASA-TM-X-74687  
77N24010

UTTL: FY 1978 aeronautics and space technology program summary

MAJS: /\*AERONAUTICS/\*AEROSPACE SCIENCES

MINS: / AIRCRAFT DESIGN/ ELECTRONICS/ ENERGY CONSERVATION/ MATERIALS/ PROPULSION SYSTEM CONFIGURATIONS/ SPACE ERECTABLE STRUCTURES/ SPACECRAFT/ V/STOL AIRCRAFT

ABS: Highlights of the aeronautics program include research on aircraft energy efficiency, supersonic cruise aircraft, vertical takeoff and landing aircraft, short haul/short takeoff and landing aircraft, and general aviation aircraft. The space technology program includes work on space structures, propulsion systems, power systems, materials, and electronics.

RPT#: NASA-TM-X-3561 L-11472  
78N11052

UTTL: Experimental and analytical determination of characteristics affecting light aircraft landing-gear dynamics

AUTH: A/FASANELLA, E. L.; B/MCGEHEE, J. R.; C/PAPPAS, M. S.

MAJS: /\*LANDING GEAR/\*LANDING LOADS/\*LIGHT AIRCRAFT  
MINS: / COEFFICIENT OF FRICTION/ DROP TESTS/ DYNAMIC CHARACTERISTICS

ABS: An experimental and analytical investigation was conducted to determine which characteristics of a light aircraft landing gear influence gear dynamic behavior significantly. The investigation focused particularly on possible modification for load control. Pseudostatic tests were conducted to determine the gear fore-and-aft spring constant, axial friction as a function of drag load, brake pressure-torque characteristics, and tire force-deflection characteristics. To study dynamic tire response, vertical drops were conducted at impact velocities of 1.2, 1.5, and 1.8 m/s onto a level surface; to determine axial-friction effects, a second series of vertical drops were made at 1.5 m/s onto surfaces inclined 5 deg and 10 deg to the horizontal. An average dynamic axial-friction coefficient of 0.15 was obtained by comparing analytical data with inclined surface drop test data. Dynamic strut bending and associated axial friction were found to be severe for the drop tests on the 10 deg surface.

RPT#: NASA-TM-73507-VOL-1 E-8916-2  
78N29100

UTTL: Effect of air temperature and relative humidity at various fuel-air ratios on exhaust emissions on a per-mode basis of an AVCO Lycoming O-320 diad light aircraft engine: Volume 1: Results and plotted data

AUTH: A/SKOROBATCKYI, M.; B/COSGROVE, D. V.; C/MENG, P. R.; D/KEMPE, E. E., JR.

MAJS: /\*AIRCRAFT ENGINES/\*ATMOSPHERIC TEMPERATURE/\*EXHAUST GASES/\*FUEL-AIR RATIO/\*HUMIDITY  
MINS: / ATMOSPHERIC DENSITY/ CARBON MONOXIDE/ ENGINE TESTS/ LIGHT AIRCRAFT/ NITROGEN OXIDES

ABS: A carbureted four cylinder air cooled O-320 DIAD Lycoming aircraft engine was tested to establish the effects of air temperature and humidity at various fuel-air ratios on the exhaust emissions on a per-mode basis. The test conditions include carburetor lean out at air temperatures of 50, 59, 80, and 100 F at relative humidities of 0, 30, 60, and 80 percent. Temperature humidity effects at the higher values of air temperature and relative humidity tested indicated

that the HC and CO emissions increased significantly, while the NOx emissions decreased. Even at a fixed fuel air ratio, the HC emissions increase and the NOx emissions decrease at the higher values of air temperature and humidity.

RPT#: NASA-TM-73831  
78N16055

UTTL: A review of NASA's propulsion programs for aviation  
AUTH: A/STEWART, W. L.; B/JOHNSON, H. W.; C/WEBER, R. J.  
MAJS: /\*CIVIL AVIATION/\*JET PROPULSION/\*NASA PROGRAMS/\* VARIABLE CYCLE ENGINES

MINS: / ENERGY CONSERVATION/ FUEL CONSUMPTION/ SUPERSONIC AIRCRAFT/ TURBOFAN ENGINES

ABS: A review of five NASA engine-oriented propulsion programs of major importance to civil aviation are presented and discussed. Included are programs directed at exploring propulsion system concepts for (1) energy conservation subsonic aircraft (improved current turbofans, advanced turbofans, and advanced turboprops); (2) supersonic cruise aircraft (variable cycle engines); (3) general aviation aircraft (improved reciprocating engines and small gas turbines); (4) powered lift aircraft (advanced turbofans); and (5) advanced rotorcraft.

RPT#: NASA-TM-73884  
78N17060

UTTL: General aviation energy-conservation research programs at NASA-Lewis Research Center

AUTH: A/WILLIS, E. A.

MAJS: /\*AIRCRAFT ENGINES/\*ENERGY CONSERVATION/\*ENGINE TESTING LABORATORIES/\*FUEL CONSUMPTION/\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS

MINS: / DIESEL ENGINES/ ECONOMIC IMPACT/ EXHAUST GASES/ WANKEL ENGINES

ABS: The major thrust of NASA's nonturbine general aviation engine programs is directed toward (1) reduced specific fuel consumption, (2) improved fuel tolerance; and (3) emission reduction. Current and planned future programs in such areas as lean operation, improved fuel management, advanced cooling techniques and advanced engine concepts, are described. These are expected to lay the technology base, by the mid to latter 1980's, for engines whose total fuel costs are as much as 30% lower than today's conventional engines.

RPT#: NASA-TM-74055  
78N13040

UTTL: A preliminary study of the performance and characteristics of a supersonic executive aircraft

AUTH: A/MASCITTI, V. R.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT DESIGN/\*AIRCRAFT PERFORMANCE/\*GENERAL AVIATION AIRCRAFT/\*SUPERSONIC CRUISE AIRCRAFT RESEARCH

MINS: / AIRCRAFT CONFIGURATIONS/ ARROW WINGS/ LEAR JET AIRCRAFT/ TITANIUM/ TURBOJET ENGINES/ VARIABLE CYCLE ENGINES

ABS: The impact of advanced supersonic technologies on the performance and characteristics of a supersonic executive aircraft was studied in four configurations with different engine locations and wing/body blending and an advanced nonafterburning turbojet or variable cycle engine. An M 2.2 design Douglas scaled arrow-wing was used with Learjet 35 accommodations. All four configurations with turbojet engines meet the performance goals of 5926 km (3200 n.mi.) range, 1981 meters (6500 feet) takeoff field length, and 77 meters per second (150 knots) approach speed. The noise levels of turbojet configurations studied are excessive. However, a turbojet with mechanical suppressor was not studied. The variable cycle engine configuration is deficient in range by 555 km (300 n.mi) but nearly meets subsonic noise rules (FAR 36 1977 edition), if coannular noise relief is assumed. All configurations are in the 33566 to 36287 kg (74,000 to 80,000 lbm) takeoff gross weight class when incorporating current titanium manufacturing technology.

RPT#: NASA-TM-74097 L-11695  
78N13011

UTTL: Aerodynamic characteristics of airplanes at high angles of attack

AUTH: A/CHAMBERS, J. R.; B/GRAFTON, S. B.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT PERFORMANCE/\*AIRCRAFT STABILITY/\*ANGLE OF ATTACK

MINS: / AERODYNAMIC STABILITY/ AERODYNAMIC STALLING/ FLIGHT CONTROL/ MILITARY AIRCRAFT/ SPIN STABILIZATION

ABS: An introduction to, and a broad overview of, the aerodynamic characteristics of airplanes at high angles of attack are provided. Items include: (1) some important fundamental phenomena which determine the aerodynamic characteristics of airplanes at high angles of attack; (2) static and dynamic aerodynamic characteristics near the stall; (3) aerodynamics of the spin; (4) test techniques used in stall/spin studies; (5) applications of aerodynamic data to problems in flight dynamics in the stall/spin area; and (6) the outlook for future research in the area.

Although stalling and spinning are flight dynamic problems of importance to all aircraft, including general aviation aircraft, commercial transports, and military airplanes, emphasis is placed on military configurations and the principle aerodynamic factors which influence the stability and control of such vehicles at high angles of attack.

RPT#: NASA-TM-75052  
78N11702

UTTL: Provisional standards of radiation safety of flight personnel and passengers in air transport of the civil aviation

MAJS: /\*AIR TRANSPORTATION/\*CIVIL AVIATION/\*PASSENGER AIRCRAFT/\*RADIATION HAZARDS/\*REGULATIONS

MINS: / FLYING PERSONNEL/ RADIATION DOSAGE/ RADIATION SOURCES

ABS: Provisional standards for radiation affecting passenger aircraft are considered. Agencies responsible for seeing that the regulations are enforced are designated while radiation sources and types of radiation are defined. Standard levels of permissible radiation are given and conditions for radiation safety are discussed. Dosimetric equipment on board aircraft is delineated and regulation effective dates are given.

RPT#: NASA-TM-75323 PAPER-77-027  
78N32054

UTTL: Profile design for an advanced-technology airfoil for general aviation aircraft

AUTH: A/WELTE, D.

MAJS: /\*AIRCRAFT DESIGN/\*AIRFOIL PROFILES/\*GENERAL AVIATION AIRCRAFT

MINS: / BOUNDARY LAYERS/ LIFT AUGMENTATION/ PRESSURE DISTRIBUTION/ TRAILING-EDGE FLAPS/ WIND TUNNEL TESTS

ABS: A profile from the NASA General Aviation Whitcomb series and NACA profiles are used as a starting point in designing an advanced airfoil for general aviation aircraft. Potential theory pressure distribution calculations, together with boundary layer calculations, permit a decrease in the null moment and an optimization of the lift characteristics of the wing. Trailing edge flap design is also improved. Wind tunnel tests are used to compare the conventional profiles, the NASA profile, and the improved design.

RPT#: NASA-TM-78638 L-11918  
78N19059

UTTL: Dynamic wind-tunnel tests of an aeromechanical gust-alleviation system using several different combinations of control surfaces

AUTH: A/STEWART, E. C.; B/DOGGETT, R. V., JR.

MAJS: /\*AERODYNAMICS/\*CONTROL SURFACES/\*GUST ALLEVIATORS/\* WIND TUNNEL MODELS/\*WIND TUNNEL TESTS

MINS: / AERODYNAMIC LOADS/ ATMOSPHERIC TURBULENCE/ FLAPS (CONTROL SURFACES)/ GUSTS/ LIGHT AIRCRAFT

ABS: Some experimental results are presented from wind tunnel studies of a dynamic model equipped with an aeromechanical gust alleviation system for reducing the normal acceleration response of light airplanes. The gust alleviation system consists of two auxiliary aerodynamic surfaces that deflect the wing flaps through mechanical linkages when a gust is encountered to maintain nearly constant airplane lift. The gust alleviation system was implemented on a 1/6-scale, rod mounted, free flying model that is geometrically and dynamically representative of small, four place, high wing, single engine, light airplanes. The effects of flaps with different spans, two size of auxiliary aerodynamic surfaces, plain and double hinged flaps, and a flap elevator interconnection were studied. The model test results are presented in terms of predicted root mean square response of the full scale airplane to atmospheric turbulence. The results show that the gust alleviation system reduces the root mean square normal acceleration response by 30 percent in comparison with the response in the flaps locked condition. Small reductions in pitch-rate response were also obtained. It is believed that substantially larger reductions in normal acceleration can be achieved by reducing the rather high levels of mechanical friction which were extant in the alleviation system of the present model.

appears to be too small. Included in the needed refinements are models to show the workload when in turbulence, when overshooting a radial or glideslope, and when copying air traffic control clearances.

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RPT#: NASA-TM-78748  
78N33731

UTTL: Adaptation of time line analysis program to single pilot instrument flight research

AUTH: A/HINTON, D. A.; B/SHAUGHNESSY, J. D.

MAJS: /\*COMPUTERIZED SIMULATION/\*HUMAN FACTORS ENGINEERING/\* INSTRUMENT FLIGHT RULES/\*PILOT PERFORMANCE/\*WORKLOADS (PSYCHOPHYSIOLOGY)

MINS: / DATA BASES/ GENERAL AVIATION AIRCRAFT/ MATHEMATICAL MODELS/ TERMINAL CONFIGURED VEHICLE PROGRAM

ABS: A data base was developed for SPIFR operation and the program was run. The outputs indicated that further work was necessary on the workload models. In particular, the workload model for the cognitive channel should be modified as the output workload

RPT#: NASA-TM-X-72843  
79N13000

UTTL: Effects of thickness on the aerodynamic characteristics of an initial low-speed family of airfoils for general aviation applications  
AUTH: A/MCGHEE, R. J.; B/BEASLEY, W. D.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRFOILS/\*THICKNESS RATIO/\*WIND TUNNEL TESTS  
MINS: / GENERAL AVIATION AIRCRAFT/ LOW SPEED/ MACH NUMBER/ REYNOLDS NUMBER/ VISCOUS FLOW/ WIND TUNNEL TESTS  
ABS: Wind tunnel tests were conducted to determine the effects of airfoil thickness-ratio on the low speed aerodynamic characteristics of an initial family of airfoils. The results were compared with theoretical predictions obtained from a subsonic viscous method. The tests were conducted over a Mach number range from 0.10 to 0.28. Chord Reynolds numbers varied from about 2.0 x 1 million to 9.0 x 1 million.

RPT#: NASA-TM-X-74018  
79N24960

UTTL: Low-speed wind tunnel results for a modified 13-percent-thick airfoil  
AUTH: A/MCGHEE, R. J.; B/BEASLEY, W. D.  
MAJS: /\*AIRFOIL PROFILES/\*AIRFOILS/\*GENERAL AVIATION AIRCRAFT/\*LOW SPEED WIND TUNNELS  
MINS: / BOUNDARY LAYER SEPARATION/ PRESSURE DISTRIBUTION/ REYNOLDS NUMBER  
ABS: Wind-tunnel tests were conducted to evaluate the effects on performance of modifying a 13-percent-thick low-speed airfoil. The airfoil contour was altered to reduce the aft upper surface pressure gradient and hence delay boundary layer separation at typical lift coefficients for light general aviation airplanes. The tests were conducted at a Mach number of 0.15 or less over a Reynolds number range from about 1,000,000 to 9,000,000.

RPT#: NASA-TM-78611 A-7920  
79N32205

UTTL: Low-cost inertial navigation for moderate-g missions  
AUTH: A/MERHAV, S.  
MAJS: /\*AIR NAVIGATION/\*ATTITUDE GYROS/\*GIMBALS/\*GYROCOMPASSES/\*HYBRID NAVIGATION SYSTEMS/\*INERTIAL NAVIGATION/\*LOW COST  
MINS: / ACCELEROMETERS/ GENERAL AVIATION AIRCRAFT/ GYROSCOPIC PENDULUMS/ MATHEMATICAL MODELS/ MICROCOMPUTERS/ POSITION ERRORS/ STRAPDOWN INERTIAL GUIDANCE/ TORQUERS  
ABS: A low cost inertial navigation system (INS) concept is described for flight missions characterized by

moderate accelerations and limited attitude variations. These missions involve general aviation aircraft, helicopters, or remotely piloted vehicles. The significance of the moderate acceleration and limited attitude is reviewed with respect to platform mechanization and instrumentation. A hybrid mechanization, partially gimballed and partially strapdown, is presented. The INS is implemented by an unbalanced two axis gimbal system and controlled by a two degree of freedom gyro. The INS provides locally level two axis acceleration information along with pitch and roll measurements. Heading information is provided by a second gyro mounted in the inner gimbal. The system error model is equivalent to that of a conventional platform with a tilt error determined by the integral of the gyro drift rate and an equivalent accelerometer type errors are also cancelled. Rapid gyro-compassing, implemented with opened gimbal control loops, and a strapdown procedure provides calibration of gyro drift rate biases.

RPT#: NASA-TM-79013 E-9802  
79N15051

UTTL: Preliminary OCGAT program test results  
AUTH: A/KOENIG, R. W.; B/SIEVERS, G. K.  
MAJS: /\*CONFERENCES/\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS/\*TURBOFAN ENGINES  
MINS: / ACOUSTICS/ DESIGN ANALYSIS/ FUEL CONSUMPTION/ PERFORMANCE TESTS/ PROJECT PLANNING/ TECHNOLOGY ASSESSMENT  
ABS: NASA Lewis Research Center is conducting a program to demonstrate that large commercial engine technology can be applied to general aviation engines to reduce noise, emissions and fuel consumption and to develop new technology where required. The overall engine program, design, and technology incorporated into the OCGAT engines are described. In addition, preliminary engine test results are presented and compared to the technical requirements the engines were designed to meet.

RPT#: NASA-TM-79031 E-9828  
79N12086

UTTL: NASA research on general aviation power plants  
AUTH: A/STEWART, W. L.; B/WEBER, R. J.; C/WILLIS, E. A.; D/SIEVERS, G. K.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS/\*PROPULSION SYSTEM CONFIGURATIONS  
MINS: / AIRCRAFT ENGINES/ DIESEL ENGINES/ EXHAUST GASES/ FUEL CONSUMPTION  
ABS: Propulsion systems are key factors in the design and performance of general aviation airplanes. NASA

research programs that are intended to support improvements in these engines are described. Reciprocating engines are by far the most numerous powerplants in the aviation fleet; near-term efforts are being made to lower their fuel consumption and emissions. Longer-term work includes advanced alternatives, such as rotary and lightweight diesel engines. Work is underway on improved turbofans and turboprops.

RPT#: NASA-TM-79073 E-9890  
79N16849

UTTL: New opportunities for future small civil turbine engines: Overiewing the GATE studies  
AUTH: A/STRACK, W. C.  
MAJS: /\*ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT/\* TECHNOLOGICAL FORECASTING/\*TURBINE ENGINES  
MINS: / AIRCRAFT ENGINES/ FIXED WINGS/ HELICOPTER ENGINES/ PERFORMANCE PREDICTION/ PISTON ENGINES/ PRODUCT DEVELOPMENT  
ABS: An overview of four independent studies forecasts the potential impact of advanced technology turbine engines in the post 1988 market, identifies important aircraft and missions, desirable engine sizes, engine performance, and cost goals. Parametric evaluations of various engine cycles, configurations, design features, and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis. Both fixed-wing and helicopter aircraft, and turboshaft, turboprop, and turbofan engines were considered. Sizable performance gains (e.g., 20% SFC decrease), and large engine cost reductions of sufficient magnitude are predicted to challenge the reciprocating engine in the 300-500 SHP class.

RPT#: NASA-TM-79075 E-9892  
79N15958

UTTL: The gate studies: Assessing the potential of future small general aviation turbine engines  
AUTH: A/STRACK, W. C.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*TURBINE ENGINES  
MINS: / AIRFRAMES/ COSTS/ ENGINE PARTS/ HELICOPTERS/ MARKETING/ TURBOFAN ENGINES  
ABS: Four studies were completed that explore the opportunities for future General Aviation turbine engines (GATE) in the 150-1000 SHP class. These studies forecasted the potential impact of advanced technology turbine engines in the post-1988 market, identified important aircraft and missions, desirable engine sizes, engine performance, and cost goals. Parametric evaluations of various engine cycles,

configurations, design features, and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis. Both fixed-wing and helicopter aircraft, and turboshaft, turboprop, and turbofan engines were considered. Sizable performance gains (e.g., 20% SFC decrease), and large engine cost reductions of sufficient magnitude to challenge the reciprocating engine in the 300-500 SHP class were predicted.

RPT#: NASA-TM-79254 E-165 AIAA-79-1824  
79N31210

UTTL: An overview of NASA research on positive displacement type general aviation engines  
AUTH: A/KEMPKE, E. E.; B/WILLIS, E. A.  
MAJS: /\*AIRCRAFT ENGINES/\*DIESEL ENGINES/\*GENERAL AVIATION AIRCRAFT/\*WANKEL ENGINES  
MINS: / COMBUSTION EFFICIENCY/ DRAG REDUCTION/ ENERGY CONSERVATION/ ENGINE DESIGN/ FUEL CONSUMPTION/ FUEL INJECTION/ POLLUTION CONTROL  
ABS: The general aviation positive displacement engine program encompassing conventional, lightweight diesel, and rotary combustion engines is described. Lean operation of current production type spark ignition engines and advanced alternative engine concepts are emphasized.

RPT#: NASA-TM-80133  
79N28158

UTTL: Potential applications of advanced aircraft in developing countries  
AUTH: A/MADDALON, D. V.  
MAJS: /\*AIR CARGO/\*AIR TRANSPORTATION/\*BRAZIL/\*DEVELOPING NATIONS/\*INDONESIA/\*REMOTE REGIONS  
MINS: / AGRICULTURAL AIRCRAFT/ ECONOMIC FACTORS/ FORESTS/ INDUSTRIAL AREAS/ MINING/ SOCIAL FACTORS  
ABS: Air transportation concepts for movement of cargo in developing countries are reviewed using aircraft which may appear in the future. For certain industrial applications, including mining and forestry, the relative costs of doing the job using different types of aircraft are compared with surface transportation systems. Two developing countries, Brazil and Indonesia, were taken as examples to determine what impact they might have on the aircraft markets of the future. Economic and demographic data on developing countries in general, and Brazil and Indonesia in particular, are reviewed. The concept of an industrial city in a remote area developed around an airport is discussed. It is noted that developing areas generally lack extensive surface transportation systems and that

an air transportation system can be implemented in a relatively short time. A developing nation interested in rapid expansion may thus find the role of air cargo far more important than has been true in developed nations. Technological developments which may dramatically increase the performance of agricultural aircraft are also reviewed.

RPT#: NASA-TM-80510

79N30173

UTTL: Radio-controlled model design and testing techniques for stall/spin evaluation of general-aviation aircraft

AUTH: A/BURK, S. M., JR.; B/WILSON, C. F., JR.

MAJS: /\*AERODYNAMIC STALLING/\*AIRCRAFT MODELS/\*AIRCRAFT SPIN  
/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*RADIO  
CONTROL/\*SPIN TESTS

MINS: / AIRCRAFT DESIGN/ COST EFFECTIVENESS/ MOMENTS OF  
INERTIA/ RECOVERY PARACHUTES/ TELEVISION CAMERAS/  
THRUST MEASUREMENT

ABS: A relatively inexpensive radio-controlled model stall/spin test technique was developed. Operational experiences using the technique are presented. A discussion of model construction techniques, spin-recovery parachute system, data recording system, and movie camera tracking system is included. Also discussed are a method of measuring moments of inertia, scaling of engine thrust, cost and time required to conduct a program, and examples of the results obtained from the flight tests.

RPT#: NASA-TM-75937  
BON16042

UTTL: Possible markets for dirigibles  
MAJS: /\*AIR TRANSPORTATION/\*AIRSHIPS/\*MARKET RESEARCH  
MINS: / AGRICULTURAL AIRCRAFT/ AIR CARGO/ FLYING PLATFORMS/  
INDUSTRIES/ MATERIALS HANDLING/ MILITARY OPERATIONS  
ABS: The use of mini, small, medium, and heavy dirigibles  
for the transportation of passengers and cargo, for  
aerial handling of materials, for the support of  
scientific platforms, and for use in agriculture and  
forest management is evaluated. The operational  
efficiency of one or more dirigibles in view of  
possible integration into the general transport system  
is described.

RPT#: NASA-TM-78709 L-12264  
BON21294

UTTL: NASA low- and medium-speed airfoil development  
AUTH: A/MCGHEE, R. J.; B/BEASLEY, W. D.; C/WHITCOMB, R. T.  
MAJS: /\*AIRFOILS/\*GENERAL AVIATION AIRCRAFT/\*LOW SPEED/\*  
TECHNOLOGY ASSESSMENT  
MINS: / AERODYNAMIC COEFFICIENTS/ STRUCTURAL DESIGN/  
THICKNESS RATIO/ WIND TUNNEL TESTS  
ABS: The status of NASA low and medium speed airfoil  
research is discussed. Effects of airfoil  
thickness-chord ratios varying from 9 percent to 21  
percent on the section characteristics for a design  
lift coefficient of 0.40 are presented for the initial  
low speed family of airfoils. Also, modifications to  
the 17-percent low-speed airfoil to reduce the  
pitching-moment coefficient and to the 21-percent low  
speed airfoil results are shown for two new medium  
speed airfoils with thickness ratios of 13 percent and  
17 percent and design-lift coefficients of 0.30.  
Applications of NASA-developed airfoils to general  
aviation aircraft are summarized.

RPT#: NASA-TM-80117  
BON28446

UTTL: Carbon fiber counting  
AUTH: A/PRIDE, R. A.  
MAJS: /\*AIRCRAFT STRUCTURES/\*CARBON FIBERS/\*COMPOSITE  
MATERIALS  
MINS: / AIRCRAFT ACCIDENTS/ CIVIL AVIATION/ FIRE DAMAGE/ JET  
ENGINE FUELS  
ABS: A method was developed for characterizing the number  
and lengths of carbon fibers accidentally released by  
the burning of composite portions of civil aircraft  
structure in a jet fuel fire after an accident.  
Representative samplings of carbon fibers collected on  
transparent sticky film were counted from photographic

enlargements with a computer aided technique which  
also provided fiber lengths.

RPT#: NASA-TM-80163  
BON10225

UTTL: Comparison of stability and control parameters for a  
light, single-engine, high-winged aircraft using  
different flight test and parameter estimation  
techniques  
AUTH: A/SUIT, W. T.; B/CANNADAY, R. L.  
MAJS: /\*CONTROL STABILITY/\*ESTIMATING/\*FLIGHT STABILITY  
TESTS/\*LATERAL STABILITY/\*LIGHT AIRCRAFT/\*LONGITUDINAL  
STABILITY  
MINS: / AIRCRAFT LANDING/ AIRCRAFT MANEUVERS/ APPROACH AND  
LANDING TESTS (STS)/ COMPUTERIZED SIMULATION/  
MATHEMATICAL MODELS  
ABS: The longitudinal and lateral stability and control  
parameters for a high wing, general aviation, airplane  
are examined. Estimations using flight data obtained  
at various flight conditions within the normal range  
of the aircraft are presented. The estimations  
techniques, an output error technique (maximum  
likelihood) and an equation error technique (linear  
regression), are presented. The longitudinal static  
parameters are estimated from climbing, descending,  
and quasi steady state flight data. The lateral  
excitations involve a combination of rudder and  
ailerons. The sensitivity of the aircraft modes of  
motion to variations in the parameter estimates are  
discussed.

RPT#: NASA-TM-80178  
BON12732

UTTL: Single pilot scanning behavior in simulated instrument  
flight  
AUTH: A/PENNINGTON, J. E.  
MAJS: /\*HUMAN FACTORS ENGINEERING/\*INSTRUMENT FLIGHT RULES/\*  
OPTICAL TRACKING/\*PILOT PERFORMANCE  
MINS: / FLIGHT SIMULATION/ GENERAL AVIATION AIRCRAFT/  
OCULOMETERS  
ABS: A simulation of tasks associated with single pilot  
general aviation flight under instrument flight rules  
was conducted as a baseline for future research  
studies on advanced flight controls and avionics. The  
tasks, ranging from simple climbs and turns to an  
instrument landing systems approach, were flown on a  
fixed base simulator. During the simulation the  
control inputs, state variables, and the pilots visual  
scan pattern including point of regard were measured  
and recorded.

RPT#: NASA-TM-80189  
BON14110

UTTL: Wind-tunnel investigation of the flow correction for a model-mounted angle of attack sensor at angles of attack from -10 deg to 110 deg

AUTH: A/MOUL, T. M.

MAJS: /\*ANGLE OF ATTACK/\*CALIBRATING/\*CORRECTION/\*FLOW MEASUREMENT/\*WIND TUNNEL TESTS

MINS: / AERODYNAMIC STALLING/ AIRCRAFT SPIN/ GENERAL AVIATION AIRCRAFT/ UPWASH/ WIND TUNNEL MODELS

ABS: A preliminary wind tunnel investigation was undertaken to determine the flow correction for a vane angle of attack sensor over an angle of attack range from -10 deg to 110 deg. The sensor was mounted ahead of the wing on a 1/5 scale model of a general aviation airplane. It was shown that the flow correction was substantial, reaching about 15 deg at an angle of attack of 90 deg. The flow correction was found to increase as the sensor was moved closer to the wing or closer to the fuselage. The experimentally determined slope of the flow correction versus the measured angle of attack below the stall angle of attack agreed closely with the slope of flight data from a similar full scale airplane.

RPT#: NASA-TM-80197  
BON15874

UTTL: A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft

AUTH: A/HOWLETT, J. T.

MAJS: /\*AIRCRAFT COMPARTMENTS/\*AIRCRAFT NOISE/\*COHERENT ACOUSTIC RADIATION/\*NOISE MEASUREMENT/\*NOISE PROPAGATION

MINS: / COHERENCE COEFFICIENT/ COMPUTER PROGRAMS/ DIGITAL COMPUTERS/ NOISE SPECTRA/ REAL TIME OPERATION

ABS: The partial coherence analysis method for noise source/path determination is summarized and the application to a two input, single output system with coherence between the inputs is illustrated. The augmentation of the calculations on a digital computer interfaced with a two channel, real time analyzer is also discussed. The results indicate possible sources of error in the computations and suggest procedures for avoiding these errors.

RPT#: NASA-TM-80203 L-13371  
BON19023

UTTL: Aeroacoustic wind-tunnel tests of a light twin-boom general-aviation airplane with free or shrouded-pusher propellers

AUTH: A/MCLEMORE, H. C.; B/PEGG, R. J.

MAJS: /\*AEROACOUSTICS/\*GENERAL AVIATION AIRCRAFT/\*LIGHT

TRANSPORT AIRCRAFT/\*PROPELLER EFFICIENCY/\*WIND TUNNEL TESTS

MINS: / AERODYNAMIC CHARACTERISTICS/ NOISE INTENSITY/ POWER EFFICIENCY/ PROPULSION SYSTEM PERFORMANCE

ABS: Tests were conducted in the Langley full-scale tunnel to determine the aerodynamic performance and acoustic characteristics of four different pusher-propeller configurations on a twin boom, general aviation airplane. The propellers included a 2-blade free propeller, two 3-blade shrouded propellers, and a 5-blade shrouded propeller. The tests were conducted for a range of airplane angles of attack from about 0 deg to 16 deg for test speeds from 0 to about 36 m/sec and for a range of propeller blade angles and rotation speeds. The free propeller provided the best aerodynamic propulsive performance. For forward flight conditions, the free propeller noise levels were lower than those of the shrouded propellers. In the static conditions the free propeller noise levels were as low as those for the shrouded propellers, except for the propeller in-plane noise where the shrouded propeller noise levels were lower.

RPT#: NASA-TM-80206 L-13548  
BON33384

UTTL: Analysis of general aviation single-pilot IFR incident data obtained from the NASA aviation safety reporting system

AUTH: A/BERGERON, H. P.

MAJS: /\*AIRCRAFT PILOTS/\*FLIGHT SAFETY/\*GENERAL AVIATION AIRCRAFT/\*INSTRUMENT FLIGHT RULES/\*NASA PROGRAMS/\* NATIONAL AVIATION SYSTEM

MINS: / AIR TRAFFIC CONTROL/ AIRCRAFT COMMUNICATION/ DATA BASES/ FLIGHT CONDITIONS/ HUMAN FACTORS ENGINEERING/ HUMAN PERFORMANCE/ PILOT ERROR

ABS: Data obtained from the NASA Aviation Safety Reporting System (ASRS) data base were used to determine problems in general aviation single pilot IFR operations. The data examined consisted of incident reports involving flight safety in the National Aviation System. Only those incidents involving general aviation fixed wing aircraft flying under IFR in instrument meteorological conditions were analyzed. The data were cataloged into one of five major problem areas: (1) controller judgement and response problems; (2) pilot judgement and response problems; (3) air traffic control intrafacility and interfacility conflicts; (4) ATC and pilot communications problems; and (5) IFR-VFR conflicts. The significance of the related problems, and the various underlying elements associated with each are discussed. Previous ASRS reports covering several areas of analysis are reviewed.

RPT#: NASA-TM-80208  
80N18011

UTTL: The aerial relay system: An energy-efficient solution to the airport congestion problem

AUTH: A/KYSER, A. C.

MAJS: /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*CIVIL AVIATION  
/\*TRANSPORTATION ENERGY

MINS: / AIR TRAFFIC CONTROL/ AIRPORTS/ TECHNOLOGICAL  
FORECASTING/ TRANSFERRING/ UNITED STATES OF AMERICA

ABS: The ability to transfer airline passengers between aircraft in flight, if adequately developed and integrated into the national air transportation system, could provide significant improvements in transportation-system performance, in terms of airport congestion, fuel consumption, and passenger service. The proposed Aerial Relay System concept, which was developed as a means of exploiting inflight transfer, makes use of large 'cruise liner' aircraft which fly continuously along their routes, docking periodically with short-haul feeder aircraft for exchange of payloads. Preliminary vehicle designs for a representative system are described and the operational feasibility of the concept for the United States in the 1990's is discussed.

RPT#: NASA-TM-80235 L-13615  
80N21293

UTTL: Emergency in-flight egress opening for general aviation aircraft

AUTH: A/BEMENT, L. J.

MAJS: /\*ABORT APPARATUS/\*EGRESS/\*GENERAL AVIATION AIRCRAFT

MINS: / ACTUATION/ AIRCRAFT CONSTRUCTION MATERIALS/ AIRCRAFT  
STRUCTURES/ PYROTECHNICS/ SKIN (STRUCTURAL MEMBER)

ABS: In support of a stall/spin research program, an emergency in-flight egress system is being installed in a light general aviation airplane. To avoid a major structural redesign for a mechanical door, an add-on 11.2 kg pyrotechnic-actuated system was developed to create an opening in the existing structure. The airplane skin will be explosively severed around the side window, across a central stringer, and down to the floor, creating an opening of approximately 76 by 76 cm. The severed panel will be jettisoned at an initial velocity of approximately 13.7 m/sec. System development included a total of 68 explosive severance tests on aluminum material using small samples, small and full scale flat panel aircraft structural mock-ups, and an actual aircraft fuselage. These tests proved explosive sizing/severance margins, explosive initiation, explosive product containment, and system dynamics.

RPT#: NASA-TM-80237 L-13585  
80N20227

UTTL: A spin-recovery parachute system for light general-aviation airplanes

AUTH: A/BRADSHAW, C.

MAJS: /\*AIRCRAFT SPIN/\*GENERAL AVIATION AIRCRAFT/\*RECOVERY  
PARACHUTES

MINS: / ACTUATORS/ MECHANICAL DEVICES/ WAKES

ABS: A tail mounted spin recovery parachute system was designed and developed by the NASA Langley Research Center for use on light general aviation airplanes. The system was designed for use on typical airplane configurations, including low wing, single engine, and twin-engine design. A mechanically triggered pyrotechnic slug gun is used to forcibly deploy a pilot parachute which extracts a bag that deploys a ring slot spin recovery parachute. The total system weighs 8.2 kg (18 lb). System design factors included airplane wake effects on parachute deployment, prevention of premature parachute deployment, positive parachute jettison, compact size, low weight, system reliability, and pilot and ground crew safety. Extensive ground tests were conducted to qualify the system. The recovery parachute was used successfully in flight 17 times.

RPT#: NASA-TM-81017  
80N21299

UTTL: Global positioning system for general aviation: Joint FAA-NASA Seminar

MAJS: /\*AIR NAVIGATION/\*CONFERENCES/\*GENERAL AVIATION  
AIRCRAFT/\*GLOBAL POSITIONING SYSTEM/\*NAVIGATION AIDS

MINS: / ANTENNAS/ NASA PROGRAMS/ NAVIGATION SATELLITES/  
RADIO RECEIVERS/ TECHNOLOGY UTILIZATION

RPT#: NASA-TM-81482 E-419  
80N21285

UTTL: High speed turboprops for executive aircraft, potential and recent test results

AUTH: A/MIKKELSON, D. C.; B/MITCHELL, G. A.

MAJS: /\*GENERAL AVIATION AIRCRAFT/\*PROPELLER EFFICIENCY/\*  
TURBOPROP AIRCRAFT

MINS: / AERODYNAMIC CONFIGURATIONS/ HIGH SPEED/ NACELLES/  
POWER EFFICIENCY/ THICKNESS RATIO/ WIND TUNNEL TESTS

ABS: Four high speed propeller models were designed and tested in an 8x6 foot wind tunnel in order to evaluate the potential of advanced propeller technology. Results from these tests show that the combination of: increased blade number, aerodynamically integrated propeller/nacelles, reduced blade thickness, spinner area ruling, and blade sweep are important in achieving high propeller efficiency at the high cruise

speeds.

RPT#: NASA-TM-81805  
BON24260

UTTL: Development of test methods for scale model simulation of aerial applications in the NASA Langley Vortex Research Facility

AUTH: A/JORDAN, F. L., JR.

MAJS: /\*AGRICULTURAL AIRCRAFT/\*AIRCRAFT WAKES/\*COMPUTERIZED SIMULATION/\*SCALE MODELS/\*VORTICES/\*WIND TUNNEL TESTS

ABS: As part of basic research to improve aerial applications technology, methods were developed at the Langley Vortex Research Facility to simulate and measure deposition patterns of aerially-applied sprays and granular materials by means of tests with small-scale models of agricultural aircraft and dynamically-scaled test particles. Interactions between the aircraft wake and the dispersed particles are being studied with the objective of modifying wake characteristics and dispersal techniques to increase swath width, improve deposition pattern uniformity, and minimize drift. The particle scaling analysis, test methods for particle dispersal from the model aircraft, visualization of particle trajectories, and measurement and computer analysis of test deposition patterns are described. An experimental validation of the scaling analysis and test results that indicate improved control of chemical drift by use of winglets are presented to demonstrate test methods.

RPT#: NASA-TM-81817  
BON28370

UTTL: Exploratory piloted simulator study of the effects of winglets on handling qualities of a representative agricultural airplane

AUTH: A/OGBURY, M. E.; B/BROWN, P. W.

MAJS: /\*AGRICULTURAL AIRCRAFT/\*BODY-WING CONFIGURATIONS/\* CONTROLLABILITY/\*MANEUVERABILITY/\*WIND TUNNEL TESTS/\* WINGS

MINS: / AIRCRAFT DESIGN/ AIRCRAFT MANEUVERS/ CONTROL SURFACES/ CROP DUSTING/ PERFORMANCE TESTS

ABS: The effects on handling qualities of adding winglets to a representative agricultural aircraft configuration during swath-run maneuvering were evaluated. Aerodynamic data used in the simulation were based on low-speed wind tunnel tests of a full scale airplane and a subscale model. The Cooper-Harper handling qualities rating scale, supplementary pilot comments, and pilot vehicle performance data were used to describe the handling qualities of the airplane with the different wing-tip configurations. Results showed that the lateral-directional handling qualities

of the airplane were greatly affected by the application of winglets and winglet cant angle. The airplane with winglets canted out 20 deg exhibited severely degraded lateral directional handling qualities in comparison to the basic airplane. When the winglets were canted inward 10 deg, the flying qualities of the configuration were markedly improved over those of the winglet-canted-out configuration or the basic configuration without winglets, indicating that proper tailoring of the winglet design may afford a potential benefit in the area of handling qualities.

RPT#: NASA-TM-75823  
81N10577

UTTL: Annoyance from light aircraft investigation carried out around four airports near Paris  
MAJS: /\*AIRPORTS/\*FRANCE/\*LIGHT AIRCRAFT/\*NOISE POLLUTION  
MINS: / AIRPORT PLANNING/ ENVIRONMENTAL ENGINEERING/ OPERATIONS RESEARCH/ RESIDENTIAL AREAS  
ABS: An opinion survey was carried out on residents living near four airports in the Paris, France area. An evaluation of their responses concerning noise pollution and possible expansion of airport activity is presented.

RPT#: NASA-TM-80064  
81N13959

UTTL: Development of a computer program data base of a navigation aid environment for simulated IFR flight and landing studies  
AUTH: A/BERGERON, H. P.; B/HAYNIE, A. T.; C/MCDEDE, J. B.  
MAJS: /\*COMPUTER PROGRAMS/\*FLIGHT SIMULATION/\*INSTRUMENT FLIGHT RULES/\*NAVIGATION AIDS  
MINS: / AIRPORTS/ COMPUTERIZED SIMULATION/ FLIGHT CONDITIONS / GENERAL AVIATION AIRCRAFT  
ABS: A general aviation single pilot instrument flight rule simulation capability was developed. Problems experienced by single pilots flying in IFR conditions were investigated. The simulation required a three dimensional spatial navaid environment of a flight navigational area. A computer simulation of all the navigational aids plus 12 selected airports located in the Washington/Norfolk area was developed. All programmed locations in the list were referenced to a Cartesian coordinate system with the origin located at a specified airport's reference point. All navigational aids with their associated frequencies, call letters, locations, and orientations plus runways and true headings are included in the data base. The simulation included a TV displayed out-the-window visual scene of country and suburban terrain and a scaled model runway complex. Any of the programmed runways, with all its associated navaids, can be referenced to a runway on the airport in this visual scene. This allows a simulation of a full mission scenario including breakout and landing.

RPT#: NASA-TM-81225 A-8311 QR-11  
81N10021

UTTL: NASA Aviation Safety Reporting System  
MAJS: /\*AIR TRAFFIC CONTROL/\*AIRCRAFT SAFETY/\*AIRFIELD SURFACE MOVEMENTS/\*AIRPORTS/\*CIVIL AVIATION/\*FLIGHT SAFETY/\*MIDAIR COLLISIONS

MINS: / AIRCRAFT LANDING/ AIRLINE OPERATIONS/ AIRPORT TOWERS / LANDING AIDS/ RUNWAYS/ TAKEOFF

ABS: A comprehensive study of near midair collisions in terminal airspace, derived from the ASRS database is presented. A selection of controller and pilot reports on airport perimeter security, unauthorized takeoffs and landings, and on winter operations is presented. A sampling of typical Alert Bulletins and their responses is presented.

RPT#: NASA-TM-81260 A-8432  
81N16022

UTTL: Human Factors of Flight-deck Automation: NASA/Industry Workshop  
AUTH: A/BOEHM-DAVIS, D. A.; B/CURRY, R. E.; C/WIENER, E. L.; D/HARRISON, R. L.  
MAJS: /\*AUTOMATIC PILOTS/\*BOREDOM/\*COCKPITS/\*FLIGHT OPERATIONS/\*HUMAN FACTORS ENGINEERING/\*SAFETY FACTORS  
MINS: / CIVIL AVIATION/ DECISION MAKING/ PILOT TRAINING/ SYSTEMS ENGINEERING/ TASK COMPLEXITY  
ABS: The scope of automation, the benefits of automation, and automation-induced problems were discussed at a workshop held to determine whether those functions previously performed manually on the flight deck of commercial aircraft should always be automated in view of various human factors. Issues which require research for resolution were identified. The research questions developed are presented.

RPT#: NASA-TM-81584 E-561  
81N10067

UTTL: Comparisons of four alternative powerplant types for future general aviation aircraft  
AUTH: A/WICKENHEISER, T. J.; B/KNIP, G.; C/PLENCNER, R. M.; D/STRACK, W. C.  
MAJS: /\*AIRCRAFT ENGINES/\*DIESEL ENGINES/\*GAS TURBINE ENGINES/\*PISTON ENGINES/\*TECHNOLOGY ASSESSMENT  
MINS: / COMPARISON/ COST ANALYSIS/ ENGINE TESTS/ PRODUCT DEVELOPMENT/ TURBINE ENGINES  
ABS: Recently completed NASA sponsored conceptual studies were culminated in the identification of promising new technologies for future spark ignition, diesel, rotary, and turbine engines. The results of a NASA in-house preliminary assessment study that compares these four powerplants types in several general aviation applications are reported. The evaluation consisted of installing each powerplant type in rubberized aircraft which are sized to accomplish fixed missions. The primary evaluation criteria include projected aircraft cost, total ownership cost, and mission fuel.

RPT#: NASA-TM-81610 E-607  
81N11769

UTTL: Core noise measurements from a small, general aviation turbofan engine

AUTH: A/RESHOTKO, M.; B/KARCHMER, A.

MAJS: /\*ENGINE NOISE/\*JET AIRCRAFT NOISE/\*NOISE MEASUREMENT  
/\*TURBOFAN ENGINES

MINS: / FAR FIELDS/ GENERAL AVIATION AIRCRAFT/ LOW  
FREQUENCIES/ PRESSURE MEASUREMENTS

ABS: As part of a program to investigate combustor and other core noises, simultaneous measurements of internal fluctuating pressure and far field noise were made with a JT15D turbofan engine. Acoustic waveguide probes, located in the engine at the combustor, at the turbine exit and in the core nozzle wall, were used to measure internal fluctuating pressures. Low frequency acoustic power determined at the core nozzle exit corresponds in level to the far field acoustic power at engine speeds below 65% of maximum, the approach condition. At engine speeds above 65% of maximum, the jet noise dominates in the far field, greatly exceeding that of the core. From coherence measurements, it is shown that the combustor is the dominant source of the low frequency core noise. The results obtained from the JT15D engine were compared with those obtained previously from a YF102 engine, both engines having reverse flow annular combustors and being in the same size class.

RPT#: NASA-TM-81666 E-686  
81N16052

UTTL: An overview of general aviation propulsion research programs at NASA Lewis Research Center

AUTH: A/WILLIS, E. A.; B/STRACK, W. C.

MAJS: /\*AIRCRAFT ENGINES/\*CIVIL AVIATION/\*COMBUSTION PHYSICS  
/\*ENGINE DESIGN/\*NASA PROGRAMS

MINS: / COMBUSTION EFFICIENCY/ FUEL CONSUMPTION/ PISTON  
ENGINES/ RESEARCH AND DEVELOPMENT/ TURBINE ENGINES

ABS: The review covers near-term improvements for current-type piston engines, as well as studies and limited corroborative research on several advanced g/a engine concepts, including diesels, small turboprops and both piston and rotary stratified-charge engines. Also described is basic combustion research, cycle modeling and diagnostic instrumentation work that is required to make new engines a reality.

RPT#: NASA-TM-81892 L-13960  
81N12012

UTTL: Flight evaluation of the effect of winglets on performance and handling qualities of a single-engine general aviation airplane

AUTH: A/HOLMES, B. J.; B/VANDAM, C. P.; C/BROWN, P. W.;  
D/DEAL, P. L.

MAJS: /\*AERODYNAMIC CONFIGURATIONS/\*AIRCRAFT PERFORMANCE/\*  
CIVIL AVIATION/\*FLIGHT TESTS/\*WINGLETS

MINS: / AERODYNAMIC STALLING/ CONTROLLABILITY/ DRAG  
REDUCTION/ FINS/ FLIGHT CHARACTERISTICS/ MINIMUM DRAG/  
PROTUBERANCES

ABS: A flight evaluation was conducted to determine the effects of winglets on the performance and handling qualities of a light, single-engine general aviation airplane. The performance measurements were made with a pace airplane to provide calibrated airspeeds; uncalibrated panel instruments in the test airplane were used to provide additional quantitative performance data. These tests were conducted with winglets on and off during the same day to measure relative performance effects. Handling qualities were evaluated by means of pilot comments. Winglets increased cruise speed 8 knots (5.6 percent) at 3962 m (13,000 ft) density altitude and 51 percent maximum continuous power setting. Maximum speed at 3962 m was virtually unchanged. Rate of climb increased approximately 6 percent, or 0.25 m/sec (50 ft/min), at 1524 m (5000 ft). Stall speed was virtually unchanged. Handling qualities were favorably affected.

TECHNICAL NOTES (TN)

Scientific and technical information considered important, complete and of importance as a contribution to existing knowledge. The designation Technical Notes (TN) was discontinued in 1977 and superseded by Technical Papers (TP).



RPT#: NASA-TN-D-7712 L-9411  
75N17368

**UTTL:** Monte Carlo analysis of inaccuracies in estimated aircraft parameters caused by unmodeled flight instrumentation errors

**AUTH:** A/HODGE, W. F.; B/BRYANT, W. H.

**MAJS:** /\*ERROR ANALYSIS/\*FLIGHT INSTRUMENTS/\*INSTRUMENT ERRORS/\*MONTE CARLO METHOD

**MINS:** / AIRCRAFT STABILITY/ COMMERCIAL AIRCRAFT/ GENERAL AVIATION AIRCRAFT/ MILITARY AIRCRAFT

**ABS:** An output error estimation algorithm was used to evaluate the effects of both static and dynamic instrumentation errors on the estimation of aircraft stability and control parameters. A Monte Carlo error analysis, using simulated cruise flight data, was performed for a high-performance military aircraft, a large commercial transport, and a small general aviation aircraft. The results indicate that unmodeled instrumentation errors can cause inaccuracies in the estimated parameters which are comparable to their nominal values. However, the corresponding perturbations to the estimated output response trajectories and characteristics equation pole locations appear to be relatively small. Control input errors and dynamic lags were found to be in the most significant of the error sources evaluated.

RPT#: NASA-TN-D-7928  
75N18169

**UTTL:** Pilot preference and procedures at uncontrolled airports

**AUTH:** A/PARKER, L. C.

**MAJS:** /\*AIRCRAFT LANDING/\*APPROACH CONTROL/\*FLIGHT PATHS/\* HUMAN FACTORS' ENGINEERING/\*PILOT PERFORMANCE

**MINS:** / AIRPORTS/ FLIGHT SAFETY/ GENERAL AVIATION AIRCRAFT/ STATISTICAL ANALYSIS/ TERMINAL FACILITIES

**ABS:** The report presents the results of a pilot questionnaire utilized at the 1974 Reading, Pennsylvania Air Show to obtain data on pilot procedures and preference in the terminal airspace of uncontrolled airports.

RPT#: NASA-TN-D-8058 L-10355  
76N15083

UTTL: A review of the NASA V-G/VGH general aviation program  
AUTH: A/JEWEL, J. W., JR.; B/MORRIS, G. J.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS  
MINS: / AIRCRAFT MANEUVERS/ GUST LOADS/ OPERATIONS RESEARCH  
ABS: The V-G and VGH data collected from a wide variety of general aviation airplanes since the inception of the NASA V-G/VGH General Aviation Program in 1962 are presented. These data were analyzed to obtain information on the gust and maneuver loads, on the operating practices, and on the effects of different types of operations on these parameters.

RPT#: NASA-TN-D-8179 L-10514  
76N21173

UTTL: Impact dynamics research facility for full-scale aircraft crash testing  
AUTH: A/VAUGHAN, V. L. J.; B/ALFARO-BOU, E.  
MAJS: /\*AIRCRAFT SURVIVABILITY/\*CRASHES/\*GENERAL AVIATION AIRCRAFT/\*IMPACT DAMAGE  
MINS: / DATA ACQUISITION/ FLIGHT TESTS/ FREE FLIGHT/ ONBOARD EQUIPMENT  
ABS: An impact dynamics research facility (IDRF) was developed to crash test full-scale general aviation aircraft under free-flight test conditions. The aircraft are crashed into the impact surface as free bodies; a pendulum swing method is used to obtain desired flight paths and velocities. Flight paths up to -60 deg and aircraft velocities along the flight paths up to about 27.0 m/s can be obtained with a combination of swing-cable lengths and release heights made available by a large gantry. Seven twin engine, 2721-kg aircraft were successfully crash tested at the facility, and all systems functioned properly. Acquisition of data from signals generated by accelerometers on board the aircraft and from external and onboard camera coverage was successful in spite of the amount of damage which occurred during each crash. Test parameters at the IDRF are controllable with flight path angles accurate within 8 percent, aircraft velocity accurate within 6 percent, pitch angles accurate to 4.25 deg, and roll and yaw angles acceptable under wind velocities up to 4.5 m/s.

RPT#: NASA-TN-D-8206 L-10735  
76N26165

UTTL: Review of drag cleanup tests in Langley full-scale tunnel (from 1935 to 1945) applicable to current general aviation airplanes  
AUTH: A/COE, P. L., JR.

MAJS: /\*DRAG REDUCTION/\*GENERAL AVIATION AIRCRAFT/\*PROPELLER DRIVE

MINS: / AERODYNAMIC CHARACTERISTICS/ AIRCRAFT DESIGN/ WIND TUNNEL TESTS

ABS: Results of drag cleanup tests conducted in the Langley full-scale tunnel during the period from 1935 to 1945 are summarized for potential application to current propeller-driven general aviation airplanes. Data from tests on 23 airplanes indicate that the drag increments produced by many individual configuration features - such as, power plant installation, air leakage, cockpit canopies, control surface gaps, and antenna installations - are not large; however, when the increments are summed, the resulting total drag increase is significant. On the basis of results of the investigation, it appears that considerable reduction in drag can be obtained by proper attention to details in aerodynamic design and by adherence to the guidelines discussed.

RPT#: NASA-TN-D-8234 L-10635  
76N31134

UTTL: An analytical study and wind tunnel tests of an aeromechanical gust-alleviation system for a light airplane  
AUTH: A/STEWART, E. C.  
MAJS: /\*GUST ALLEVIATORS/\*LIGHT AIRCRAFT/\*WIND TUNNEL TESTS  
MINS: / AERODYNAMIC COEFFICIENTS/ GRAPHS (CHARTS)/ TABLES (DATA)  
ABS: The results of an analytical study of a system using stability derivatives determined in static wind tunnel tests of a 1/6 scale model of a popular, high wing, light airplane equipped with the gust alleviation system are reported. The longitudinal short period mode dynamics of the system are analyzed, and include the following: (1) root loci, (2) airplane frequency responses to vertical gusts, (3) power spectra of the airplane responses in a gust spectrum, (4) time history responses to vertical gusts, and (5) handling characteristics. The system reduces the airplane's normal acceleration response to vertical gusts while simultaneously increasing the pitching response and reducing the damping of the longitudinal short period mode. The normal acceleration response can be minimized by using the proper amount of static alleviation and a fast response system with a moderate amount of damping. The addition of a flap elevator interconnect or a pitch damper system further increases the alleviation while moderating the simultaneous increase in pitching response. The system provides direct lift control and may reduce the stick fixed longitudinal static stability.

RPT#: NASA-TN-D-8236 L-10736

76N26218

UTTL: Wind-tunnel investigation of a Fowler flap and spoiler for an advanced general aviation wing

AUTH: A/PAULSON, J. W., JR.

MAJS: /\*ANGLE OF ATTACK/\*FLAPS (CONTROL SURFACES)/\*LATERAL CONTROL/\*WIND TUNNEL STABILITY TESTS

MINS: / GENERAL AVIATION AIRCRAFT/ GRAPHS (CHARTS)/ JET BOUNDARIES/ SPOILERS

ABS: The wing was tested without fuselage or empennage and was fitted with approximately three-quarter span Fowler flaps and half span spoilers. The spoilers were hinged at the 70 percent chord point and vented when the flaps were deflected. Static longitudinal and lateral aerodynamic data were obtained over an angle of attack range of -8 deg to 22 deg for various flap deflections and positions, spoiler geometries, and vent lip geometries. Lateral characteristics indicate that the spoilers are generally adequate for lateral control. In general, the spoiler effectiveness increases with increasing angle of attack, increases with increasing flap deflections, and is influenced by vent lip geometry. In addition, the data show that some two-dimensional effects on spoiler effectiveness are reduced in the three-dimensional case. Results also indicate significant increase in lift coefficient as the Fowler flaps are deflected; when the flap was fully deflected, the maximum wing lift coefficient was increased about 96 percent.

RPT#: NASA-TN-D-8283 L-10878  
77N11033

UTTL: Landing practices of general aviation pilots in  
single-engine light airplanes

AUTH: A/GOODE, M. W.; B/OBRYAN, T. C.; C/YENNI, K. R.;  
D/CANNADAY, R. L.; E/MAYO, M. H.

MAJS: /\*AIRCRAFT LANDING/\*GENERAL AVIATION AIRCRAFT/\*PILOT  
PERFORMANCE

MINS: / APPROACH CONTROL/ CIVIL AVIATION/ FLIGHT  
CHARACTERISTICS

ABS: The methods and techniques used by a group of general  
aviation pilots during the landing phase of light  
airplane operations are documented. The results of 616  
landings made by 22 pilots in 2 modern, four-place,  
single-engine, flight airplanes (one having a low wing  
and the other, a high wing) are presented. The  
landings were made on both a long runway (1524 m (5000  
ft)) and a short runway (762 m (2500 ft)); both  
runways were considered typical of those used in  
general aviation. The results generally show that most  
of the approaches were fast with considerable floating  
during the flares and with touchdowns that were  
relatively flat or nose-low.

RPT#: NASA-TN-D-8521 L-11352  
77N31072

UTTL: A comparison of the results of dynamic wind-tunnel  
tests with theoretical predictions for an  
aeromechanical gust-alleviation system for light  
airplanes

AUTH: A/STEWART, E. C.; B/REDD, L. T.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*GUST ALLEVIATORS/\*SCALE  
MODELS/\*WIND TUNNEL TESTS

MINS: / AERODYNAMIC LOADS/ FLAPS (CONTROL SURFACES)/  
MATHEMATICAL MODELS/ PREDICTION ANALYSIS TECHNIQUES

ABS: Dynamic wind tunnel tests have been conducted on a  
1/6-scale model of a general aviation airplane  
equipped with an all-mechanical gust alleviation  
system which uses auxiliary aerodynamic surfaces to  
drive the flaps. The longitudinal short period motions  
were studied under simulated gust conditions in order  
to verify the mathematical model used in a previous  
study to predict the performance of the full scale  
system and determine the amount of normal acceleration  
alleviation which could be attained. The model  
responses were measured for different configurations  
with the system active and without the system active  
for comparison. The tests confirmed the general  
relationships between the experimental variables and  
the model responses predicted by the mathematical  
model, but there were significant differences in the  
magnitudes of the responses. The experimental results

for the model were used to estimate a reduction of 30  
percent in the rms normal acceleration response of a  
similar full scale airplane in atmospheric turbulence.

RPT#: NASA-TN-D-8524 L-11305  
77N28094

UTTL: Aerodynamic characteristics of wing-body configuration  
with two advanced general aviation airfoil sections  
and simple flap systems

AUTH: A/MORGAN, H. L., JR.; B/PAULSON, J. W., JR.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*BODY-WING  
CONFIGURATIONS/\*GENERAL AVIATION AIRCRAFT

MINS: / DRAG/ FLAPS (CONTROL SURFACES)/ LIFT/ WIND TUNNEL  
TESTS

ABS: Aerodynamic characteristics of a general aviation wing  
equipped with NACA 65 sub 2-415, NASA GA(W)-1, and  
NASA GA(PC)-1 airfoil sections were examined. The NASA  
GA(W)-1 wing was equipped with plain, split, and  
slotted partial- and full-span flaps and ailerons. The  
NASA GA(PC)-1 wing was equipped with plain, partial-  
and full-span flaps. Experimental chordwise  
static-pressure distribution and wake drag  
measurements were obtained for the NASA GA(PC)-1 wing  
at the 22.5-percent spanwise station. Comparisons were  
made between the three wing configurations to evaluate  
the wing performance, stall, and maximum lift  
capabilities. The results of this investigation  
indicated that the NASA GA(W)-1 wing had a higher  
maximum lift capability and almost equivalent drag  
values compared with both the NACA 65 sub 2-415 and  
NASA GA(PC)-1 wings. The NASA GA(W)-1 had a maximum  
lift coefficient of 1.32 with 0 deg flap deflection,  
and 1.78 with 41.6 deg deflection of the partial-span  
slotted flap. The effectiveness of the NASA GA(W)-1  
plain and slotted ailerons with differential  
deflections were equivalent. The NASA GA(PC)-1 wing  
with full-span flaps deflected 0 deg for the design  
climb configuration showed improved lift and drag  
performance over the cruise flap setting of -10 deg.

TECHNICAL PAPERS (TP)

These documents record the findings of significant work conducted by NASA scientific and technical personnel. Technical Papers are the Agency's counterpart to professional papers and, therefore, are released only after a professional review controlled by the originating Headquarters or installation office. For documentation purposes Technical Papers are preferred over professional journal articles because they have less stringent limitations on manuscript length or number of figures.



there is a large surface area, but the airflow is restricted.

RPT#: NASA-TP-1009 L-11227  
77N33111

**UTTL:** Spin-tunnel investigation of the spinning characteristics of typical single-engine general aviation airplane designs. 1. Low-wing model A: Effects of tail configurations

**AUTH:** A/BURK, S. M., JR.; B/BOWMAN, J. S., JR.; C/WHITE, W. L.

**MAJS:** /\*AERODYNAMIC CONFIGURATIONS/\*AIRCRAFT DESIGN/\*LOW WING AIRCRAFT/\*SPIN TESTS/\*TAIL ASSEMBLIES

**MINS:** / DYNAMIC STABILITY/ LIGHT AIRCRAFT/ SCALE MODELS/ SPIN DYNAMICS

**ABS:** The effects of tail design on spin and recovery were investigated in a spin tunnel. A 1/11-scale model of a research airplane which represents a typical low-wing, single engine, light general aviation airplane was used. A tail design criterion for satisfactory spin recovery for light airplanes was evaluated. The effects of other geometric design features on the spin and recovery characteristics were also determined. Results indicate that the existing tail design criterion for light airplanes, which uses the tail damping power factor as a parameter, cannot be used to predict spin-recovery characteristics.

RPT#: NASA-TP-1054 E-9098  
77N32432

**UTTL:** Effect of fin passage length on optimization of cylinder head cooling fins

**AUTH:** A/SIEGEL, R.; B/GRAHAM, R. W.

**MAJS:** /\*AIRCRAFT ENGINES/\*COOLING FINS/\*ENGINE DESIGN

**MINS:** / AIR FLOW/ HEAT TRANSFER/ OPTIMIZATION/ WALL TEMPERATURE

**ABS:** The heat transfer performance of baffled cooling fins on cylinder heads of small, air-cooled, general-aviation aircraft engines was analyzed to determine the potential for improving cooling fin design. Flow baffles were assumed to be installed tightly against the fin end edges, an ideal baffle configuration for guiding all flow between the fins. A rectangular flow passage is thereby formed between each set of two adjacent fins, the fin base surface, and the baffle. These passages extend around each side of the cylinder head, and the cooling air absorbs heat as it flows within them. For each flow passage length, the analysis was concerned with optimizing fin spacing and thickness to achieve the best heat transfer for each fin width. Previous literature has been concerned mainly with maximizing the local fin conductance and has not considered the heating of the gas in the flow direction, which leads to higher wall temperatures at the fin passage exits. If the fins are close together,

RPT#: NASA-TP-1043 L-11355  
78N13071

UTTL: Effects of control inputs on the estimation of stability and control parameters of a light airplane  
AUTH: A/CANNADAY, R. L.; B/SUIT, W. T.  
MAJS: /\*AERODYNAMIC STABILITY/\*CONTROLLABILITY/\*ESTIMATING/\*  
INPUT/OUTPUT ROUTINES/\*LIGHT AIRCRAFT/\*  
PARAMETERIZATION  
MINS: / COMPUTER PROGRAMMING/ DERIVATION/ FLIGHT TESTS/  
MAXIMUM LIKELIHOOD ESTIMATES  
ABS: The maximum likelihood parameter estimation technique was used to determine the values of stability and control derivatives from flight test data for a low-wing, single-engine, light airplane. Several input forms were used during the tests to investigate the consistency of parameter estimates as it relates to inputs. These consistencies were compared by using the ensemble variance and estimated Cramer-Rao lower bound. In addition, the relationship between inputs and parameter correlations was investigated. Results from the stabilator inputs are inconclusive but the sequence of rudder input followed by aileron input or aileron followed by rudder gave more consistent estimates than did rudder or ailerons individually. Also, square-wave inputs appeared to provide slightly improved consistency in the parameter estimates when compared to sine-wave inputs.

RPT#: NASA-TP-1076 L-11804  
78N12040

UTTL: Spin-tunnel investigation of the spinning characteristics of typical single-engine general aviation airplane designs. 2: Low-wing model A; tail parachute diameter and canopy distance for emergency spin recovery  
AUTH: A/BURK, S. M., JR.; B/BOWMAN, J. S., JR.; C/WHITE, W. L.  
MAJS: /\*LIGHT AIRCRAFT/\*RECOVERY PARACHUTES/\*SPIN STABILIZATION/\*TAIL ASSEMBLIES  
MINS: / GYROSCOPIC STABILITY/ SCALE MODELS/ SPIN TESTS/ WIND TUNNEL STABILITY TESTS  
ABS: A spin tunnel study is reported on a scale model of a research airplane typical of low-wing, single-engine, light general aviation airplanes to determine the tail parachute diameter and canopy distance (riser length plus suspension-line length) required for emergency spin recovery. Nine tail configurations were tested, resulting in a wide range of developed spin conditions, including steep spins and flat spins. The results indicate that the full-scale parachute diameter required for satisfactory recovery from the most critical conditions investigated is about 3.2 m

and that the canopy distance, which was found to be critical for flat spins, should be between 4.6 and 6.1 m.

RPT#: NASA-TP-1157 L-12008  
78N20115

UTTL: Ground distance covered during airborne horizontal deceleration of an airplane  
AUTH: A/PHILLIPS, W. H.  
MAJS: /\*AIRCRAFT LANDING/\*DECELERATION/\*GENERAL AVIATION AIRCRAFT/\*LANDING LOADS/\*LANDING SPEED  
MINS: / DRAG REDUCTION/ FLOATING/ GROUND EFFECT/ GROUND WIND / LIFT  
ABS: The distance an airplane floats with respect to the ground during deceleration at constant altitude is analyzed taking into account the effects of a constant wind. By use of suitable nondimensionalizing parameters, data applicable to all airplanes are presented by means of a single family of curves.

RPT#: NASA-TP-1276 L-12157  
78N31101

UTTL: Simulation and flight evaluation of a head-up landing aid for general aviation  
AUTH: A/HARRIS, R. L., SR.; B/GOODE, M. W.; C/YENNI, K. R.  
MAJS: /\*FLIGHT SIMULATION/\*GENERAL AVIATION AIRCRAFT/\*  
HEAD-UP DISPLAYS/\*LANDING AIDS  
MINS: / AILERONS/ CONTROL SURFACES/ DISPLAY DEVICES/  
ELEVATORS (CONTROL SURFACES)/ FLIGHT TESTS/  
INDEPENDENT VARIABLES/ INDICATING INSTRUMENTS/ LANDING SITES/ LANDING SPEED/ PILOT PERFORMANCE/ RUDDERS/  
STANDARD DEVIATION/ VISUAL AIDS  
ABS: A head-up general aviation landing aid called a landing site indicator (LASI) was tested in a fixed-base, visual simulator and in an airplane to determine the effectiveness of the LASI. The display, which had a simplified format and method of implementation, presented to the pilot in his line of sight through the windshield a graphic representation of the airplane's velocity vector. In each testing model (simulation of flight), each of 4 pilots made 20 landing approaches with the LASI and 20 approaches without it. The standard deviations of approach and touchdown parameters were considered an indication of pilot consistency. Use of the LASI improved consistency and also reduced elevator, aileron, and rudder control activity. Pilots' comments indicated that the LASI reduced work load. An appendix is included with a discussion of the simulator effectiveness for visual flight tasks.

RPT#: NASA-TP-1306 L-12291  
79N20071

UTTL: Determination of stability and control parameters of a light airplane from flight data using two estimation methods

AUTH: A/KLEIN, V.

MAJS: /\*AERODYNAMIC STABILITY/\*AIRCRAFT CONTROL/\*IN-FLIGHT MONITORING/\*LIGHT AIRCRAFT/\*MAXIMUM LIKELIHOOD ESTIMATES/\*REGRESSION ANALYSIS

MINS: / CONTROL SURFACES/ EQUATIONS OF MOTION/ FLIGHT CHARACTERISTICS/ LEAST SQUARES METHOD/ PARAMETERIZATION

ABS: Two identification methods, the equation error method and the output error method, are used to estimate stability and control parameter values from flight data for a low-wing, single-engine, general aviation airplane. The estimated parameters from both methods are in very good agreement primarily because of sufficient accuracy of measured data. The estimated static parameters also agree with the results from steady flights. The effect of power different input forms are demonstrated. Examination of all results available gives the best values of estimated parameters and specifies their accuracies.

RPT#: NASA-TP-1321 L-12439  
79N14874

UTTL: Noise transmission through flat rectangular panels into a closed cavity

AUTH: A/BARTON, C. K.; B/DANIELS, E. F.

MAJS: /\*AIRCRAFT NOISE/\*CAVITIES/\*FLAT SURFACES/\*LIGHT AIRCRAFT/\*NOISE PROPAGATION/\*RECTANGULAR PANELS

MINS: / ACOUSTIC ATTENUATION/ GLASS FIBERS/ LOW FREQUENCIES/ NOISE REDUCTION/ SINE WAVES/ STIFFNESS

ABS: Five panels backed by a closed cavity were studied experimentally and analytically to determine the noise transmission characteristics of the coupled panel-cavity system. The closed cavity was studied both with and without fiber-glass lining to provide either an absorbent or a reverberant acoustic space. The effects on noise reduction of cavity absorption, measurement location within the cavity, panel mass, and panel stiffness were examined. Results indicated that both measurement location and absorption in the cavity have significant effects on the noise reduction. Increasing panel mass improves the noise reduction at almost all frequencies, and increasing panel stiffness improves noise reduction below the fundamental resonance frequency. A simple, one dimensional analytical model was developed which provided good agreement with the experimental results.

RPT#: NASA-TP-1324 AVRADCOM-TR-78-45  
79N14018

UTTL: Low-speed aerodynamic characteristics of a 16-percent-thick variable-geometry airfoil designed for general aviation applications

AUTH: A/BARNWELL, R. W.; B/NOONAN, K. W.; C/MCGHEE, R. J.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRFOIL PROFILES/\* GENERAL AVIATION AIRCRAFT/\*LOW SPEED

MINS: / AERODYNAMIC CONFIGURATIONS/ AERODYNAMIC STALLING/ ANGLE OF ATTACK/ BOUNDARY LAYERS/ DRAG/ LAND/ LEADING EDGES/ LIFT/ PRESSURE CHAMBERS/ REYNOLDS NUMBER/ TRAILING EDGES

ABS: Tests were conducted in the Langley low-turbulence pressure tunnel to determine the aerodynamic characteristics of climb, cruise, and landing configurations. These tests were conducted over a Mach number range from 0.10 to 0.35, a chord Reynolds number range from 2.0 x 1 million to 20.0 x 1 million, and an angle-of-attack range from -8 deg to 20 deg. Results show that the maximum section lift coefficients increased in the Reynolds number range from 2.0 x 1 million to 9.0 x 1 million and reached values of approximately 2.1, 1.8, and 1.5 for the landing, climb, and cruise configurations, respectively. Stall characteristics, although of the trailing-edge type, were abrupt. The section lift-drag ratio of the climb configuration with fixed transition near the leading edge was about 78 at a lift coefficient of 0.9, a Mach number of 0.15, and a Reynolds number of 4.0 x 1 million. Design lift coefficients of 0.9 and 0.4 for the climb and cruise configurations were obtained at the same angle of attack, about 6 deg, as intended. Good agreement was obtained between experimental results and the predictions of a viscous, attached-flow theoretical method.

RPT#: NASA-TP-1477 L-12778

80N10512

UTTL: Light airplane crash tests at three roll angles  
AUTH: A/CASTLE, C. B.; B/ALFARO-BOU, E.  
MAJS: /\*CRASHES/\*GENERAL AVIATION AIRCRAFT/\*IMPACT TESTS/\*  
ROLL

MINS: / ACCELEROMETERS/ AIRCRAFT COMPARTMENTS/ AIRCRAFT  
SURVIVABILITY/ IMPACT DAMAGE/ TRANSVERSE ACCELERATION

ABS: Three similar twin engine general aviation airplanes  
were crash tested at the Langley impact dynamics  
research facility at 27 m/sec and at nominal roll  
angles of 0 deg, -15 deg, and -30 deg. Other flight  
parameters were held constant. The test facility,  
instrumentation, test specimens, and test method are  
briefly described. Structural damage and accelerometer  
data for each of the three impact conditions are  
presented and discussed.

RPT#: NASA-TP-1481

80N11505

UTTL: Light airplane crash tests at three pitch angles  
AUTH: A/VAUGHAN, V. L., JR.; B/ALFARO-BOU, E.  
MAJS: /\*CRASH LANDING/\*GENERAL AVIATION AIRCRAFT/\*IMPACT  
TESTS/\*LIGHT AIRCRAFT

MINS: / ACCELEROMETERS/ HUMAN FACTORS ENGINEERING/ IMPACT  
DAMAGE/ PITCH (INCLINATION)/ STRUCTURAL STRAIN

ABS: Three similar twin-engine general aviation airplane  
specimens were crash tested at an impact dynamics  
research facility at 27 m/sec, a flight path angle of  
-15 deg, and pitch angles of -15 deg, 0 deg, and 15  
deg. Other crash parameters were held constant. The  
test facility, instrumentation, test specimens, and  
test method are briefly described. Structural damage  
and accelerometer data for each of the three impact  
conditions are presented and discussed.

RPT#: NASA-TP-1589 L-13143

80N13026

UTTL: Exploratory study of the effects of wing-leading-edge  
modifications on the stall/spin behavior of a light  
general aviation airplane

MAJS: /\*AERODYNAMIC STALLING/\*AIRCRAFT SPIN/\*GENERAL  
AVIATION AIRCRAFT/\*LEADING EDGES/\*LIGHT AIRCRAFT/\*WING  
PROFILES

MINS: / AERODYNAMIC STABILITY/ FLIGHT TESTS/ LATERAL  
STABILITY/ LEADING EDGE SLATS

ABS: Configurations with full-span and segmented  
leading-edge flaps and full-span and segmented  
leading-edge droop were tested. Studies were conducted  
with wind-tunnel models, with an outdoor  
radio-controlled model, and with a full-scale

airplane. Results show that wing-leading-edge  
modifications can produce large effects on stall/spin  
characteristics, particularly on spin resistance. One  
outboard wing-leading-edge modification tested  
significantly improved lateral stability at stall,  
spin resistance, and developed spin characteristics.

RPT#: NASA-TP-1591 L-13135

80N22266

UTTL: Full-scale wind tunnel investigation of the Advanced  
Technology Light Twin-Engine airplane (ATLIT)

AUTH: A/HASSELL, J. L., JR.; B/NEWSOM, W. A., JR.; C/YIP,  
L. P.

MAJS: /\*AERODYNAMIC STABILITY/\*AIRCRAFT CONTROL/\*AIRCRAFT  
PERFORMANCE/\*ATLIT PROJECT/\*FULL SCALE TESTS/\*WIND  
TUNNEL TESTS

MINS: / ANGLE OF ATTACK/ DRAG REDUCTION/ PROPELLER  
EFFICIENCY/ SIDESLIP/ WINGLETS

ABS: An investigation was conducted to evaluate the  
aerodynamic performance, stability, and control  
characteristics of the Advanced Technology Light Twin  
Engine airplane (ATLIT). Data were measured over an  
angle of attack range from -4 deg to 20 deg for  
various angles of sideslip between -5 deg and 15 deg  
at Reynolds numbers of 0.000023 and 0.000035 for  
various settings of power and flap deflection.  
Measurements were also made by means of special thrust  
torque balances to determine the installed propeller  
characteristics. Part of the investigation was devoted  
to drag cleanup of the basic airplane and to the  
evaluation of the effect of winglets on drag and  
stability.

RPT#: NASA-TP-1636 L-13054

80N25345

UTTL: Measurement of the handling characteristics of two  
light airplanes

MAJS: /\*CONTROLLABILITY/\*FLIGHT TESTS/\*GENERAL AVIATION  
AIRCRAFT

MINS: / AERODYNAMIC STALLING/ AIRCRAFT CONTROL/ AIRCRAFT  
PERFORMANCE/ LATERAL CONTROL/ LONGITUDINAL CONTROL

ABS: A flight investigation of the handling characteristics  
of two single engine general aviation airplanes, one a  
high wing and the other a low wing, included a variety  
of measurements of different characteristics of the  
airplanes. The characteristics included those of the  
control systems, performance, longitudinal and lateral  
responses, and stall motions.

RPT#: NASA-TP-1647 L-12494  
80N22358

**UTTL:** Description of an experimental (hydrogen peroxide) rocket system and its use in measuring aileron and rudder effectiveness of a light airplane

**AUTH:** A/OBRYAN, T. C.; B/GOODE, M. W.; C/GREGORY, F. D.; D/MAYO, M. H.

**MAJS:** /\*AILERONS/\*HYDROGEN PEROXIDE/\*LIGHT AIRCRAFT/\*ROCKET ENGINES/\*RUDDERS/\*SYSTEM EFFECTIVENESS

**MINS:** / CONTROLLABILITY/ ROCKET THRUST/ ROLLING MOMENTS/ YAWING MOMENTS

**ABS:** A hydrogen peroxide fueled rocket system, which is to be used as a research tool in flight studies of stall and spin maneuvers, was installed on a light, four place general aviation airplane. The pilot controlled rocket system produces moments about either the roll or the yaw body axis to augment or oppose the aerodynamic forces and inertial moments acting on the airplane during various flight maneuvers, including the spin. These controlled moments of a known magnitude can be used in various ways to help analyze and interpret the importance of the various factors which influence airplane maneuvers. The rocket system and its installation in the airplane are described, and the results of flight tests used to measure rudder and aileron effectiveness at airspeeds above the stall are presented. These tests also serve to demonstrate the operational readiness of the rocket system for future research operations.

RPT#: NASA-TP-1498 L-12976  
81N12015

**UTTL:** Low-speed aerodynamic characteristics of a 13 percent thick medium speed airfoil designed for general aviation applications

**AUTH:** A/MCGHEE, R. J.; B/BEASLEY, W. D.

**MAJS:** /\*AIRCRAFT DESIGN/\*ANGLE OF ATTACK/\*GENERAL AVIATION AIRCRAFT/\*WIND TUNNEL TESTS

**MINS:** / AERODYNAMIC CHARACTERISTICS/ MACH NUMBER/ REYNOLDS NUMBER

**ABS:** Wind tunnel tests were conducted to determine the low speed, two dimensional aerodynamic characteristics of a 13percent thick medium speed airfoil designed for general aviation applications. The results were compared with data for the 13 percent thick low speed airfoil. The tests were conducted over a Mach number range from 0.10 to 0.32, a chord Reynolds number range from  $2.0 \times 10^6$  to the 6th power to  $12.0 \times 10^6$  to the 6th power, and an angle of attack frange from about -8 deg to 10 deg. The objective of retaining good high-lift low speed characteristics for an airfoil designed to have good medium speed cruise performance was achieved.

RPT#: NASA-TP-1762 L-13946  
81N16039

**UTTL:** Use of constrained optimization in the conceptual design of a medium-range subsonic transport

**AUTH:** A/SLIWA, S. M.

**MAJS:** /\*COST ANALYSIS/\*DESIGN ANALYSIS/\*NONLINEAR PROGRAMMING/\*OPTIMIZATION/\*TRANSPORT AIRCRAFT

**MINS:** / AERODYNAMIC CONFIGURATIONS/ AIRCRAFT PERFORMANCE/ GENERAL AVIATION AIRCRAFT

**ABS:** Constrained parameter optimization was used to perform the optimal conceptual design of a medium range transport configuration. The impact of choosing a given performance index was studied, and the required income for a 15 percent return on investment was proposed as a figure of merit. A number of design constants and constraint functions were systematically varied to document the sensitivities of the optimal design to a variety of economic and technological assumptions. A comparison was made for each of the parameter variations between the baseline configuration and the optimally redesigned configuration.



### CONTRACTOR REPORTS (CR)

These documents record scientific and technical findings generated by NASA-sponsored R&D and related efforts that are considered desirable for release by NASA. They are subdivided into low-numbered and high-numbered subseries contractor reports. The low-numbered subseries are similar in quality to NASA Technical Papers and are produced and disseminated in the same manner as NASA Technical Papers.

The high-numbered subseries do not meet the same criteria as the low-numbered subseries although they contain new technical information. They are produced and disseminated in the manner of NASA Technical Memorandums.



RPT#: NASA-CR-132531  
75N10933

UTTL: Statistical analysis of general aviation VG-VGH data  
AUTH: A/CLAY, L. E.; B/DICKEY, R. L.; C/MORAN, M. S.;  
D/PAYAUYS, K. W.; E/SEVERYN, T. P.  
MAJS: /\*FLIGHT RECORDERS/\*GENERAL AVIATION AIRCRAFT/\*  
STATISTICAL ANALYSIS  
MINS: / ACCELERATION/ AERODYNAMIC LOADS/ AIRSPEED/ DATA  
SAMPLING/ GUST LOADS/ IMPACT LOADS  
ABS: To represent the loads spectra of general aviation  
aircraft operating in the Continental United States,  
VG and VGH data collected since 1963 in eight  
operational categories were processed and analyzed.  
Adequacy of data sample and current operational  
categories, and parameter distributions required for  
valid data extrapolation were studied along with  
envelopes of equal probability of exceeding the normal  
load factor ( $n_{sub z}$ ) versus airspeed for gust and  
maneuver loads and the probability of exceeding  
current design maneuver, gust, and landing impact  $n_{sub z}$   
limits. The significant findings are included.

RPT#: NASA-CR-132677  
75N25901

UTTL: Flight test and evaluation of Omega navigation for  
general aviation  
AUTH: A/HWOSCHINSKY, P. V.  
MAJS: /\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*OMEGA  
NAVIGATION SYSTEM  
MINS: / GROUND BASED CONTROL/ HYPERBOLIC NAVIGATION/  
POSITION (LOCATION)/ RADIO RECEIVERS/ RADIO WAVES/  
SYSTEMS ANALYSIS  
ABS: A seventy hour flight test program was performed to  
determine the suitability and accuracy of a low cost  
Omega navigation receiver in a general aviation  
aircraft. An analysis was made of signal availability  
in two widely separated geographic areas. Comparison  
is made of the results of these flights with other  
navigation systems. Conclusions drawn from the test  
experience indicate that developmental system  
improvement is necessary before a competent fail safe  
or fail soft area navigation system is offered to  
general aviation.

RPT#: NASA-CR-137604 MDC-J4484-VOL-2  
75N22301

UTTL: Analysis of operational requirements for medium  
density air transportation, volume 2  
MAJS: /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*COMMERCIAL  
AIRCRAFT/\*SHORT TAKEOFF AIRCRAFT  
MINS: / ECONOMIC FACTORS/ GENERAL AVIATION AIRCRAFT/ MARKET

#### RESEARCH

ABS: The medium density air travel market is examined and  
defined in terms of numbers of people transported per  
route per day and frequency of service. The  
operational characteristics for aircraft to serve this  
market are determined and a basepoint aircraft is  
designed from which tradeoff studies and parametric  
variations can be conducted. The impact of the  
operational characteristics on the air travel system  
is evaluated along with the economic viability of the  
study aircraft. Research and technology programs for  
future study consideration are identified.

RPT#: NASA-CR-137605 MDC-J4484-VOL-3  
75N22302

UTTL: Analysis of operational requirements for medium  
density air transportation. Volume 3: Appendix  
MAJS: /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*COMMERCIAL  
AIRCRAFT/\*SHORT TAKEOFF AIRCRAFT  
MINS: / ECONOMIC FACTORS/ GENERAL AVIATION AIRCRAFT/ MARKET  
RESEARCH  
ABS: For abstract, see N75-22301.

RPT#: NASA-CR-137628  
75N16554

UTTL: Analysis of technology requirements and potential  
demand for general aviation avionics systems for  
operation in the 1980's  
AUTH: A/COHN, D. M.; B/KAYSER, J. H.; C/SENKO, G. M.;  
D/GLENN, D. R.  
MAJS: /\*AVIONICS/\*COST EFFECTIVENESS/\*GENERAL AVIATION  
AIRCRAFT/\*TECHNOLOGICAL FORECASTING  
MINS: / DEMAND (ECONOMICS)/ ECONOMIC ANALYSIS/ LOW COST/  
NASA PROGRAMS/ TECHNOLOGY ASSESSMENT/ TECHNOLOGY  
TRANSFER  
ABS: Avionics systems are identified which promise to  
reduce economic constraints and provide significant  
improvements in performance, operational capability  
and utility for general aviation aircraft in the  
1980's.

RPT#: NASA-CR-143237 TM-17  
75N28278

UTTL: Common antenna preamplifier-isolator for VLF-LF  
receivers  
AUTH: A/BURHANS, R. W.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*LOW FREQUENCIES/\*  
PREAMPLIFIERS/\*RECEIVERS/\*VERY LOW FREQUENCIES  
MINS: / AIRCRAFT ANTENNAS/ OMEGA NAVIGATION SYSTEM/  
PERFORMANCE TESTS  
ABS: A modified high impedance preamplifier circuit which

provides outputs to drive an Omega-VLF receiver and an ADF-LF receiver from a common antenna on general aviation aircraft is reported. The preamplifier was evaluated with fixed ground station receivers and results show the burn out problem of the first stage MOSFET during very close lightning discharges was eliminated.

RPT#: NASA-CR-2443  
75N12943

UTTL: Development of a Fowler flap system for a high performance general aviation airfoil  
AUTH: A/WENTZ, W. H., JR.; B/SEETHARAM, H. C.  
MAJS: /\*FLOW VISUALIZATION/\*GAW-1 AIRFOIL/\*GENERAL AVIATION AIRCRAFT/\*TRAILING-EDGE FLAPS/\*WIND TUNNEL TESTS / AERODYNAMIC COEFFICIENTS/ COMPUTERIZED DESIGN/ PRESSURE DISTRIBUTION/ SUBSONIC SPEED  
ABS: A two-dimensional wind-tunnel evaluation of two Fowler flap configurations on the new GA(W)-1 airfoil was conducted. One configuration used a computer-designed 29-percent chord Fowler flap. The second configuration was modified to have increased Fowler action with a 30-percent chord flap. Force, pressure, and flow-visualization data were obtained at Reynolds numbers of 2.2 million to 2.9 million. Optimum slot geometry and performance were found to be close to computer predictions. A C sub L max of 3.8 was achieved. Optimum flap deflection, slot gap, and flap overlap are presented as functions of C sub L. Tests were made with the lower surface cusp filled in to show the performance penalties that result. Some data on the effects of adding vortex generators and hinged-plate spoilers were obtained.

RPT#: NASA-CR-2523  
75N24677

UTTL: Light aircraft lift, drag, and moment prediction: A review and analysis  
AUTH: A/SMETANA, F. O.; B/SUMMEY, D. C.; C/SMITH, N. S.; D/CARDEN, R. K.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*COMPUTER PROGRAMS/\* LIGHT AIRCRAFT/\*PREDICTION ANALYSIS TECHNIQUES  
MINS: / AERODYNAMIC COEFFICIENTS/ AERODYNAMIC DRAG/ AIRCRAFT CONFIGURATIONS/ FLOW CHARACTERISTICS/ LIFT  
ABS: The historical development of analytical methods for predicting the lift, drag, and pitching moment of complete light aircraft configurations in cruising flight is reviewed. Theoretical methods, based in part on techniques described in the literature and in part on original work, are developed. These methods form the basis for understanding the computer programs given to: (1) compute the lift, drag, and moment of

conventional airfoils, (2) extend these two-dimensional characteristics to three dimensions for moderate-to-high aspect ratio unswept wings, (3) plot complete configurations, (4) convert the fuselage geometric data to the correct input format, (5) compute the fuselage lift and drag, (6) compute the lift and moment of symmetrical airfoils to  $M = 1.0$  by a simplified semi-empirical procedure, and (7) compute, in closed form, the pressure distribution over a prolate spheroid at  $\alpha = 0$ . Comparisons of the predictions with experiment indicate excellent lift and drag agreement for conventional airfoils and wings. Limited comparisons of body-alone drag characteristics yield reasonable agreement. Also included are discussions for interference effects and techniques for summing the results above to obtain predictions for complete configurations.

RPT#: NASA-CR-132720 ASI-TR-75-22-VOL-1  
76N18094

**UTTL:** Flight test and evaluation of Omega navigation in a general aviation aircraft. Volume 1: Technical

**AUTH:** A/HOWELL, J. D.; B/HOFFMAN, W. C.; C/HWOSCHINSKY, P. V.; D/WISCHMEYER, C. E.

**MAJS:** /\*AIR NAVIGATION/\*OMEGA NAVIGATION SYSTEM

**MINS:** / AIRCRAFT MANEUVERS/ ALTITUDE/ DATA PROCESSING/ FLIGHT TESTS/ PIPER AIRCRAFT/ PRECIPITATION (METEOROLOGY)/ SIGNAL TO NOISE RATIOS/ TERRAIN/ VERTICAL TAKEOFF AIRCRAFT

**ABS:** A low cost flight research program was conducted to evaluate the performance of differential Omega navigation in a general aviation aircraft. The flight program consisted of two distinct parts corresponding to the two major objectives of the study. The Wallops Flight Program was conducted to obtain Omega signal and phase data in the Wallops Flight Center vicinity to provide preliminary technical information and experience in preparation for a comprehensive NASA/FAA flight test program of an experimental differential Omega system. The Northeast Corridor Flight Program was conducted to examine Omega operational suitability and performance on low altitude area navigation (RNAV) routes for city-center to city-center VTOL commercial operations in the Boston-New York-Washington corridor. The development, execution and conclusions of the flight research program are described. The results of the study provide both quantitative and qualitative data on the Omega Navigation System under actual operating conditions.

RPT#: NASA-CR-132721 ASI-TR-75-22-VOL-2  
76N18095

**UTTL:** Flight test and evaluation of Omega navigation in a general aviation aircraft. Volume 2: Appendices

**AUTH:** A/HOWELL, J. D.; B/HOFFMAN, W. C.; C/HWOSCHINSKY, P. V.; D/WISCHMEYER, C. E.

**MAJS:** /\*AIR NAVIGATION/\*OMEGA NAVIGATION SYSTEM

**MINS:** / COMPUTER PROGRAMS/ DATA PROCESSING/ FLIGHT PLANS/ FLIGHT TESTS/ GRAPHS (CHARTS)/ PIPER AIRCRAFT/ SIGNAL TO NOISE RATIOS/ VERTICAL TAKEOFF AIRCRAFT

**ABS:** Detailed documentation for each flight of the Omega Flight Evaluation study is presented, including flight test description sheets and actual flight data plots. Computer programs used for data processing and flight planning are explained and the data formats utilized by the Custom Interface Unit are summarized.

RPT#: NASA-CR-134854 NAPTC-PE-61  
76N11099

**UTTL:** Rotor burst protection program: Statistics on aircraft gas turbine engine rotor failures that occurred in US commercial aviation during 1973

**AUTH:** A/DELUCIA, R. A.; B/MANGANO, G. J.

**MAJS:** /\*ACCELERATION PROTECTION/\*CIVIL AVIATION/\*FRAGMENTATION/\*GAS TURBINE ENGINES/\*ROTORS/\*RUPTURING /\*STATISTICAL ANALYSIS

**MINS:** / ENGINE FAILURE/ ROTATING DISKS/ STRUCTURAL FAILURE/ TURBOMACHINE BLADES

**ABS:** Statistical data on gas turbine rotor failures that have occurred in U.S. commercial aviation during 1973 was presented. Analysis of the data led to the following conclusions: (1) the incidence of rotor failure and uncontained burst is significantly high enough to warrant continuation of the efforts of the Rotor Burst Protection Program (RBPP). (2) of all the types of fragments generated, disk fragments, because of their size, high energy content and high rate of uncontainment (100 %), continue to be a major threat to the welfare and safety of commercial aircraft passengers. (3) the number of uncontained blade failures is surprisingly high since rotor blade containment is required for engine certification under FAA regulations. (4) it appears that causes beyond the control or scope of present technology are still primarily responsible for most of the rotor failures that occur.

RPT#: NASA-CR-137671  
76N10089

**UTTL:** Multivariate Analysis, Retrieval, and Storage system (MARS). Volume 1: MARS system and analysis techniques

**AUTH:** A/HAGUE, D. S.; B/VANDERBERG, J. D.; C/WOODBURY, N. W.

**MAJS:** /\*AIRCRAFT DESIGN/\*COMPUTER PROGRAMS/\*DATA BASES/\*DATA STORAGE/\*INFORMATION RETRIEVAL/\*MULTIVARIATE STATISTICAL ANALYSIS/\*PREDICTION ANALYSIS TECHNIQUES

**MINS:** / ENGINE DESIGN/ GENERAL AVIATION AIRCRAFT/ REGRESSION ANALYSIS/ TURBOFAN AIRCRAFT/ WEIGHT ANALYSIS

**ABS:** A method for rapidly examining the probable applicability of weight estimating formulae to a specific aerospace vehicle design is presented. The Multivariate Analysis Retrieval and Storage System (MARS) is comprised of three computer programs which sequentially operate on the weight and geometry characteristics of past aerospace vehicles designs. Weight and geometric characteristics are stored in a set of data bases which are fully computerized. Additional data bases are readily added to the MARS system and/or the existing data bases may be easily

expanded to include additional vehicles or vehicle characteristics.

RPT#: NASA-CR-137859  
76N31215

UTTL: Flight simulation study to determine MLS lateral course width requirements on final approach for general aviation

AUTH: A/CRUMRINE, R. J.

MAJS: /\*FLIGHT SIMULATION/\*GENERAL AVIATION AIRCRAFT/\*  
MICROWAVE LANDING SYSTEMS/\*RUNWAY CONDITIONS

MINS: / AIR TRAFFIC CONTROL/ AIRCRAFT LANDING/ AIRCRAFT  
PILOTS/ INSTRUMENT LANDING SYSTEMS/ TAKEOFF

ABS: An investigation of the effects of various lateral course widths and runway lengths for manual CAT I Microwave Landing System instrument approaches was carried out with instrument rated pilots in a General Aviation simulator. Data are presented on the lateral dispersion at the touchdown zone, and the middle and outer markers, for approaches to 3,000, 8,000 (and trial 12,000 foot) runway lengths with full scale angular lateral course widths of + or - 1.19 deg, + or - 2.35 deg, and + or - 3.63 deg. The distance from touchdown where the localizer deviation went to full scale was also recorded. Pilot acceptance was measured according to the Cooper-Harper rating system.

RPT#: NASA-CR-137861  
76N28233

UTTL: Transcription of the Workshop on General Aviation Advanced Avionics Systems

AUTH: A/TASHKER, M.

MAJS: /\*AVIONICS/\*CONFERENCES/\*GENERAL AVIATION AIRCRAFT

MINS: / DISPLAY DEVICES/ INTEGRATED CIRCUITS/  
MICROPROCESSORS/ MINICOMPUTERS

ABS: Papers are presented dealing with the design of reliable, low cost, advanced avionics systems applicable to general aviation in the 1980's and beyond. Sensors, displays, integrated circuits, microprocessors, and minicomputers are among the topics discussed.

RPT#: NASA-CR-137889  
76N30214

UTTL: Computer technology forecast study for general aviation

AUTH: A/SEACORD, C. L.; B/VAUGHN, D.

MAJS: /\*AERONAUTICAL ENGINEERING/\*AIRFRAMES/\*COMPUTER  
STORAGE DEVICES/\*COMPUTER SYSTEMS DESIGN/\*GENERAL  
AVIATION AIRCRAFT

MINS: / AIRBORNE/SPACEBORNE COMPUTERS/ ENGINE DESIGN/

TECHNOLOGICAL FORECASTING/ TECHNOLOGY ASSESSMENT  
ABS: A multi-year, multi-faceted program is underway to investigate and develop potential improvements in airframes, engines, and avionics for general aviation aircraft. The objective of this study was to assemble information that will allow the government to assess the trends in computer and computer/operator interface technology that may have application to general aviation in the 1980's and beyond. The current state of the art of computer hardware is assessed, technical developments in computer hardware are predicted, and nonaviation large volume users of computer hardware are identified.

RPT#: NASA-CR-137909 ASI-TR-76-35  
76N33179

UTTL: Forecast of the general aviation air traffic control environment for the 1980's

AUTH: A/HOFFMAN, W. C.; B/HOLLISTER, W. M.

MAJS: /\*AIR TRAFFIC CONTROL/\*AIRBORNE SURVEILLANCE RADAR/\*  
AIRCRAFT COMMUNICATION/\*INSTRUMENT LANDING SYSTEMS

MINS: / AERONAUTICAL SATELLITES/ AIRCRAFT DESIGN/ AVIONICS/  
FLIGHT CONTROL/ GENERAL AVIATION AIRCRAFT

ABS: The critical information required for the design of a reliable, low cost, advanced avionics system which would enhance the safety and utility of general aviation is stipulated. Sufficient data is accumulated upon which industry can base the design of a reasonably priced system having the capability required by general aviation in and beyond the 1980's. The key features of the Air Traffic Control (ATC) system are: a discrete address beacon system, a separation assurance system, area navigation, a microwave landing system, upgraded ATC automation, airport surface traffic control, a wake vortex avoidance system, flight service stations, and aeronautical satellites. The critical parameters that are necessary for component design are identified. The four primary functions of ATC (control, surveillance, navigation, and communication) and their impact on the onboard avionics system design are assessed.

RPT#: NASA-CR-145627  
76N10997

UTTL: Proceedings of the NASA, Industry, University, General Aviation Drag Reduction Workshop

AUTH: A/ROSKAM, J.

MAJS: /\*AIRCRAFT CONFIGURATIONS/\*CONFERENCES/\*DRAG REDUCTION  
/\*GENERAL AVIATION AIRCRAFT

MINS: / AERODYNAMIC DRAG/ AIRCRAFT DESIGN/ BODY-WING AND  
TAIL CONFIGURATIONS/ GOVERNMENT/INDUSTRY RELATIONS/  
PREDICTION ANALYSIS TECHNIQUES/ WIND TUNNEL TESTS

RPT#: NASA-CR-145776  
76N11994

UTTL: General aviation and community development  
AUTH: A/SINCOFF, M. Z.; B/DAJANI, J. S.  
MAJS: /\*AIRPORT PLANNING/\*GENERAL AVIATION AIRCRAFT  
MINS: / AIR TRAFFIC CONTROL/ AIR TRANSPORTATION/ AIRCRAFT  
PERFORMANCE/ ENVIRONMENT PROTECTION/ NATIONAL AVIATION  
SYSTEM

RPT#: NASA-CR-145936  
76N17091

UTTL: New potentials for conventional aircraft when powered  
by hydrogen-enriched gasoline  
AUTH: A/MENARD, W. A.; B/MOYNIHAN, P. I.; C/RUPE, J. H.  
MAJS: /\*FUEL INJECTION/\*GAS MIXTURES/\*GENERAL AVIATION  
AIRCRAFT/\*HYDROGEN FUELS  
MINS: / COMBUSTION EFFICIENCY/ EXHAUST GASES/ FUEL  
CONSUMPTION/ FUEL-AIR RATIO  
ABS: Hydrogen enrichment for aircraft piston engines is  
studied. The feasibility is examined of inflight  
injection of hydrogen in general aviation aircraft  
engines to reduce fuel consumption and to lower  
emission levels. Results are summarized.

RPT#: NASA-CR-145979 ESS-4039-103-75 TR-403905  
76N14089

UTTL: General aviation technology assessment  
AUTH: A/JACOBSON, I. D.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*TECHNOLOGY ASSESSMENT  
MINS: / AERODYNAMIC CHARACTERISTICS/ AIRCRAFT PERFORMANCE/  
AIRCRAFT SAFETY/ DATA ACQUISITION/ SURVEYS  
ABS: The existing problem areas in general aviation were  
investigated in order to identify those which can  
benefit from technological payoffs. The emphasis was  
placed on acceptance by the pilot/passenger in areas  
such as performance, safety, handling qualities, ride  
quality, etc. Inputs were obtained from three sectors:  
industry; government; and user, although slanted  
toward the user group. The results should only be  
considered preliminary due to the small sample sizes  
of the data. Trends are evident however and a general  
methodology for allocating effort in future programs  
is proposed.

RPT#: NASA-CR-146324  
76N18115

UTTL: Flight test of a stall sensor and evaluation of its  
application to an aircraft stall deterrent system  
using the NASA LRC general aviation simulator  
AUTH: A/BENNETT, G.  
MAJS: /\*AERODYNAMIC STALLING/\*FLIGHT SIMULATORS/\*FLIGHT

TESTS/\*SENSORS

MINS: / AIRCRAFT CONTROL/ COMPUTERIZED SIMULATION/ FORTRAN  
ABS: A series of flight maneuvers were developed to cover  
the range of flight conditions and to define the  
repeatability and hysteresis of the sensors. Initial  
flights were made with two sensors at the + or - 68  
percent span and 60 percent and 70 percent chord  
stations. The primary effort in simulation program  
development was to modify the LRC General Aviation  
Simulator (GAS) Fortran programs to allow execution on  
the MSU UNIVAC 1106. A simple model of the  
sensor-servo stall deterrent system was developed. A  
one degree of freedom model of pitch dynamics of the  
airplane and stall deterrent system was developed to  
make initial estimates of the control system gains. A  
position error plus rate damping control algorithm was  
found to have acceptable characteristics.

RPT#: NASA-CR-147159  
76N22216

UTTL: Technology and politics: The regional airport  
experience  
AUTH: A/STARLING, J. D.; B/BROWN, J.; C/GERHARDT, J. M.;  
D/DOMINUS, M. I.  
MAJS: /\*AIRPORTS/\*POLITICS/\*REGIONAL PLANNING/\*TECHNOLOGIES  
/\*URBAN DEVELOPMENT  
MINS: / AIRPORT PLANNING/ CIVIL AVIATION/ ECONOMIC  
DEVELOPMENT/ ECONOMIC FACTORS/ LAND MANAGEMENT/ LAND  
USE  
ABS: The findings of a comparative study of the following  
six regional airports were presented: Dallas/Fort  
Worth, Kansas City, Washington, D.C., Montreal, Tampa,  
and St. Louis. Each case was approached as a unique  
historical entity, in order to investigate common  
elements such as: the use of predictive models in  
planning, the role of symbolism to heighten dramatic  
effects, the roles of community and professional  
elites, and design flexibility. Some of the factors  
considered were: site selection, consolidation of  
airline service, accessibility, land availability and  
cost, safety, nuisance, and pollution constraints,  
economic growth, expectation of regional growth, the  
demand forecasting conundrum, and design decisions.  
The hypotheses developed include the following: the  
effect of political, social, and economic conflicts,  
the stress on large capacity and dramatic,  
high-technology design, projections of rapid growth to  
explain the need for large capital outlays.

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RPT#: NASA-CR-147979  
76N32177

UTTL: Development of criteria for the design of a low noise level general aviation propeller

AUTH: A/ORMSBEE, A. I.

MAJS: /\*DESIGN ANALYSIS/\*GENERAL AVIATION AIRCRAFT/\*NOISE (SOUND)/\*PROPELLERS

MINS: / AIRCRAFT NOISE/ AIRCRAFT PERFORMANCE/ NOISE REDUCTION

ABS: The theoretical and experimental investigation of general aviation propellers is considered. The objective is to improve noise generation characteristics without loss of performance.

RPT#: NASA-CR-147985 ESS-4035-105-76  
76N24282

UTTL: Development and application of an atmospheric turbulence model for use in flight simulators in flight simulators

AUTH: A/JACOBSON, I. D.; B/JOSHI, D. S.

MAJS: /\*ATMOSPHERIC TURBULENCE/\*FLIGHT SIMULATORS

MINS: / AIRCRAFT CONTROL/ ATMOSPHERIC MODELS

ABS: The influence of simulated turbulence on aircraft handling qualities was investigated. Pilot opinion of the handling qualities of a light general aviation aircraft were evaluated in a motion-base simulator using a simulated turbulence environment. A realistic representation of turbulence disturbances is described in terms of rms intensity and scale length and their random variations with time. The time histories generated by the proposed turbulence models showed characteristics which appear to be more similar to real turbulence than the frequently-used Gaussian turbulence model. In addition, the proposed turbulence models can flexibly accommodate changes in atmospheric conditions and be easily implemented in flight simulator studies. Six turbulence time histories, including the conventional Gaussian model, were used in an IFR-tracking task. The realism of each of the turbulence models and the handling qualities of the simulated airplane were evaluated. Analysis of pilot opinions shows that at approximately the same rms intensities of turbulence, the handling quality ratings transit from the satisfactory level, for the simple Gaussian model, to an unacceptable level for more realistic and compositely structured turbulence models.

RPT#: NASA-CR-148147 TM-28  
76N26176

UTTL: Small-aircraft flight evaluation of Rustrak chart recorder

AUTH: A/SALTER, R. J., JR.; B/LILLEY, R. W.

MAJS: /\*LIGHT AIRCRAFT/\*RECORDING INSTRUMENTS/\*VIBRATION EFFECTS

MINS: / AIRCRAFT ENGINES/ AIRCRAFT MANEUVERS/ FLIGHT TESTS/ INSTRUMENT ERRORS/ OMEGA NAVIGATION SYSTEM/ VIBRATION DAMPING/ WIND (METEOROLOGY)

ABS: It was found that the RUSTRAK recorder was only slightly hampered by aircraft vibration while in level cruising flight or while taxiing, regardless of light turbulence or particular mounting configuration. No one mounting configuration was better than the other. There is some (approximately 1/4 inch) vibration error during climbs, descents, and touchdowns in choppy weather. However, it was found that improved performance resulted from setting the recorder on carpet rather than the metal floor plate. This suggests that padding the recorder with some cushioning, shock-damping material might reduce the engine vibration and wind chop effects.

RPT#: NASA-CR-148148 REPT-75-163-1  
76N23249

UTTL: An assessment of the benefits of the use of NASA developed fuel conservative technology in the US commercial aircraft fleet

MAJS: /\*CIVIL AVIATION/\*ENERGY POLICY/\*FUEL CONSUMPTION/\* NASA PROGRAMS

MINS: / BOUNDARY LAYER CONTROL/ COMMERCIAL AIRCRAFT/ COMPOSITE MATERIALS/ COST REDUCTION/ ENGINE PARTS/ FUEL CONTROL/ LAMINAR BOUNDARY LAYER/ TECHNOLOGY ASSESSMENT/ TURBOPROP AIRCRAFT

ABS: Cost and benefits of a fuel conservative aircraft technology program proposed by NASA are estimated. NASA defined six separate technology elements for the proposed program: (a) engine component improvement (b) composite structures (c) turboprops (d) laminar flow control (e) fuel conservative engine and (f) fuel conservative transport. There were two levels postulated: The baseline program was estimated to cost \$490 million over 10 years with peak funding in 1980. The level two program was estimated to cost an additional \$180 million also over 10 years. Discussions with NASA and with representatives of the major commercial airframe manufacturers were held to estimate the combinations of the technology elements most likely to be implemented, the potential fuel savings from each combination, and reasonable dates for incorporation of these new aircraft into the fleet.

RPT#: NASA-CR-148287  
76N26221

UTTL: Development of capabilities for stall/spin research  
AUTH: A/CRAIG, A.  
MAJS: /\*AERODYNAMIC STALLING/\*GENERAL AVIATION AIRCRAFT/\*  
RESEARCH MANAGEMENT  
MINS: / AERODYNAMIC BALANCE/ LOW SPEED WIND TUNNELS/ ROTARY  
STABILITY/ STATIC AERODYNAMIC CHARACTERISTICS/ WIND  
TUNNEL TESTS  
ABS: Apparatus and techniques were developed for measuring  
in a low-speed wind tunnel the static and dynamic  
(rotary balance) aerodynamic data pertinent to spin  
behavior of a general aviation aircraft. The main  
results were: (1) collection of static force and  
moment data for several airplane configurations at  
angles of attack from 0 to 90 degrees and angles of  
sideslip from 0 to 40 degrees; and (2) difficulties,  
shortcomings, and unsuitability of some aspects of the  
rotary balance mount as constructed were discovered  
and identified for avoidance in a new design for a  
mount.

RPT#: NASA-CR-2605 RE-90  
76N10002

UTTL: A passive gust alleviation system for a light aircraft  
AUTH: A/ROESCH, P.; B/HARLAN, R. B.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT CONTROL/\*  
GENERAL AVIATION AIRCRAFT/\*GUST ALLEVIATORS  
MINS: / AIRCRAFT DESIGN/ AIRCRAFT STABILITY/ ATMOSPHERIC  
TURBULENCE  
ABS: A passive aeromechanical gust alleviation system was  
examined for application to a Cessna 172. The system  
employs small auxiliary wings to sense changes in  
angle of attack and to drive the wing flaps to  
compensate the resulting incremental lift. The flaps  
also can be spring loaded to neutralize the effects of  
variations in dynamic pressure. Conditions for gust  
alleviation are developed and shown to introduce  
marginal stability if both vertical and horizontal  
gusts are compensated. Satisfactory behavior is  
realized if only vertical gusts are absorbed; however,  
elevator control is effectively negated by the system.  
Techniques to couple the elevator and flaps are  
demonstrated to restore full controllability without  
sacrifice of gust alleviation.

RPT#: NASA-CR-2625 REPT-126  
76N12077

UTTL: An in-flight simulation of lateral control  
nonlinearities  
AUTH: A/ELLIS, D. R.; B/TILAK, N. W.  
MAJS: /\*FLIGHT SIMULATORS/\*GENERAL AVIATION AIRCRAFT/\*

LATERAL CONTROL/\*SPOILERS

MINS: / NONLINEARITY/ SYSTEM EFFECTIVENESS  
ABS: An in-flight simulation program was conducted to  
explore, in a generalized way, the influence of  
spoiler-type roll-control nonlinearities on handling  
qualities. The roll responses studied typically  
featured a dead zone or very small effectiveness for  
small control inputs, a very high effectiveness for  
mid-range deflections, and low effectiveness again for  
large inputs. A linear force gradient with no  
detectable breakout force was provided. Given  
otherwise good handling characteristics, it was found  
that moderate nonlinearities of the types tested might  
yield acceptable roll control, but the best level of  
handling qualities is obtained with linear,  
aileron-like control.

RPT#: NASA-CR-2739 CG-D-1-76  
76N33472

UTTL: Development and field testing of a Light Aircraft Oil  
Surveillance System (LAOSS)  
AUTH: A/BURNS, W.; B/HERZ, M. J.  
MAJS: /\*AIRBORNE EQUIPMENT/\*FLIGHT TESTS/\*LIGHT AIRCRAFT/\*  
OIL SLICKS/\*RESEARCH AND DEVELOPMENT/\*SURVEILLANCE  
MINS: / OIL POLLUTION/ POLARIZED LIGHT/ REMOTE SENSORS/  
TELEVISION CAMERAS  
ABS: An experimental device consisting of a conventional TV  
camera with a low light level photo image tube and  
motor driven polarized filter arrangement was  
constructed to provide a remote means of  
discriminating the presence of oil on water surfaces.  
This polarized light filtering system permitted a  
series of successive, rapid changes between the  
vertical and horizontal components of reflected  
polarized skylight and caused the oil based substances  
to be more easily observed and identified as a  
flashing image against a relatively static water  
surface background. This instrument was flight tested,  
and the results, with targets of opportunity and more  
systematic test site data, indicate the potential  
usefulness of this airborne remote sensing instrument.

RPT#: NASA-CR-137679  
77N24133

UTTL: Civil mini-RPA's for the 1980's: Avionics design considerations  
AUTH: A/KARMARKAR, J. S.  
MAJS: /\*AVIONICS/ CIVIL AVIATION/ REMOTELY PILOTED VEHICLES  
/\*TECHNOLOGY UTILIZATION  
MINS: / AERIAL RECONNAISSANCE/ COST EFFECTIVENESS/ FIRE  
FIGHTING/ MICROPROGRAMMING/ REMOTE SENSORS  
ABS: A number of remote sensing or surveillance tasks (e.g., fire fighting, crop monitoring) in the civilian sector of our society may be performed in a cost effective manner by use of small remotely piloted aircraft (RPA). This study was conducted to determine equipment (and the associated technology) that is available, and that could be applied to the mini-RPA and to examine the potential applications of the mini-RPA with special emphasis on the wild fire surveillance mission. The operational considerations of using the mini-RPA as affected by government regulatory agencies were investigated. These led to equipment requirements (e.g., infra-red sensors) over and above those for the performance of the mission. A computer technology survey and forecast was performed. Key subsystems were identified, and a distributed microcomputer configuration, that was functionally modular, was recommended. Areas for further NASA research and development activity were also identified.

RPT#: NASA-CR-137894 LMSC-D057323  
77N10047

UTTL: Civil uses of remotely piloted aircraft  
AUTH: A/ADERHOLD, J. R.; B/GORDON, G.; C/SCOTT, G. W.  
MAJS: /\*CIVIL AVIATION/COST EFFECTIVENESS/MISSION PLANNING  
/\*REMOTELY PILOTED VEHICLES/TECHNOLOGY ASSESSMENT  
MINS: / AIRCRAFT SAFETY/ AIRLINE OPERATIONS/ TECHNOLOGICAL  
FORECASTING  
ABS: The technology effort is identified and assessed that is required to bring the civil uses of RPVs to fruition and to determine whether or not the potential market is real and economically practical, the technologies are within reach, the operational problems are manageable, and the benefits are worth the cost. To do so, the economic, technical, and environmental implications are examined. The time frame is 1980-85. Representative uses are selected; detailed functional and performance requirements are derived for RPV systems; and conceptual system designs are devised. Total system cost comparisons are made with non-RPV alternatives. The potential market demand for RPV systems is estimated. Environmental and safety

requirements are examined, and legal and regulatory concerns are identified. A potential demand for 2,000-11,000 RPV systems is estimated. Typical cost savings of 25-35% compared to non-RPV alternatives are determined. There appear to be no environmental problems, and the safety issue appears manageable.

RPT#: NASA-CR-137895 LMSC-D057322  
77N10048

UTTL: Civil uses of remotely piloted aircraft  
AUTH: A/ADERHOLD, J. R.; B/GORDON, G.; C/SCOTT, G. W.  
MAJS: /\*CIVIL AVIATION/ECONOMIC ANALYSIS/REMOTELY PILOTED  
VEHICLES/TECHNOLOGY ASSESSMENT  
MINS: / ENVIRONMENTAL ENGINEERING/ HUMAN FACTORS ENGINEERING  
/ PILOTLESS AIRCRAFT  
ABS: The economic, technical, and environmental implications of remotely piloted vehicles (RPV) are examined. The time frame is 1980-85. Representative uses are selected; detailed functional and performance requirements are derived for RPV systems; and conceptual system designs are devised. Total system cost comparisons are made with non-RPV alternatives. The potential market demand for RPV systems is estimated. Environmental and safety requirements are examined, and legal and regulatory concerns are identified. A potential demand for 2,000-11,000 RPV systems is estimated. Typical cost savings of 25 to 35% compared to non-RPV alternatives are determined. There appear to be no environmental problems, and the safety issue appears manageable.

RPT#: NASA-CR-137944 AIRESEARCH-76-211893  
77N11054

UTTL: Study of small turbofan engines applicable to single-engine light airplanes  
AUTH: A/MERRILL, G. L.  
MAJS: /\*LIGHT AIRCRAFT/TURBOFAN ENGINES  
MINS: / COST ANALYSIS/ FUEL CONSUMPTION/ GENERAL AVIATION  
AIRCRAFT/ NOISE REDUCTION  
ABS: The design, efficiency and cost factors are investigated for application of turbofan propulsion engines to single engine, general aviation light airplanes. A companion study of a hypothetical engine family of a thrust range suitable to such aircraft and having a high degree of commonality of design features and parts is presented. Future turbofan powered light airplanes can have a lower fuel consumption, lower weight, reduced airframe maintenance requirements and improved engine overhaul periods as compared to current piston engine powered airplanes. Achievement of compliance with noise and chemical emission regulations is expected without impairing performance.

operating cost or safety.

RPT#: NASA-CR-137950  
77N17033

UTTL: Study of industry information requirements for flight control and navigation systems of STOL aircraft  
AUTH: A/GORHAM, J. A.  
MAJS: /\*AIR NAVIGATION/\*AIRCRAFT INDUSTRY/\*AVIONICS/\*FLIGHT CONTROL/\*OPERATIONS RESEARCH/\*SHORT TAKEOFF AIRCRAFT  
MINS: / CIVIL AVIATION/ DATA ACQUISITION/ GUIDANCE (MOTION)/ USER REQUIREMENTS  
ABS: Answers to specific study questions are used to ascertain the data requirements associated with a guidance, navigation and control system for a future civil STOL airplane. Results of the study were used to recommend changes for improving the outputs of the STOLAND flight experiments program.

RPT#: NASA-CR-145059 REPT-43U-1228  
77N13038

UTTL: Preliminary study of NAVSTAR/GPS for general aviation  
AUTH: A/ALBERTS, R. D.; B/RUEDGER, W. H.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*NAVSTAR SATELLITES/\* POSITIONING/\*SATELLITE NAVIGATION SYSTEMS  
MINS: / ECONOMIC ANALYSIS/ FUNCTIONAL ANALYSIS/ TECHNOLOGY TRANSFER  
ABS: The activities conducted as a planning effort to focus attention on the applicability of the global positioning system for general aviation are described. The description of GPS, its impact on economic and functional aspects of general aviation avionics, as well as a declaration of potential extensions of the basic concept have been studied in detail.

RPT#: NASA-CR-145090  
77N13043

UTTL: Improvements in aircraft extraction programs  
AUTH: A/BALAKRISHNAN, A. V.; B/MAINE, R. E.  
MAJS: /\*CESSNA 172 AIRCRAFT/\*COMPUTER PROGRAMS/\*EXTRACTION/\* F-8 AIRCRAFT  
MINS: / CONVERGENCE/ ESTIMATING/ GRAPHS (CHARTS)/ LINEAR EQUATIONS/ RLC CIRCUITS  
ABS: Flight data from an F-8 Corsair and a Cessna 172 was analyzed to demonstrate specific improvements in the LRC parameter extraction computer program. The Cramer-Rao bounds were shown to provide a satisfactory relative measure of goodness of parameter estimates. It was not used as an absolute measure due to an inherent uncertainty within a multiplicative factor, traced in turn to the uncertainty in the noise bandwidth in the statistical theory of parameter

estimation. The measure was also derived on an entirely nonstatistical basis, yielding thereby also an interpretation of the significance of off-diagonal terms in the dispersion matrix. The distinction between coefficients as linear and non-linear was shown to be important in its implication to a recommended order of parameter iteration. Techniques of improving convergence generally, were developed, and tested out on flight data. In particular, an easily implemented modification incorporating a gradient search was shown to improve initial estimates and thus remove a common cause for lack of convergence.

RPT#: NASA-CR-149247  
77N13044

UTTL: Research on the exploitation of advanced composite materials to lightly loaded structures  
AUTH: A/MAR, J. W.  
MAJS: /\*COMPOSITE MATERIALS/\*GLIDERS/\*LIGHT AIRCRAFT  
MINS: / COMPRESSIVE STRENGTH/ EPOXY RESINS/ GRAPHITE/ STABILIZERS (FLUID DYNAMICS)/ TENSILE STRENGTH  
ABS: The objective was to create a sailplane which could fly in weaker thermals than present day sailplanes (by being lighter) and to fly in stronger thermals than present sailplanes (by carrying more water ballast). The research was to tackle the interaction of advanced composites and the aerodynamic performance, the interaction of fabrication procedures and the advanced composites, and the interaction of advanced composites and the design process. Many pieces of the overall system were investigated but none were carried to the resolution required for engineering application. Nonetheless, interesting and useful results were obtained and are here reported.

RPT#: NASA-CR-151973 AD-200  
77N23096

UTTL: Conceptual design of a single turbofan engine powered light aircraft  
AUTH: A/NEWMAN, M.; B/HUGGINS, G. L.  
MAJS: /\*EXPERIMENTAL DESIGN/\*GENERAL AVIATION AIRCRAFT/\* LIGHT AIRCRAFT/\*TURBOFAN ENGINES  
MINS: / CESSNA AIRCRAFT/ ENGINE DESIGN/ PRODUCT DEVELOPMENT/ SIZING (SHAPING)  
ABS: The NASA developed General Aviation Synthesis Program (GASP) was evaluated as to its usefulness as a design tool. This evaluation was accomplished by: conducting a conceptual study of a Cessna designed turbofan aircraft using Cessna's sizing routines and the GASP, and comparing the GASP methodology to the design procedures now in use by Cessna. This evaluation

concluded that the GASP needs extensive modifications to fulfill its purpose; but once these are made the program could be a useful new tool for general aviation.

RPT#: NASA-CR-152621 UVA/528066/ESS77/106  
77N20115

UTTL: Effects of simulated turbulence on aircraft handling qualities  
AUTH: A/JACOBSON, I. D.; B/JOSHI, D. S.  
MAJS: /\*AIRCRAFT MANEUVERS/\*ALTITUDE SIMULATION/\*FLIGHT SIMULATION/\*TURBULENCE EFFECTS  
MINS: / AERODYNAMIC STABILITY/ FLIGHT CHARACTERISTICS/ LIGHT AIRCRAFT/ NORMAL DENSITY FUNCTIONS  
ABS: The influence of simulated turbulence on aircraft handling qualities is presented. Pilot opinions of the handling qualities of a light general aviation aircraft were evaluated in a motion-base simulator using a simulated turbulence environment. A realistic representation of turbulence disturbances is described in terms of rms intensity and scale length and their random variations with time. The time histories generated by the proposed turbulence models showed characteristics which are more similar to real turbulence than the frequently-used Gaussian turbulence model. The proposed turbulence models flexibly accommodate changes in atmospheric conditions and are easily implemented in flight simulator studies.

RPT#: NASA-CR-153268 KU-FRL-317-2  
77N27871

UTTL: A research program to reduce interior noise in general aviation airplanes  
AUTH: A/PESCHIER, T. D.; B/ANDREWS, D.; C/HENDERSON, T.  
MAJS: /\*AIRCRAFT NOISE/\*AVIONICS/\*GENERAL AVIATION AIRCRAFT /\*NOISE REDUCTION  
MINS: / INSULATION/ NOISE SPECTRA/ SUPERHIGH FREQUENCIES  
ABS: The relevance of KU-FRL test results in predicting (theoretically or semi-empirically) interior noise levels in general aviation aircraft was studied. As a result of this study, it was decided to make a few additions to the program. These additions are: (1) to use three (instead of two) noise sources in the plane wave tube to evaluate the influence of excitation spectrum on panel response, (2) to use theoretical and experimental data obtained in the course of the project to develop more efficient noise reduction materials (or procedures to apply these), or to develop guidelines for the design of such materials for procedures, and (3) to use nonstructural materials in the collection of specimens to be tested in the

KU-FRL plane wave tube.

RPT#: NASA-CR-153291 REPT-770441  
77N26122

UTTL: Flight test data for light aircraft spoiler roll control systems  
AUTH: A/KOHLMAN, D. L.  
MAJS: /\*FLIGHT TESTS/\*LATERAL CONTROL/\*LIGHT AIRCRAFT/\* SPOILERS  
MINS: / FLAPS (CONTROL SURFACES)/ ROLLING MOMENTS/ WIND TUNNEL TESTS/ YAW  
ABS: The results of flight tests to determine the characteristics of spoiler roll control systems on three different light aircraft are summarized. Comparisons are made with wind tunnel data where available. Flight tests indicate that excellent roll characteristics can be achieved with spoilers. Yaw coupling with roll control inputs is virtually eliminated. Roll rates remain high when flaps are deployed at low speed. Very mild nonlinearities in control effectiveness exist, and there was no deadband or lag detected.

RPT#: NASA-CR-153914 UILU-ENG-77-0511 AAE-77-11  
77N27074

UTTL: Low speed airfoil study  
AUTH: A/ORMSBEE, A. I.  
MAJS: /\*AIRFOILS/\*LOW SPEED  
MINS: / BOUNDARY LAYER SEPARATION/ DESIGN ANALYSIS/ GENERAL AVIATION AIRCRAFT/ LIFT AUGMENTATION/ TURBULENT BOUNDARY LAYER  
ABS: Airfoil geometries were developed for low speed high lift applications, such as general aviation aircraft, propellers and helicopter rotors. The primary effort was to determine the extent to which the application of turbulent boundary layer separation criteria, plus manipulation of other input parameters, specifically trailing edging velocity ratio, could be utilized to achieve high C sub Lmax airfoils with relatively low drag at C sub Lmax. Both single-element and double-element airfoils were considered. Wind tunnel testing of some airfoils was included.

RPT#: NASA-CR-153985 TM-52  
77N30101

UTTL: Interactive LORAN-C to geographic and geographic-to-LORAN-C computation  
AUTH: A/PIECUCH, L. M.; B/LILLEY, R. W.  
MAJS: /\*COMPUTER PROGRAMS/\*LORAN C/\*NAVIGATION AIDS  
MINS: / AIR NAVIGATION/ DATA CONVERSION ROUTINES/ FILE MAINTENANCE (COMPUTERS)/ GENERAL AVIATION AIRCRAFT/

USER REQUIREMENTS

**ABS:** The LORAN program is stored in CMS disk files for use by Avionics Engineering Center terminal users. A CMS EXEC file named LORAN controls program operation. The user types LORAN and the program then prompts for data input and produces output on the terminal. The FORTRAN program refers to a disk file of LORAN master data giving station locations, coding delays, repetition rate and station pair identification letters. For Geographic-to-LORAN conversion, no iterative computations are required; the program is a straightforward coordinate conversion based upon the techniques described by the Navy. For LORAN-to-Geographic conversion, the original Navy program required a dead-reckoned position, near the actual unknown fix, to begin computations. No iteration was performed to obtain the LORAN fix, but internal program errors occurred at execution time if the dead-reckoned fix were displaced from the actual fix by more than a few minutes of latitude or longitude. In order to enhance usefulness of the program for the terminal user, an iterative routine was added which allows a single dead-reckoned position to be entered from the master data file for each LORAN chain. The results compare exactly with the LORAN-C navigation chart, and provide adequate benchmark data for general aviation flight planning and data analysis.

RPT#: NASA-CR-154619  
77N27021

**UTTL:** Analysis of flight equipment purchasing practices of representative air carriers  
**MAJS:** /\*AIRCRAFT EQUIPMENT/\*AIRLINE OPERATIONS/\*CIVIL AVIATION/\*INVESTMENTS/\*PROCUREMENT POLICY/\*REPLACING  
**MINS:** / DECISION MAKING/ INVENTORY MANAGEMENT/ MANAGEMENT METHODS/ PASSENGER AIRCRAFT/ SERVICE LIFE  
**ABS:** The process through which representative air carriers decide whether or not to purchase flight equipment was investigated as well as their practices and policies in retiring surplus aircraft. An analysis of the flight equipment investment decision process in ten airlines shows that for the airline industry as a whole, the flight equipment investment decision is in a state of transition from a wholly informal process in earliest years to a much more organized and structured process in the future. Individual air carriers are in different stages with respect to the formality and sophistication associated with the flight equipment investment decision.

RPT#: NASA-CR-154620  
77N28101

**UTTL:** Evaluation of NASA-sponsored research on capital investment decision making in the civil aviation industry  
**AUTH:** A/DONOVAN, D. J.  
**MAJS:** /\*CIVIL AVIATION/\*DECISION MAKING/\*INVESTMENTS/\*NASA PROGRAMS/\*OPERATIONS RESEARCH  
**MINS:** / AIRCRAFT INDUSTRY/ AIRLINE OPERATIONS/ ECONOMIC FACTORS/ MANAGEMENT METHODS/ PROCUREMENT POLICY  
**ABS:** Significant findings of three studies undertaken to provide the NASA Aircraft Energy Efficiency (ACEE) Office with information regarding how aircraft manufacturers and commercial airlines make investment decisions concerning the acquisition of new and derivative technology are analyzed and their general implications explored. Topics discussed include: the market for airline aircraft, factors affecting the corporate decision making process of air transport manufacturers, and flight equipment purchasing practices of representative air carriers.

RPT#: NASA-CR-155002 AAE-77-12-PT-1  
UILU-ENG-77-0512-PT-1  
77N31156

**UTTL:** Propeller study. Part 1: Introduction and overview  
**AUTH:** A/ORMSBEE, A. I.  
**MAJS:** /\*AERONAUTICAL ENGINEERING/\*DESIGN ANALYSIS/\*DYNAMIC TESTS/\*PROPELLER EFFICIENCY/\*PROPELLERS/\*STRUCTURAL DESIGN CRITERIA  
**MINS:** / ACOUSTIC PROPERTIES/ AERODYNAMIC CONFIGURATIONS/ GENERAL AVIATION AIRCRAFT/ PROPELLER BLADES/ SHAFTS (MACHINE ELEMENTS)  
**ABS:** A general aerodynamic-acoustic theory was developed for determining the acoustical design of propellers used on general aviation aircraft. Data from the theoretical investigation were applied in the design of a propeller whose thrust and torque were measured during a series of YO-3A aircraft flight tests.

RPT#: NASA-CR-155152 KU-FRL-317-3  
77N33957

**UTTL:** A research program to reduce interior noise in general aviation airplanes. Design of an acoustic panel test facility  
**AUTH:** A/ROSKAM, J.; B/MUIRHEAD, V. U.; C/SMITH, H. W.; D/HENDERSON, T. D.  
**MAJS:** /\*ACOUSTIC ATTENUATION/\*GENERAL AVIATION AIRCRAFT/\* NOISE REDUCTION/\*PANELS/\*STRUCTURAL DESIGN/\*TEST FACILITIES  
**MINS:** / AIRCRAFT NOISE/ DATA PROCESSING/ NOISE MEASUREMENT/ PLANE WAVES/ PREDICTION ANALYSIS TECHNIQUES

**ABS:** The design, construction, and costs of a test facility for determining the sound transmission loss characteristics of various panels and panel treatments are described. The pressurization system and electronic equipment used in experimental testing are discussed as well as the reliability of the facility and the data gathered. Tests results are compared to pertinent acoustical theories for panel behavior and minor anomalies in the data are examined. A method for predicting panel behavior in the stiffness region is also presented.

RPT#: NASA-CR-155153 KU-FRL-317-4  
77N33958

**UTTL:** A research to reduce interior noise in general aviation airplanes. General aviation interior noise study

**AUTH:** A/ROSKAM, J.; B/MUIRHEAD, V. U.; C/SMITH, H. W.; D/PESCHIER, T. D.

**MAJS:** /\*ACOUSTIC ATTENUATION/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*PANELS/\*PRESSURIZED CABINS

**MINS:** / ACOUSTIC PROPERTIES/ AIRCRAFT NOISE/ DIFFERENTIAL PRESSURE/ SOUND GENERATORS/ STIFFNESS

**ABS:** The construction, calibration, and properties of a facility for measuring sound transmission through aircraft type panels are described along with the theoretical and empirical methods used. Topics discussed include typical noise source, sound transmission path, and acoustic cabin properties and their effect on interior noise. Experimental results show an average sound transmission loss in the mass controlled frequency region comparable to theoretical predictions. The results also verify that transmission losses in the stiffness controlled region directly depend on the fundamental frequency of the panel. Experimental and theoretical results indicate that increases in this frequency, and consequently in transmission loss, can be achieved by applying pressure differentials across the specimen.

RPT#: NASA-CR-155154 KU-FRL-317-5  
77N33959

**UTTL:** A research program to reduce interior noise in general aviation airplanes

**AUTH:** A/ROSKAM, J.; B/MUIRHEAD, V. U.; C/SMITH, H. W.; D/PESCHIER, T. D.; E/DURENBERGER, D.; F/VANDAM, K.; G/SHU, T. C.

**MAJS:** /\*ACOUSTIC ATTENUATION/\*AIRCRAFT COMPARTMENTS/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*PANELS

**MINS:** / DAMPING/ FLAT PLATES/ GRAPHS (CHARTS)/ MASS DISTRIBUTION/ PRESSURE EFFECTS/ PRESSURIZED CABINS/ STIFFNESS

**ABS:** Analytical and semi-empirical methods for determining the transmission of sound through isolated panels and predicting panel transmission loss are described. Test results presented include the influence of plate stiffness and mass and the effects of pressurization and vibration damping materials on sound transmission characteristics. Measured and predicted results are presented in tables and graphs.

RPT#: NASA-CR-2699 D6-75775  
77N10033

**UTTL:** An exploratory study to determine the integrated technological air transportation system ground requirements of liquid-hydrogen-fueled subsonic, long-haul civil air transports

**MAJS:** /\*AIRLINE OPERATIONS/\*CRYOGENIC FLUID STORAGE/\*HYDROGEN FUELS/\*JET ENGINE FUELS/\*LIQUID HYDROGEN

**MINS:** / AIRPORTS/ CIVIL AVIATION/ COST ANALYSIS/ TECHNOLOGY ASSESSMENT

**ABS:** A baseline air terminal concept was developed which permitted airlines and the airport to operate JP- or LH2-fueled aircraft at common terminal gates. The concept included installation of a hydrogen liquefaction and storage facility on airport property, as well as the fuel distribution system. The capital investment and hydrogen-related operating costs to the airlines were estimated.

RPT#: NASA-CR-2773 UTEC-ME-75-159  
77N14615

**UTTL:** The subjective evaluation of noise from light aircraft

**AUTH:** A/SHEPHERD, K. P.

**MAJS:** /\*AIRCRAFT NOISE/\*LIGHT AIRCRAFT/\*NOISE MEASUREMENT/\*PSYCHOACOUSTICS

**MINS:** / HUMAN BEINGS/ NOISE TOLERANCE/ TIME MEASUREMENT

**ABS:** A study was conducted in which subjects evaluated the sounds of a light aircraft and a motorcycle. Particular emphasis was placed on examining the duration of the sounds. Thirty subjects gave annoyance ratings to a total of 50 sounds, with peak levels between 65 and 85dB(A). It was found that aircraft and motorcycles have differing optimum duration corrections. The conventional duration correction used in the calculation of EPNL is far from being the optimum for light aircraft.

RPT#: NASA-CR-2774  
77N20027

UTTL: Prediction of light aircraft horizontal tail onset flows: A review and analysis

AUTH: A/SUMMEY, D. C.; B/SMETANA, F. O.

MAJS: /\*AIRCRAFT WAKES/\*FLOW VELOCITY/\*HORIZONTAL TAIL SURFACES/\*LIGHT AIRCRAFT

MINS: / COMPUTER PROGRAMS/ DOWNWASH/ TRAILING-EDGE FLAPS/ VELOCITY DISTRIBUTION

ABS: The theoretical basis of the two computer programs (WASH and WAKE) are developed. WASH calculates the location of wake-sheet streamlines behind the wing, and upwash and downwash angles ahead of and behind the wing, respectively. WAKE computes two-dimensional velocity profiles along the wake streamlines given the upper and lower surface velocity profiles at the wing trailing edge. Comparisons with experiment indicate good agreement for wake location, downwash angles, and two-dimensional velocity profiles at low to moderate angles of attack. The adaptation of the results of the two programs to predict the total onset flow at the tail is discussed.

RPT#: NASA-CR-2832  
77N33104

UTTL: Flight evaluation of an advanced technology light twin-engine airplane (ATLIT)

AUTH: A/HOLMES, B. J.

MAJS: /\*AIRCRAFT PERFORMANCE/\*AIRFOILS/\*ATLIT PROJECT/\* FLIGHT TESTS

MINS: / LIFT DRAG RATIO/ PERFORMANCE PREDICTION/ PERFORMANCE TESTS/ SEPARATED FLOW

ABS: Project organization and execution, airplane description and performance predictions, and the results of the flight evaluation of an advanced technology light twin engine airplane (ATLIT) are presented. The ATLIT is a Piper PA-34-200 Seneca I modified by the installation of new wings incorporating the GA(W)-1 (Whitcomb) airfoil, reduced wing area, roll control spoilers, and full span Fowler flaps. The conclusions for the ATLIT evaluation are based on complete stall and roll flight test results and partial performance test results. The Stalling and rolling characteristics met design expectations. Climb performance was penalized by extensive flow separation in the region of the wing body juncture. Cruise performance was found to be penalized by a large value of zero lift drag. Calculations showed that, with proper attention to construction details, the improvements in span efficiency and zero lift drag would permit the realization of the predicted increases in cruising and maximum rate of climb performance.

RPT#: E78-10184 NASA-CR-157374 INPE-1289-NTE/124  
78N31483

UTTL: INPE's crop survey program using combined LANDSAT and aircraft data  
AUTH: A/DEJESUSPARADA, N.; B/BATISTA, G. T.; C/TARDIN, A. T.; D/NOVAES, R. A.; E/MENDONCA, F. J.; F/LEE, D. C. L.; G/CHEN, S. C.  
MAJS: /\*BRAZIL/\*CROP IDENTIFICATION/\*CROP INVENTORIES/\*GRASSLANDS/\*SOILS/\*SUGAR CANE/\*VEGETATION  
MINS: / ALGORITHMS/ EARTH RESOURCES PROGRAM/ PHOTOINTERPRETATION  
ABS: There are no author-identified significant results in this report.

RPT#: NASA-CR-132333 REPT-2558  
78N13851

UTTL: Investigation of acoustic properties of a rigid foam with application to noise reduction in light aircraft  
AUTH: A/HOLMER, C. I.  
MAJS: /\*ACOUSTIC PROPERTIES/\*ENGINE NOISE/\*LIGHT AIRCRAFT/\*MATHEMATICAL MODELS/\*NOISE REDUCTION/\*POLYURETHANE FOAM  
MINS: / ABSORPTIVITY/ AIRCRAFT COMPARTMENTS/ RIGID STRUCTURES/ SOUND TRANSMISSION  
ABS: A analytic model of sound transmission into an aircraft cabin was developed as well as test procedures which appropriately rank order properties which affect sound transmission. The proposed model agrees well with available data, and reveals that the pertinent properties of an aircraft cabin for sound transmission include: stiffness of cabin walls at low frequencies (as this reflects on impedance of the walls) and cabin wall transmission loss and interior absorption at mid and high frequencies. Below 315 Hz the foam contributes substantially to wall stiffness and sound transmission loss of typical light aircraft cabin construction, and could potentially reduce cabin noise levels by 3-5 db in this frequency range at a cost of about 0.2 lb/sq. ft. of treated cabin area. The foam was found not to have significant sound absorbing properties.

RPT#: NASA-CR-135265 AIRESEARCH-21-2391 RADC-TR-77-216  
78N12083

UTTL: Cost/benefit analysis of advanced material technologies for small aircraft turbine engines  
AUTH: A/COMNEY, D. H.  
MAJS: /\*AIRCRAFT ENGINES/\*COST EFFECTIVENESS/\*ENGINE PARTS/\*FABRICATION/\*LIGHT AIRCRAFT/\*TECHNOLOGY ASSESSMENT/\*TURBINE ENGINES  
MINS: / GENERAL AVIATION AIRCRAFT/ LAMINATES/ ROTOR BLADES

(TURBOMACHINERY)/ SERVICE LIFE/ STATORS

ABS: Cost/benefit studies were conducted on ten advanced material technologies applicable to small aircraft gas turbine engines to be produced in the 1985 time frame. The cost/benefit studies were applied to a two engine, business-type jet aircraft in the 6800- to 9100-Kg (15,000- to 20,000-lb) gross weight class. The new material technologies are intended to provide improvements in the areas of high-pressure turbine rotor components, high-pressure turbine rotor components, high-pressure turbine stator airfoils, and static structural components. The cost/benefit of each technology is presented in terms of relative value, which is defined as a change in life cycle cost times probability of success divided by development cost. Technologies showing the most promising cost/benefits based on relative value are uncooled single crystal MAR-M 247 turbine blades, cooled DS MAR-M 247 turbine blades, and cooled ODS 'M'CrAl laminate turbine stator vanes.

RPT#: NASA-CR-141433  
78N22491

UTTL: Laser Doppler velocimeter aerial spray measurements  
AUTH: A/ZALAY, A. D.; B/EBERLE, W. R.; C/HOWLE, R. E.; D/SHRIDER, K. R.  
MAJS: /\*DOPPLER EFFECT/\*INFRARED LASERS/\*SPRAYING/\*VELOCITY MEASUREMENT  
MINS: / AGRICULTURE/ FLIGHT TESTS/ LIGHT AIRCRAFT/ TRANSPORT PROPERTIES  
ABS: An experimental research program for measuring the location, spatial extent, and relative concentration of airborne spray clouds generated by agricultural aircraft is described. The measurements were conducted with a ground-based laser Doppler velocimeter. The remote sensing instrumentation, experimental tests, and the results of the flight tests are discussed. The cross section of the aerial spray cloud and the observed location, extent, and relative concentration of the airborne particulates are presented. It is feasible to use a mobile laser Doppler velocimeter to track and monitor the transport and dispersion of aerial spray generated by an agricultural aircraft.

RPT#: NASA-CR-143849  
78N15692

UTTL: An analysis of flight data from aircraft landings with and without the aid of a painted diamond on the same runway  
AUTH: A/SWAROOP, R.; B/ASHWORTH, G. R.  
MAJS: /\*LANDING AIDS/\*MARKERS/\*RUNWAYS/\*STATISTICAL ANALYSIS  
MINS: / DATA REDUCTION/ FLIGHT TESTS/ PATTERN RECOGNITION/

## SHAPES/ VISUAL AIDS

**ABS:** The usefulness of a painted diamond on a runway as a visual aid to perform safe landings of aircraft was studied. Flight data on glideslope intercepts, flight path elevation angles, and touchdown distances were collected and analyzed. It is concluded that an appropriately painted diamond on a runway has the potential of providing glideslope information for the light weight class of general aviation aircraft. This conclusion holds irrespective of the differences in landing techniques used by the pilots.

RPT#: NASA-CR-145307 RTI-4378-1009-F  
78N18028

**UTTL:** Continued investigation of potential application of Omega navigation to civil aviation

**AUTH:** A/BAXA, E. G., JR.

**MAJS:** /\*CIVIL AVIATION/\*OMEGA NAVIGATION SYSTEM/\*TECHNOLOGY UTILIZATION

**MINS:** / DATA ACQUISITION/ ERROR ANALYSIS/ GRAPHS (CHARTS)/ WEIGHTING FUNCTIONS

**ABS:** Major attention is given to an analysis of receiver repeatability in measuring OMEGA phase data. Repeatability is defined as the ability of two like receivers which are co-located to achieve the same LOP phase readings. Specific data analysis is presented. A propagation model is described which has been used in the analysis of propagation anomalies. Composite OMEGA analysis is presented in terms of carrier phase correlation analysis and the determination of carrier phase weighting coefficients for minimizing composite phase variation. Differential OMEGA error analysis is presented for receiver separations. Three frequency analysis includes LOP error and position error based on three and four OMEGA transmissions. Results of phase amplitude correlation studies are presented.

RPT#: NASA-CR-145342 RTI-1464-00-00F  
78N24132

**UTTL:** General aviation avionics equipment maintenance

**AUTH:** A/PARKER, C. D.; B/TOMMERDAHL, J. B.

**MAJS:** /\*AIRCRAFT MAINTENANCE/\*AVIONICS/\*GENERAL AVIATION AIRCRAFT

**MINS:** / COST ANALYSIS/ PERFORMANCE/ RELIABILITY

**ABS:** Maintenance of general aviation avionics equipment was investigated with emphasis on single engine and light twin engine general aviation aircraft. Factors considered include the regulatory agencies, avionics manufacturers, avionics repair stations, the statistical character of the general aviation community, and owners and operators. The maintenance, environment, and performance, repair costs, and

reliability of avionics were defined. It is concluded that a significant economic stratification is reflected in the maintenance problems encountered, that careful attention to installations and use practices can have a very positive impact on maintenance problems, and that new technologies and a general growth in general aviation will impact maintenance.

RPT#: NASA-CR-145378  
78N32094

**UTTL:** Avionics performance analysis: A historical review and a current assessment of flight instrumentation and control systems in civil aviation

**MAJS:** /\*AVIONICS/\*CIVIL AVIATION/\*FLIGHT CONTROL/\*FLIGHT INSTRUMENTS/\*PERFORMANCE PREDICTION

**MINS:** / AIR TRANSPORTATION/ COST REDUCTION/ FLIGHT SAFETY/ TECHNOLOGY ASSESSMENT/ VALUE ENGINEERING

**ABS:** The role of flight instrumentation and control systems in the advancement of civil aviation to the safest form of commercial transportation is discussed. Safety, cost reduction, and increased capabilities provided by recent developments are emphasized. Cost/performance considerations are considered in terms of determining the relative values of comparable systems or the absolute worth of a system.

RPT#: NASA-CR-151972  
78N16045

**UTTL:** Conceptual design of single turbofan engine powered light aircraft

**AUTH:** A/SNYDER, F. S.; B/VOORHEES, C. G.; C/HEINRICH, A. M.; D/BAISDEN, D. N.

**MAJS:** /\*AIRCRAFT DESIGN/\*LIGHT AIRCRAFT/\*MONOPLANES/\*NASA PROGRAMS/\*TURBOFAN ENGINES

**MINS:** / EVALUATION/ METHODOLOGY/ PRODUCTION ENGINEERING/ PROJECT MANAGEMENT

**ABS:** The conceptual design of a four place single turbofan engine powered light aircraft was accomplished utilizing contemporary light aircraft conventional design techniques as a means of evaluating the NASA-Ames General Aviation Synthesis Program (GASP) as a preliminary design tool. In certain areas, disagreement or exclusion were found to exist between the results of the conventional design and GASP processes. Detail discussion of these points along with the associated contemporary design methodology are presented.

RPT#: NASA-CR-152025  
78N10060

UTTL: Preliminary candidate advanced avionics system for general aviation  
AUTH: A/MCCALLA, T. M.; B/GRISMORE, F. L.; C/GREATLINE, S. E.; D/BIRKHEAD, L. M.  
MAJS: /\*AIRCRAFT SAFETY/\*AVIONICS/\*CIVIL AVIATION/\*GENERAL AVIATION AIRCRAFT/\*MICROELECTRONICS/\*SYSTEMS ENGINEERING  
MINS: / COST EFFECTIVENESS/ MICROPROCESSORS/ RELIABILITY ENGINEERING  
ABS: An integrated avionics system design was carried out to the level which indicates subsystem function, and the methods of overall system integration. Sufficient detail was included to allow identification of possible system component technologies, and to perform reliability, modularity, maintainability, cost, and risk analysis upon the system design. Retrofit to older aircraft, availability of this system to the single engine two place aircraft, was considered.

RPT#: NASA-CR-152069  
78N17931

UTTL: Determination of the flight equipment maintenance costs of commuter airlines  
MAJS: /\*AIRCRAFT EQUIPMENT/\*AIRCRAFT MAINTENANCE/\*AIRLINE OPERATIONS/\*COST ANALYSIS/\*PASSENGER AIRCRAFT  
MINS: / AVIONICS/ GENERAL AVIATION AIRCRAFT/ INVENTORY MANAGEMENT/ OPERATIONS RESEARCH  
ABS: Labor and materials costs associated with maintaining and operating 12 commuter airlines carrying an average of from 42 to 1,100 passengers daily in a variety of aircraft types were studied to determine the total direct maintenance cost per flight hour for the airframe, engine, and avionics and other instruments. The distribution of maintenance costs are analyzed for two carriers, one using turboprop aircraft and the other using piston engine aircraft.

RPT#: NASA-CR-156067 TM-56  
78N20100

UTTL: Stand-alone development system using a KIM-1 microcomputer module  
AUTH: A/NICKUM, J. D.  
MAJS: /\*AIRBORNE/SPACEBORNE COMPUTERS/\*ELECTRONIC MODULES/\* MICROPROCESSORS  
MINS: / AIRCRAFT EQUIPMENT/ AVIONICS/ GUIDANCE SENSORS/ HARDWARE/ INTERFACES/ LORAN C  
ABS: A small microprocessor-based system designed to: contain all or most of the interface hardware, designed to be easy to access and modify the hardware, to be capable of being strapped to the seat of a small

general aviation aircraft, and to be independent of the aircraft power system is described. The system is used to develop a low cost Loran C sensor processor, but is designed such that the Loran interface boards may be removed and other hardware interfaces inserted into the same connectors. This flexibility is achieved through memory-mapping techniques into the microprocessor.

RPT#: NASA-CR-156142  
78N20110

UTTL: A study of low-cost reliable actuators for light aircraft. Part A: Chapters 1-8  
AUTH: A/EIJSINK, H.; B/RICE, M.  
MAJS: /\*ACTUATORS/\*CONTROL SURFACES/\*CONTROLLERS/\*FLIGHT CONTROL/\*LIGHT AIRCRAFT  
MINS: / DYNAMIC RESPONSE/ LOW COST/ PERFORMANCE PREDICTION/ POSITIONING/ RELIABILITY ANALYSIS  
ABS: An analysis involving electro-mechanical, electro-pneumatic, and electro-hydraulic actuators was performed to study which are compatible for use in the primary and secondary flight controls of a single engine light aircraft. Actuator characteristics under investigation include cost, reliability, weight, force, volumetric requirements, power requirements, response characteristics and heat accumulation characteristics. The basic types of actuators were compared for performance characteristics in positioning a control surface model and then were mathematically evaluated in an aircraft to get the closed loop dynamic response characteristics. Conclusions were made as to the suitability of each actuator type for use in an aircraft.

RPT#: NASA-CR-156143 KU-FRL-351-PT-B  
78N20111

UTTL: A study of low-cost reliable actuators for light aircraft. Part B: Appendices  
AUTH: A/EIJSINK, H.; B/RICE, M.  
MAJS: /\*ACTUATORS/\*CONTROL SURFACES/\*CONTROLLERS/\*FLIGHT CONTROL/\*LIGHT AIRCRAFT  
MINS: / COMPUTER PROGRAMS/ DYNAMIC RESPONSE/ LOW COST/ PERFORMANCE PREDICTION/ POSITIONING/ RELIABILITY ANALYSIS  
ABS: Computer programs written in FORTRAN are given for time response calculations on pneumatic and linear hydraulic actuators. The programs are self-explanatory with comment statements. Program output is also included.

RPT#: NASA-CR-156170 KU-FRL-317-6  
78N21889

UTTL: Experimental and theoretical sound transmission  
AUTH: A/ROSKAM, J.; B/MUIRHEAD, V. U.; C/SMITH, H. W.;  
D/DURENBERGER, D. W.

MAJS: /\*AIRCRAFT COMPARTMENTS/\*AIRCRAFT NOISE/\*AIRCRAFT  
STRUCTURES/-NOISE REDUCTION/\*PANELS/\*SOUND  
TRANSMISSION

MINS: / ACOUSTIC PROPERTIES/ HONEYCOMB STRUCTURES/ NOISE  
MEASUREMENT/ TEST FACILITIES/ UNIVERSITY PROGRAM

ABS: The capabilities of the Kansas University- Flight  
Research Center for investigating panel sound  
transmission as a step toward the reduction of  
interior noise in general aviation aircraft were  
discussed. Data obtained on panels with holes, on  
honeycomb panels, and on various panel treatments at  
normal incidence were documented. The design of  
equipment for panel transmission loss tests at  
nonnormal (slanted) sound incidence was described. A  
comprehensive theory-based prediction method was  
developed and shows good agreement with experimental  
observations of the stiffness controlled, the region,  
the resonance controlled region, and the mass-law  
region of panel vibration.

RPT#: NASA-CR-156714  
78N20990

UTTL: Identification and promulgation of objectives for OAST  
R and T programs, Task 2

MAJS: /\*MANAGEMENT METHODS/\*NASA PROGRAMS/\*OPERATIONS  
RESEARCH/\*PROJECT PLANNING/\*RESEARCH AND DEVELOPMENT

MINS: / AERONAUTICS/ AEROSPACE ENGINEERING/ DECISION MAKING/  
GENERAL AVIATION AIRCRAFT/ PROJECT MANAGEMENT

ABS: Overall perspectives and guidelines are discussed for  
defining and promulgating NASA's Office of Aeronautics  
and Space Technology (OAST) objectives to meet  
national needs and goals in aeronautical, space, and  
nuclear technology. Emphasis is placed on the  
practicality of ultimately instituting  
objective-setting processes within the normal OAST  
operation, and of establishing quantitative measures  
to be used as a working management tool in determining  
the degree to which the objectives have been or are  
being met.

RPT#: NASA-CR-156715  
78N20051

UTTL: Aviation system modeling study and alternatives

MAJS: /\*AERONAUTICAL ENGINEERING/\*DATA BASES/\*TECHNOLOGY  
ASSESSMENT

MINS: / CIVIL AVIATION/ MODELS/ NASA PROGRAMS/ RESEARCH AND  
DEVELOPMENT

ABS: The Aviation System Modeling Study was directed toward  
two primary goals: an improved understanding of the  
U.S. aviation system, and technology. There are three  
major categories into which the individual study  
efforts may be subdivided. These three categories are:  
special issue studies, task studies, and data base  
development.

RPT#: NASA-CR-156838  
78N11890

UTTL: The benefits of improved technologies in agricultural  
aviation

AUTH: A/LIETZKE, K.; B/ABRAM, P.; C/BRAEN, C.; D/GIVENS,  
S.; E/HAZELRIGG, G. A., JR.; F/FISH, R.; G/CLYNE,  
F.; H/SAND, F.

MAJS: /\*AGRICULTURE/\*ECONOMIC ANALYSIS/\*PESTICIDES

MINS: / BIBLIOGRAPHIES/ CIVIL AVIATION/ COST REDUCTION/ CROP  
GROWTH/ INSECTICIDES

ABS: The results are present for a study of the economic  
benefits attributed to a variety of potential  
technological improvements in agricultural aviation.  
Part 1 gives a general description of the ag-air  
industry and discusses the information used in the  
data base to estimate the potential benefits from  
technological improvements. Part 2 presents the  
benefit estimates and provides a quantitative basis  
for the estimates in each area study. Part 3 is a  
bibliography of references relating to this study.

RPT#: NASA-CR-157051  
78N27045

UTTL: The benefits of improved technologies in agricultural  
aviation

MAJS: /\*AGRICULTURE/\*AIRCRAFT CONFIGURATIONS/\*CROP GROWTH/\*  
ECONOMIC IMPACT/\*LIGHT AIRCRAFT/\*TECHNOLOGY ASSESSMENT

MINS: / AIRCRAFT INDUSTRY/ CIVIL AVIATION/ COST REDUCTION/  
FERTILIZERS/ PESTICIDES/ SPRAYING

ABS: The economic benefits attributable to a variety of  
potential technological improvements in agricultural  
aviation are discussed. Topics covered include: the  
ag-air industry, the data base used to estimate the  
potential benefits and a summary of the potential  
benefits from technological improvements; ag-air  
activities in the United States; foreign ag-air  
activities; major ag-air aircraft in use and  
manufacturers' sales and distribution networks; and  
estimates of the benefits to the United States of  
proposed technological improvements to the aircraft  
and dispersal equipment. A bibliography of references  
is appended.

RPT#: NASA-CR-157210 KU-FRL-313-5 SR-4  
78N25078

UTTL: A study of commuter airplane design optimization  
AUTH: A/KEPPEL, B. V.; B/EYSINK, H.; C/HAMMER, J.;  
D/HAWLEY, K.; E/MEREDITH, P.; F/ROSKAM, J.  
MAJS: /\*AIRCRAFT DESIGN/\*COMPUTERIZED DESIGN/\*GENERAL  
AVIATION AIRCRAFT/\*OPTIMIZATION/\*PASSENGER AIRCRAFT/\*  
SHORT HAUL AIRCRAFT  
MINS: / CURVE FITTING/ DYNAMIC PROGRAMMING/ DYNAMIC  
STABILITY/ STABILITY DERIVATIVES/ SUBROUTINES  
ABS: The usability of the general aviation synthesis  
program (GASP) was enhanced by the development of  
separate computer subroutines which can be added as a  
package to this assembly of computerized design  
methods or used as a separate subroutine program to  
compute the dynamic longitudinal, lateral-directional  
stability characteristics for a given airplane.  
Currently available analysis methods were evaluated to  
ascertain those most appropriate for the design  
functions which the GASP computerized design program  
performs. Methods for providing proper constraint  
and/or analysis functions for GASP were developed as  
well as the appropriate subroutines.

RPT#: NASA-CR-157582 TM-60  
78N31068

UTTL: Phase-locked tracking loops for LORAN-C  
AUTH: A/BURHANS, R. W.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*LORAN C/\*PHASE LOCKED  
SYSTEMS/\*RADAR RECEIVERS/\*SIGNAL DETECTORS  
MINS: / NAVIGATION AIDS/ SIGNAL DETECTION/ SWITCHING  
CIRCUITS/ TRACKING FILTERS/ VOLTAGE REGULATORS  
ABS: Portable battery operated LORAN-C receivers were  
fabricated to evaluate simple envelope detector  
methods with hybrid analog to digital phase locked  
loop sensor processors. The receivers are used to  
evaluate LORAN-C in general aviation applications.  
Complete circuit details are given for the  
experimental sensor and readout system.

RPT#: NASA-CR-157587 KU-FRL-317-9  
78N31874

UTTL: A research program to reduce interior noise in general  
aviation airplanes: Investigation of the  
characteristics of an acoustic panel test facility  
AUTH: A/GROSVELD, F.; B/VANAKEN, J.  
MAJS: /\*GENERAL AVIATION AIRCRAFT/\*MEASURING INSTRUMENTS/\*  
NOISE REDUCTION/\*SOUND INTENSITY/\*TEST FACILITIES  
MINS: / ACOUSTIC MEASUREMENTS/ AIRCRAFT COMPARTMENTS/ PANEL  
FLUTTER/ SOUND PRESSURE  
ABS: Sound pressure levels in the test facility were  
studied that are caused by varying: (1) microphone

positions; (2) equalizer setting; and (3) panel  
clamping forces. Measurements were done by using a  
Beranek tube or this Beranek tube in combinations with  
an extension tube and a special test section. In all  
configurations tests were executed with and without a  
test panel installed. The influence of the speaker  
back panel and the back panel of the Beranek tube on  
the sound pressure levels inside the test tube were  
also investigated. It is shown that the definition of  
noise reduction is more useful in relation to this  
test facility than transmission loss.

RPT#: NASA-CR-157588 KU-FRL-317-8  
78N31873

UTTL: A research program to reduce interior noise in general  
aviation airplanes: Noise reduction through a  
cavity-backed flexible plate  
AUTH: A/ROSKAM, J.; B/VANDAM, C. P. G.  
MAJS: /\*CAVITIES/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION  
/\*PLATES (STRUCTURAL MEMBERS)  
MINS: / AIRCRAFT COMPARTMENTS/ MODULUS OF ELASTICITY/ PANEL  
FLUTTER/ PREDICTION ANALYSIS TECHNIQUES/ TRANSMISSION  
LOSS/ VIBRATION DAMPING  
ABS: A prediction method is reported for noise reduction  
through a cavity-backed panel. The analysis takes into  
account only cavity modes in one direction. The  
results of this analysis were to find the effect of  
acoustic stiffness of a backing cavity on the panel  
behavior. The resulting changes in the noise reduction  
through the panel are significant.

RPT#: NASA-CR-157745 AAE-TR-78-5 UILU-ENG-78-0505  
78N33048

UTTL: A distribution model for the aerial application of  
granular agricultural particles  
AUTH: A/FERNANDES, S. T.; B/ORMSBEE, A. I.  
MAJS: /\*AGRICULTURE/\*DISPERSING/\*DISTRIBUTION FUNCTIONS/\*  
GRANULAR MATERIALS/\*MATHEMATICAL MODELS/\*PARTICLE SIZE  
DISTRIBUTION  
MINS: / AERODYNAMIC DRAG/ COMPUTER PROGRAMS/ LIGHT AIRCRAFT/  
PROBABILITY THEORY/ SCALING LAWS  
ABS: A model is developed to predict the shape of the  
distribution of granular agricultural particles  
applied by aircraft. The particle is assumed to have a  
random size and shape and the model includes the  
effect of air resistance, distributor geometry and  
aircraft wake. General requirements for the  
maintenance of similarity of the distribution for  
scale model tests are derived and are addressed to the  
problem of a nongeneral drag law. It is shown that if  
the mean and variance of the particle diameter and  
density are scaled according to the scaling laws

governing the system, the shape of the distribution will be preserved. Distributions are calculated numerically and show the effect of a random initial lateral position, particle size and drag coefficient. A listing of the computer code is included.

RPT#: NASA-CR-2935 KU-FRL-203  
78N15055

UTTL: Flight evaluation of a spoiler roll control system on a light twin-engine airplane

AUTH: A/KOHLMAN, D. L.

MAJS: /\*FLIGHT TESTS/\*JET AIRCRAFT/\*LATERAL CONTROL/\*LIGHT AIRCRAFT/\*SPOILERS

MINS: / AERODYNAMIC COEFFICIENTS/ DYNAMIC PRESSURE/ FLAPS (CONTROL SURFACES)/ LIFT

ABS: A flight test program was conducted to evaluate the characteristics of a spoiler roll control system on a light twin-engine airplane. The spoilers provided excellent roll control with no deadband or reduced sensitivity for small deflections. Roll power increased significantly with the flaps deployed. Cable stretch limited spoiler authority at high dynamic pressure. Data were presented on roll rates, sideslip, wheel deflections, and wheel forces.

RPT#: NASA-CR-156840  
79N25665

UTTL: A review of the meteorological parameters which affect aerial application

AUTH: A/CHRISTENSEN, L. S.; B/FROST, W.  
MAJS: /\*AGRICULTURAL AIRCRAFT/\*CHEMICAL COMPOUNDS/\*  
DISPERSING/\*METEOROLOGICAL PARAMETERS

MINS: / MATHEMATICAL MODELS/ TEMPERATURE GRADIENTS/ WIND  
(METEOROLOGY)

ABS: The ambient wind field and temperature gradient were found to be the most important parameters. Investigation results indicated that the majority of meteorological parameters affecting dispersion were interdependent and the exact mechanism by which these factors influence the particle dispersion was largely unknown. The types and approximately ranges of instrumented capabilities for a systematic study of the significant meteorological parameters influencing aerial applications were defined. Current mathematical dispersion models were also briefly reviewed. Unfortunately, a rigorous dispersion model which could be applied to aerial application was not available.

RPT#: NASA-CR-157452 KU-FRL-417-10  
79N29958

UTTL: The effect of oblique angle of sound incidence, realistic edge conditions, curvature and in-plane panel stresses on the noise reduction characteristics of general aviation type panels

AUTH: A/GROSVELD, F.; B/LAMERIS, J.; C/DUNN, D.  
MAJS: /\*ACOUSTIC PROPERTIES/\*AIRCRAFT NOISE/\*CURVED PANELS/\*  
GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*STRESSES  
MINS: / AIRCRAFT COMPARTMENTS/ ALUMINUM/ INCIDENCE/ LOADS  
(FORCES)/ PLANE WAVES

ABS: Experiments and a theoretical analysis were conducted to predict the noise reduction of inclined and curved panels. These predictions are compared to the experimental results with reasonable agreement between theory and experiment for panels under an oblique angle of sound incidence. Theoretical as well as experimental results indicate a big increase in noise reduction when a flat test panel is curved. Further curving the panel slightly decreases the noise reduction. Riveted flat panels are shown to give a higher noise reduction in the stiffness-controlled frequency region, while bonded panels are superior in this region when the test panel is curved. Experimentally measured noise reduction characteristics of flat aluminum panels with uniaxial in-plane stresses are presented and discussed. These test results indicate an important improvement in the noise reduction of these panels in the frequency range

below the fundamental panel/cavity frequency.

RPT#: NASA-CR-157629 TM-64  
79N13018

UTTL: Initial flight test of a Loran-C receiver/data collection system

AUTH: A/FISCHER, J. P.; B/NICKUM, J. D.  
MAJS: /\*DATA ACQUISITION/\*FLIGHT TESTS/\*LORAN C/\*RADAR  
RECEIVERS

MINS: / GENERAL AVIATION AIRCRAFT/ NAVIGATION AIDS/ PHASE  
LOCKED SYSTEMS/ TRACKING (POSITION)

ABS: Development of a low cost Loran C receiver for general aviation use is discussed. The preparation and procedure of a flight test conducted with a receiver design which utilizes a phase locked loop oscillator to track the Loran C signals is described. It is indicated that such a receiver is a viable alternative for future work in developing a low cost Loran-C navigator.

RPT#: NASA-CR-158076  
79N15943

UTTL: Flight test evaluation of predicted light aircraft drag, performance, and stability

AUTH: A/SMETANA, F. O.; B/FOX, S. R.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*FLIGHT TESTS/\*LIGHT  
AIRCRAFT/\*PERFORMANCE PREDICTION

MINS: / ACCURACY/ DATA PROCESSING/ FLOW CHARTS/ INPUT/OUTPUT  
ROUTINES/ LEAST SQUARES METHOD/ NONLINEAR EQUATIONS

ABS: A technique was developed which permits simultaneous extraction of complete lift, drag, and thrust power curves from time histories of a single aircraft maneuver such as a pullup (from V sub max to V sub stall) and pushover (to sub V max for level flight.) The technique is an extension to non-linear equations of motion of the parameter identification method of Hiff and Taylor and includes provisions for internal data compatibility improvement as well. The technique was shown to be capable of correcting random errors in the most sensitive data channel and yielding highly accurate results. This technique was applied to flight data taken on the ATLIT aircraft. The drag and power values obtained from the initial least squares estimate are about 15% less than the 'true' values. If one takes into account the rather dirty wing and fuselage existing at the time of the tests, however, the predictions are reasonably accurate. The steady state lift measurements agree well with the extracted values only for small values of alpha. The predicted value of the lift at alpha = 0 is about 33% below that found in steady state tests while the predicted lift slope is 13% below the steady state value.

RPT#: NASA-CR-158753 KU-FRL-399-1  
79N26018

**UTTL:** Comparison of theoretical predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane

**AUTH:** A/VAHDAM, C. P. G.; B/GRISWOLD, M.; C/ROSKAM, J.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*ATLIT PROJECT/\* PREDICTION ANALYSIS TECHNIQUES

**MINS:** / AERODYNAMIC COEFFICIENTS/ PITCHING MOMENTS/ WIND TUNNEL TESTS

**ABS:** An analytical method is presented for predicting the lift coefficient, the pitching moment coefficient, and the drag coefficient of light, twin-engine, propeller-driven airplanes. The method was applied to the Advanced Technology Light Twin-Engine airplane. The calculated characteristics were then correlated against full scale wind tunnel data. The analytical method was found to predict the drag and pitching moment fairly well. However, the lift prediction was extremely poor.

RPT#: NASA-CR-158787 ARL-79-1  
79N27092

**UTTL:** The development of methods for predicting and measuring distribution patterns of aerial sprays

**AUTH:** A/ORMSBEE, A. I.; B/BRAGG, M. B.; C/MAUGHMER, M. D.

**MAJS:** /\*AIRCRAFT WAKES/\*DISPERSING/\*PREDICTION ANALYSIS TECHNIQUES/\*SCALE MODELS/\*SPRAYING/\*WIND TUNNEL TESTS

**MINS:** / AGRICULTURAL AIRCRAFT/ PARTICLE TRAJECTORIES/ SCALING LAWS/ SLIPSTREAMS/ VORTICES

**ABS:** The capability of conducting scale model experiments which involve the ejection of small particles into the wake of an aircraft close to the ground is developed. A set of relationships used to scale small-sized dispersion studies to full-size results are experimentally verified and, with some qualifications, basic deposition patterns are presented. In the process of validating these scaling laws, the basic experimental techniques used in conducting such studies, both with and without an operational propeller, were developed. The procedures that evolved are outlined. The envelope of test conditions that can be accommodated in the Langley Vortex Research Facility, which were developed theoretically, are verified using a series of vortex trajectory experiments that help to define the limitations due to wall interference effects for models of different sizes.

RPT#: NASA-CR-158919  
79N12857

**UTTL:** Evaluation of aero Commander Propeller acoustic data: Static operations

**AUTH:** A/PIERSOL, A. G.; B/WILBY, E. G.; C/WILBY, J. F.

**MAJS:** /\*AEROACOUSTICS/\*DATA PROCESSING/\*LIGHT AIRCRAFT/\* PROPELLER DRIVE

**MINS:** / ACOUSTIC MEASUREMENTS/ AIRCRAFT NOISE/ PRESSURE DISTRIBUTION/ PROPELLER BLADES/ STATIC TESTS

**ABS:** Acoustic data are analyzed from a series of ground tests performed on an Aero Commander propeller-driven aircraft with an array of microphones flush-mounted on one side of the fuselage. The analyses were concerned with the propeller blade passage noise during static operation at several different engine speeds and included calculations of the magnitude and phase of the blade passage tones, the amplitude stability of the tones, and the spatial phase and coherence of the tones. The results indicate that the pressure field impinging on the fuselage represents primarily aerodynamic (near field) effects in the plane of the propeller at all frequencies. Forward and aft of the propeller plane aerodynamic effects still dominate the pressure field at frequencies below 200 Hz; but at higher frequencies, the pressure field is due to acoustic propagation from an equivalent center located about 0.15 to 0.30 blade diameters inboard from the propeller hub.

RPT#: NASA-CR-158937 R79-912839-24  
79N21000

**UTTL:** Study of future world markets for agricultural aircraft

**AUTH:** A/GOBETZ, F. W.; B/ASSARABOWSKI, R. J.

**MAJS:** /\*AGRICULTURE/\*FARM CROPS/\*GENERAL AVIATION AIRCRAFT/\* MARKET RESEARCH

**MINS:** / COLOMBIA/ CROP GROWTH/ DEVELOPING NATIONS/ ECONOMIC DEVELOPMENT/ FERTILIZERS/ PESTICIDES

**ABS:** The future world market for US-manufactured agricultural aircraft was studied and the technology needs for foreign markets were identified. Special emphasis was placed on the developing country market, but the developed countries and the communist group were also included in the forecasts. Aircraft needs were projected to the year 2000 by a method which accounted for field size, crop production, treated area, productivity, and attrition of the fleet. A special scenario involving a significant shift toward aerial fertilization was also considered. An operations analysis was conducted to compare the relative application costs of various existing and hypothetical future aircraft. A case study was made of Colombia as an example of a developing country in

which aviation is emerging as an important industry.

RPT#: NASA-CR-158938  
79N26046

UTTL: System design requirements for advanced rotary-wing agricultural aircraft.

AUTH: A/LEMONT, H. E.

MAJS: /\*AGRICULTURAL AIRCRAFT/\*CROP DUSTING/\*ROTARY WINGS/\*SYSTEMS ENGINEERING

MINS: / BOOMS (EQUIPMENT)/ DISPERSIONS/ ECONOMIC ANALYSIS/ HELICOPTER PERFORMANCE/ LIFT DEVICES/ OPERATIONAL PROBLEMS/ REQUIREMENTS/ WEIGHT ANALYSIS

ABS: Helicopter aerial dispersal systems were studied to ascertain constraints to the system, the effects of removal of limitations (technical and FAA regulations), and subsystem improvements. Productivity indices for the aircraft and swath effects were examined. Typical missions were formulated through conversations with operators, and differing gross weight aircraft were synthesized to perform these missions. Economic analysis of missions and aircraft indicated a general correlation of small aircraft (3000 lb gross weight) suitability for small fields (25 acres), and low dispersion rates (less than 32 lb/acre), with larger aircraft (12,000 lb gross weight) being more favorable for bigger fields (200 acres) and heavier dispersal rates (100 lb/acre). Operator problems, possible aircraft and system improvements, and selected removal of operating limitations were reviewed into recommendations for future NASA research items.

RPT#: NASA-CR-158953  
79N12081

UTTL: Basic avionics module design for general aviation aircraft

AUTH: A/SMYTH, R. K.; B/SMYTH, D. E.

MAJS: /\*AVIONICS/\*GENERAL AVIATION AIRCRAFT

MINS: / DIGITAL SYSTEMS/ MICROPROCESSORS/ SYSTEMS ENGINEERING

ABS: The design of an advanced digital avionics system (basic avionics module) for general aviation aircraft operated with a single pilot under IFR conditions is described. The microprocessor based system provided all avionic functions, including flight management, navigation, and lateral flight control. The mode selection was interactive with the pilot. The system used a navigation map data base to provide operation in the current and planned air traffic control environment. The system design included software design listings for some of the required modules. The distributed microcomputer uses the IEEE 488 bus for

interconnecting the microcomputer and sensors.

RPT#: NASA-CR-158974 F-C4705  
79N13055

UTTL: Design and test of the 172K fluidic rudder

AUTH: A/BELSTERLING, C. A.

MAJS: /\*CESSNA 172 AIRCRAFT/\*FLIGHT CONTROL/\*FLIGHT TESTS/\*FLUIDICS/\*RUDDERS

MINS: / AIRCRAFT DESIGN/ AIRCRAFT STABILITY/ AIRFOILS/ FLIGHT CONDITIONS/ WIND TUNNEL TESTS

ABS: Progress in the development of concepts for control of aircraft without moving parts or a separate source of power is described. The design and wind tunnel tests of a full scale fluidic rudder for a Cessna 172K aircraft, intended for subsequent flight tests were documented. The 172K fluidic rudder was designed to provide a control force equivalent to 3.3 degrees of deflection of the conventional rudder. In spite of an extremely thin airfoil, cascaded fluidic amplifiers were built to fit, with the capacity for generating the required level of control force. Wind tunnel tests demonstrated that the principles of lift control using ram air power are sound and reliable under all flight conditions. The tests also demonstrated that the performance of the 172K fluidic rudder is not acceptable for flight tests until the design of the scoop is modified to prevent interference with the lift control phenomenon.

RPT#: NASA-CR-158989  
79N18074

UTTL: An assessment of the risks presented by the use of carbon fiber composites in commercial aviation. Volume 1: Final report. Volume 2: Supporting appendices

AUTH: A/KALELKAR, A. S.; B/FIKSEL, J.; C/RAJ, P. P. K.; D/ROSENFELD, D. B.

MAJS: /\*AIRCRAFT STRUCTURES/\*CARBON FIBERS/\*CIVIL AVIATION/\*COMMERCIAL AIRCRAFT/\*COMPOSITE MATERIALS/\*RISK

MINS: / AIRCRAFT ACCIDENTS/ AIRPORTS/ DATA PROCESSING/ ECONOMIC ANALYSIS/ MARKETING/ MATHEMATICAL MODELS/ PENETRATION/ PROBABILITY THEORY/ RELIABILITY ANALYSIS/ VULNERABILITY

RPT#: NASA-CR-159022  
79N22068

UTTL: General aviation IFR operational problems

AUTH: A/BOLZ, E. H.; B/EISELE, J. E.

MAJS: /\*CIVIL AVIATION/\*GENERAL AVIATION AIRCRAFT/\*INSTRUMENT FLIGHT RULES/\*OPERATIONAL PROBLEMS

MINS: / AIR TRAFFIC CONTROL/ AIRCRAFT PILOTS/ AVIONICS/ STATISTICAL ANALYSIS

**ABS:** Operational problems of general aviation IFR operators (particularly single pilot operators) were studied. Several statistical bases were assembled and utilized to identify the more serious problems and to demonstrate their magnitude. These bases include official activity projections, historical accident data and delay data, among others. The GA operating environment and cockpit environment were analyzed in detail. Solutions proposed for each of the problem areas identified are based on direct consideration of currently planned enhancements to the ATC system, and on a realistic assessment of the present and future limitations of general aviation avionics. A coordinated set of research program is suggested which would provide the developments necessary to implement the proposed solutions.

RPT#: NASA-CR-159099  
79N29957

**UTTL:** Engine-induced structural-borne noise in a general aviation aircraft

**AUTH:** A/UNRUH, J. F.; B/SCHIEDT, D. C.; C/POMERENING, D. J.

**MAJS:** /\*AIRCRAFT NOISE/\*ENGINE NOISE/\*NOISE INTENSITY/\*NOISE MEASUREMENT/\*NOISE REDUCTION

**MINS:** / AIRCRAFT COMPARTMENTS/ AIRCRAFT STRUCTURES/ CESSNA 172 AIRCRAFT/ ENGINE MONITORING INSTRUMENTS/ ENGINE TESTS

**ABS:** Structural borne interior noise in a single engine general aviation aircraft was studied to determine the importance of engine induced structural borne noise and to determine the necessary modeling requirements for the prediction of structural borne interior noise. Engine attached/detached ground test data show that engine induced structural borne noise is a primary interior noise source for the single engine test aircraft. Cabin noise is highly influenced by responses at the propeller tone, and cabin acoustic resonances can influence overall noise levels. Results from structural and acoustic finite element coupled models of the test aircraft show that wall flexibility has a strong influence on fundamental cabin acoustic resonances. The lightweight fuselage structure has a high modal density, and finite element analysis procedures are appropriate for the prediction of structural borne noise.

RPT#: NASA-CR-159100 D210-11336-1  
79N31164

**UTTL:** Development of crashworthy passenger seats for general-aviation aircraft

**AUTH:** A/REILLY, M. J.; B/TANNER, A. E.

**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*LIGHT AIRCRAFT/\*SAFETY MANAGEMENT/\*SEATS

**MINS:** / CRASHES/ DESIGN ANALYSIS/ ENERGY ABSORPTION/ IMPACT LOADS

**ABS:** Two types of energy absorbing passenger seat concepts suitable for installation in light twin-engine fixed wing aircraft were developed. An existing passenger seat for such an aircraft was used to obtain the envelope constraints. Ceiling suspended and floor supported seat concept designs were developed. A restraint system suitable for both concepts was designed. Energy absorbing hardware for both concepts was fabricated and tension and compression tests were conducted to demonstrate the stroking capability and the force deflection characteristics. Crash impact analysis was made and seat loads developed. The basic seat structures were analyzed to determine the adequacy of their strength under impact loading.

RPT#: NASA-CR-159558 DDA-EDR-9528  
79N21073

**UTTL:** Study of an advanced General Aviation Turbine Engine (GATE)

**AUTH:** A/GILL, J. C.; B/SHORT, F. R.; C/STATON, D. V.; D/ZOLEZZI, B. A.; E/CURRY, C. E.; F/ORELUP, M. J.; G/VAUGHT, J. M.; H/HUMPHREY, J. M.

**MAJS:** /\*GAS TURBINE ENGINES/\*GENERAL AVIATION AIRCRAFT/\* TECHNOLOGY ASSESSMENT

**MINS:** / AIRCRAFT INDUSTRY/ AIRCRAFT PERFORMANCE/ COST ANALYSIS/ ENGINE DESIGN/ FUEL CONSUMPTION/ HELICOPTERS / ROTARY WINGS/ TURBOFAN ENGINES/ TURBOPROP ENGINES/ TURBOSHAFTS/ WEIGHT ANALYSIS

**ABS:** The best technology program for a small, economically viable gas turbine engine applicable to the general aviation helicopter and aircraft market for 1985-1990 was studied. Turboshaft and turboprop engines in the 112 to 746 kw (150 to 1000 hp) range and turboprop engines up to 6672 N (1500 lbf) thrust were considered. A good market for new turbine engines was predicted for 1988 providing aircraft are designed to capitalize on the advantages of the turbine engine. Parametric engine families were defined in terms of design and off-design performance, mass, and cost. These were evaluated in aircraft design missions selected to represent important market segments for fixed and rotary-wing applications. Payoff parameters influenced by engine cycle and configuration changes were aircraft gross mass, acquisition cost, total cost

of ownership, and cash flow. Significant advantage over a current technology, small gas turbine engines was found especially in cost of ownership and fuel economy for airframes incorporating an air-cooled high-pressure ratio engine. A power class of 373 kw (500 hp) was recommended as the next frontier for technology advance where large improvements in fuel economy and engine mass appear possible through component research and development.

RPT#: NASA-CR-159603 WRC-78-113-15  
79N25017

UTTL: Advanced General Aviation Turbine Engine (GATE) concepts

AUTH: A/LAYS, E. J.; B/MURRAY, G. L.

MAJS: /\*ENGINES/\*GENERAL AVIATION AIRCRAFT/\*LIFE CYCLE COSTS  
/\*PROPULSION/\*TURBINE ENGINES

MINS: / COMPONENT RELIABILITY/ FUEL CONSUMPTION/ TURBOFANS/  
TURBOPROP ENGINES/ TURBOSHAFTS

ABS: Concepts are discussed that project turbine engine cost savings through use of geometrically constrained components designed for low rotational speeds and low stress to permit manufacturing economies. Aerodynamic development of geometrically constrained components is recommended to maximize component efficiency. Conceptual engines, airplane applications, airplane performance, engine cost, and engine-related life cycle costs are presented. The powerplants proposed offer encouragement with respect to fuel efficiency and life cycle costs, and make possible remarkable airplane performance gains.

RPT#: NASA-CR-159624 TELEDYNE-CAE-1600  
79N29189

UTTL: Advanced General Aviation Turbine Engine (GATE) study

AUTH: A/SMITH, R.; B/BENSTEIN, E. H.

MAJS: /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GAS TURBINE ENGINES  
/\*GENERAL AVIATION AIRCRAFT

MINS: / AIRCRAFT CONFIGURATIONS/ COST REDUCTION/ FIXED WINGS  
/ MARKET RESEARCH/ PERFORMANCE PREDICTION/ POLLUTION CONTROL/  
PROPULSION SYSTEM CONFIGURATIONS/ ROTARY WINGS/ TECHNOLOGICAL FORECASTING

ABS: The small engine technology requirements suitable for general aviation service in the 1987 to 1988 time frame were defined. The market analysis showed potential United States engines sales of 31,500 per year providing that the turbine engine sales price approaches current reciprocating engine prices. An optimum engine design was prepared for four categories of fixed wing aircraft and for rotary wing applications. A common core approach was derived from the optimum engines that maximizes engine commonality

over the power spectrum with a projected price competitive with reciprocating piston engines. The advanced technology features reduced engine cost, approximately 50 percent compared with current technology.

RPT#: NASA-CR-3097  
79N30145

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle-of-attack range of 8 deg to 90 deg. 1: High-wing model B

AUTH: A/BIHRLE, W., JR.; B/HULTBERG, R. S.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*FLUID FLOW/\*GENERAL AVIATION AIRCRAFT/\*VORTICES

MINS: / AERODYNAMIC CONFIGURATIONS/ ANGLE OF ATTACK/ GRAPHS (CHARTS)/ SPIN TESTS/ WIND TUNNEL TESTS

ABS: Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance located in a spin tunnel are presented in plotted form for a 1/6.5 scale, single engine, high wing, general aviation airplane model. The configurations tested included the basic airplane, various wing leading-edge devices, tail designs, and rudder control settings as well as airplane components. Data are presented without analysis for an angle of attack range of 8 deg to 90 deg and clockwise and counter-clockwise rotations covering an  $(\omega)/2V$  range from 0 to 0.85.

RPT#: NASA-CR-3098  
79N33163

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle-of-attack range of 8 deg to 90 deg. 2: Low-wing model B

AUTH: A/BIHRLE, W., JR.; B/HULTBERG, R. S.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AERODYNAMIC CONFIGURATIONS/\*GENERAL AVIATION AIRCRAFT

MINS: / ANGLE OF ATTACK/ GRAPHS (CHARTS)/ SPIN/ WIND TUNNEL TESTS

ABS: Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance located in the spin tunnel are presented in plotted form for a 1/6.5 scale, single engine, low wing, general aviation airplane model. The configurations tested included the basic airplane, various wing leading-edge devices, tail designs, and rudder control settings as well as airplane components. Data are presented without analysis for an angle-of-attack range of 8 deg to 90 deg and clockwise and counter-clockwise rotations covering an  $(\omega)(b)/2V$  range from 0 to 0.85.

RPT#: NASA-CR-3099  
79N31152

UTTL: Rotary balance data for a single-engine trainer design for an angle-of-attack range of 8 deg to 90 deg

AUTH: A/PANTASON, P.; B/DICKENS, W.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*ANGLE OF ATTACK/\*LEADING EDGES/\*SPIN TESTS/\*TRAINING AIRCRAFT/\*VORTICES

MINS: / AERIAL RUDDERS/ AILERONS/ AIRCRAFT MODELS/ AIRCRAFT PERFORMANCE/ ELEVATORS (CONTROL SURFACES)/ FLIGHT CHARACTERISTICS/ GENERAL AVIATION AIRCRAFT/ WING PROFILES

ABS: Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/6 scale, single engine trainer airplane model. The configurations tested included the basic airplane, various wing leading edge devices, elevator, aileron and rudder control settings as well as airplane components. Data are presented without analysis for an angle of attack range of 8 to 90 degrees and clockwise and counter-clockwise rotations.

RPT#: NASA-CR-3101  
79N31149

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle-of-attack range of 8 deg to 90 deg. 2: High-wing model A

AUTH: A/MULCAY, W.; B/ROSE, R.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*GENERAL AVIATION AIRCRAFT/\*ROTARY STABILITY/\*SPIN TESTS

MINS: / ANGLE OF ATTACK/ BODY-WING AND TAIL CONFIGURATIONS/ WIND TUNNEL TESTS

ABS: Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/5-scale, single-engine, high-wing, general aviation airplane model. The configurations tested included various tail designs and fuselage shapes. Data are presented without analysis for an angle of attack range of 8 to 90 degrees and clockwise and counter-clockwise rotations covering an Omega b/2 v range from 0 to 0.85.

RPT#: NASA-CR-159035  
BON11079

UTTL: AVIONICS: Projections for civil aviation, 1995-2000  
AUTH: A/MCREE, G. J.; B/LUEG, R. E.; C/CARLSON, P. A.;  
D/CHOI, Y. H.; E/CRITTENDEN, J. B.; F/DOZIER, J. C.;  
G/EASTMAN, R. M.; H/GRAVANDER, J. W.; I/HARGROVE, A.  
; J/KEATON, A. E.  
MAJS: /\*AIR TRANSPORTATION/\*AVIONICS/\*CIVIL AVIATION  
MINS: / AIR TRAFFIC CONTROL/ SYSTEMS ENGINEERING/  
TECHNOLOGICAL FORECASTING  
ABS: A view of the 1995-2000 civil aviation avionics system  
is summarized. Descriptions of the scenarios  
considered, the avionics technologies, the 1995-2000  
avionics system, and an evaluation of the impacts are  
presented. Recommendations are also presented.

RPT#: NASA-CR-159090  
BON10962

UTTL: A study of the cost-effective markets for new  
technology agricultural aircraft  
AUTH: A/HAZELRIGG, G. A., JR.; B/CLYNE, F.  
MAJS: /\*AGRICULTURAL AIRCRAFT/\*AIRCRAFT DESIGN/\*COST  
EFFECTIVENESS/\*MARKET RESEARCH/\*TECHNOLOGY UTILIZATION  
MINS: / DATA BASES/ DECISION MAKING/ INDUSTRIES/ NASA  
PROGRAMS/ OPERATIONS RESEARCH/ USER REQUIREMENTS  
ABS: A previously developed data base was used to estimate  
the regional and total U.S. cost-effective markets for  
a new technology agricultural aircraft as  
incorporating features which could result from  
NASA-sponsored aerial applications research. The  
results show that the long-term market penetration of  
a new technology aircraft would be near 3,000  
aircraft. This market penetration would be attained in  
approximately 20 years. Annual sales would be about  
200 aircraft after 5 to 6 years of introduction. The  
net present value of cost savings benefit which this  
aircraft would yield (measured on an infinite horizon  
basis) would be about \$35 million counted at a 10  
percent discount rate and \$120 million at a 5 percent  
discount rate. At both discount rates the present  
value of cost savings exceeds the present value of  
research and development (R&D) costs estimated for the  
development of the technology base needed for the  
proposed aircraft. These results are quite  
conservative as they have been derived neglecting  
future growth in the agricultural aviation industry,  
which has been averaging about 12 percent per year  
over the past several years.

RPT#: NASA-CR-159145 RT1/1404/00-01F  
BON18020

UTTL: Continued study of NAVSTAR/GPS for general aviation  
AUTH: A/ALBERTS, R. D.; B/RUEDGER, W. H.  
MAJS: /\*CIVIL AVIATION/\*GLOBAL POSITIONING SYSTEM/\*NAVSTAR  
SATELLITES/\*TECHNOLOGY ASSESSMENT  
MINS: / AIRCRAFT GUIDANCE/ AIRCRAFT SAFETY/ COLLISION  
AVOIDANCE/ DATA LINKS/ TECHNOLOGY UTILIZATION  
ABS: A conceptual approach for examining the full potential  
of Global Positioning Systems (GPS) for the general  
aviation community is presented. Aspects of an  
experimental program to demonstrate these concepts are  
discussed. The report concludes with the observation  
that the true potential of GPS can only be exploited  
by utilization in concert with a data link. The  
capability afforded by the combination of position  
location and reporting stimulates the concept of GPS  
providing the auxiliary functions of collision  
avoidance, and approach and landing guidance. A series  
of general recommendations for future NASA and civil  
community efforts in order to continue to support GPS  
for general aviation are included.

RPT#: NASA-CR-159176 R-6132  
BON15062

UTTL: Design study of a low cost civil aviation GPS receiver  
system  
AUTH: A/CNOSSEN, R.; B/GILBERT, G. A.  
MAJS: /\*CIVIL AVIATION/\*DISPLAY DEVICES/\*GENERAL AVIATION  
AIRCRAFT/\*GLOBAL POSITIONING SYSTEM/\*RADAR RECEIVERS/\*  
SYSTEMS ENGINEERING  
MINS: / AVIONICS/ COMPUTER SYSTEMS PROGRAMS/ MICROCOMPUTERS/  
NAVIGATION AIDS/ NAVSTAR SATELLITES  
ABS: A low cost Navstar receiver system for civil aviation  
applications was defined. User objectives and  
constraints were established. Alternative navigation  
processing design trades were evaluated. Receiver  
hardware was synthesized by comparing technology  
projections with various candidate system designs. A  
control display unit design was recommended as the  
result of field test experience with Phase I GPS sets  
and a review of special human factors for general  
aviation users. Areas requiring technology development  
to ensure a low cost Navstar Set in the 1985 timeframe  
were identified.

RPT#: NASA-CR-159206  
BON26391

UTTL: An assessment of the risk arising from electrical  
effects associated with the release of carbon fibers  
from general aviation aircraft fires  
AUTH: A/ROSENFELD, D.; B/FIKSEL, J.

**MAJS:** /\*CARBON FIBERS/\*COMBUSTION PRODUCTS/\*COST ESTIMATES/\*  
ELECTRICAL FAULTS/\*GENERAL AVIATION AIRCRAFT/\*RISK  
**MINS:** / AIRCRAFT EQUIPMENT/ AIRCRAFT SAFETY/ GRAPHITE-EPOXY  
COMPOSITE MATERIALS/ POISSON DENSITY FUNCTIONS  
**ABS:** A Poisson type model was developed and exercised to  
estimate the risk of economic losses through 1993 due  
to potential electric effects of carbon fibers  
released from United States general aviation aircraft  
in the aftermath of a fire. Of the expected 354 annual  
general aviation aircraft accidents with fire  
projected for 1993, approximately 88 could involve  
carbon fibers. The average annual loss was estimated  
to be about \$250 (1977 dollars) and the likelihood of  
exceeding \$107,000 (1977 dollars) in annual loss in  
any one year was estimated to be at most one in ten  
thousand.

RPT#: NASA-CR-159237  
80N21100

**UTTL:** Development and evaluation of a general aviation real  
world noise simulator  
**AUTH:** A/GALANTER, E.; B/POPPER, R.  
**MAJS:** /\*AIRCRAFT NOISE/\*COCKPIT SIMULATORS/\*GENERAL AVIATION  
AIRCRAFT  
**MINS:** / AIRCRAFT PILOTS/ NOISE MEASUREMENT/ NOISE SPECTRA/  
PSYCHOACOUSTICS  
**ABS:** An acoustic playback system is described which  
realistically simulates the sounds experienced by the  
pilot of a general aviation aircraft during engine  
idle, take-off, climb, cruise, descent, and landing.  
The physical parameters of the signal as they appear  
in the simulator environment are compared to analogous  
parameters derived from signals recorded during actual  
flight operations. The acoustic parameters of the  
simulated and real signals during cruise conditions  
are within plus or minus two dB in third octave bands  
from 0.04 to 4 kHz. The overall A-weighted levels of  
the signals are within one dB of signals generated in  
the actual aircraft during equivalent maneuvers.  
Psychoacoustic evaluations of the simulator signal are  
compared with similar measurements based on  
transcriptions of actual aircraft signals. The  
subjective judgments made by human observers support  
the conclusion that the simulated sound closely  
approximates transcribed sounds of real aircraft.

RPT#: NASA-CR-159329  
80N31353

**UTTL:** Computation of spanwise distribution of circulation  
and lift coefficient for flapped wings of arbitrary  
planform  
**AUTH:** A/RAZAK, K.

**MAJS:** /\*AERODYNAMIC COEFFICIENTS/\*AGRICULTURAL AIRCRAFT/\*  
CROP DUSTING/\*LIFT/\*WING LOADING  
**MINS:** / COMPUTER PROGRAMS/ FLAPS (CONTROL SURFACES)/  
VORTICITY  
**ABS:** The question of the effect of distribution and  
magnitude of spanwise circulation and shed vorticity  
from an airplane wing on the distribution pattern of  
agricultural products distributed from an airplane was  
studied. The first step in an analysis of this  
question is the determination of the actual  
distribution of lift along an airplane wing, from  
which the pattern of shed vorticity can be determined.  
A procedure is developed to calculate the span loading  
for flapped and unflapped wings of arbitrary aspect  
ratio and taper ratio. The procedure was programmed on  
a small programmable calculator, the Hewlett Packard  
HP-97, and also was programmed in BASIC language. They  
could be used to explore the variations in span  
loading that can be secured by variable flap  
deflections or the effect of flying at varying air  
speeds at different airplane gross weights. Either an  
absolute evaluation of span loading can be secured or  
comparative span loading can be evaluated to determine  
their effect on swath width and swath distribution  
pattern. The programs are intended to assist the user  
in evaluating the effect of a given spanload  
distribution.

RPT#: NASA-CR-159702  
80N10460

**UTTL:** Spray nozzle designs for agricultural aviation  
applications  
**AUTH:** A/LEE, K. W.; B/PUTNAM, A. A.; C/GIESEKE, J. A.;  
D/GOLOVIN, M. N.; E/HALE, J. A.  
**MAJS:** /\*AGRICULTURAL AIRCRAFT/\*DROP SIZE/\*NOZZLE DESIGN/\*  
NOZZLE EFFICIENCY/\*SPRAY CHARACTERISTICS/\*SPRAY  
NOZZLES  
**MINS:** / AIR JETS/ DROPS (LIQUIDS)/ LIQUID ATOMIZATION/  
NOZZLE FLOW/ PESTICIDES/ SPRAYERS/ ULTRASONICS  
**ABS:** Techniques of generating monodisperse sprays and  
information concerning chemical liquids used in  
agricultural aviation are surveyed. The periodic  
dispersion of liquid jet, the spinning disk method,  
and ultrasonic atomization are the techniques  
discussed. Conceptually designed spray nozzles for  
generating monodisperse sprays are assessed. These are  
based on the classification of the drops using  
centrifugal force, on using two opposing liquid laden  
air jets, and on operating a spinning disk at an  
overloaded flow. Performance requirements for the  
designs are described and estimates of the operational  
characteristics are presented.

RPT#: NASA-CR-159758 AIRESEARCH-21-3071  
80N21331

UTTL: Airesearch OCGAT program  
AUTH: A/HELDENBRAND, R. W.; B/NORGREN, W. M.  
MAJS: /\*ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT/\*NOISE  
REDUCTION/\*QUIET ENGINE PROGRAM/\*TURBOFAN ENGINES  
MINS: / AIRCRAFT ENGINES/ EXHAUST EMISSION/ FUEL CONSUMPTION  
/ GEARS/ JET AIRCRAFT NOISE/ NACELLES  
ABS: A model TFE731-1 engine was used as a baseline for the  
NASA quiet clean general aviation turbofan engine and  
engine/nacelle program designed to demonstrate the  
applicability of large turbofan engine technology to  
small general aviation turbofan engines, and to obtain  
significant reductions in noise and pollutant  
emissions while reducing or maintaining fuel  
consumption levels. All new technology design for  
rotating parts and all items in the engine and nacelle  
that contributed to the acoustic and pollution  
characteristics of the engine system were of flight  
design, weight, and construction. The major noise,  
emissions, and performance goals were met. Noise  
levels estimated for the three FAR Part 36 conditions,  
are 10 to 15 ENPD below FAA requirements; emission  
values are considerably reduced below that of current  
technology engines; and the engine performance  
represents a TSFC improvement of approximately 9  
percent over other turbofan engines.

RPT#: NASA-CR-159777  
80N19450

UTTL: Monodisperse atomizers for agricultural aviation  
applications  
AUTH: A/CHRISTENSEN, L. S.; B/STEELY, S. L.  
MAJS: /\*AGRICULTURAL AIRCRAFT/\*ATOMIZERS/\*ATOMIZING/\*SPRAY  
NOZZLES  
MINS: / CAPILLARY FLOW/ DROP SIZE/ DROPS (LIQUIDS)/ NOZZLE  
DESIGN  
ABS: Conceptual designs of two monodisperse spray nozzles  
are described and the rationale used in each design is  
discussed. The nozzles were designed to eliminate  
present problems in agricultural aviation  
applications, such as ineffective plant coverage,  
drift due to small droplets present in the spray being  
dispersed, and nonuniform swath coverages.  
Monodisperse atomization techniques are reviewed and a  
synopsis of the information obtained concerning  
agricultural aviation spray applications is presented.

RPT#: NASA-CR-159781 ORI-TR-1686  
80N18586

UTTL: Aerial applications dispersal systems control  
requirements study  
AUTH: A/BAUCHSPIES, J. S.; B/CLEARY, W. L.; C/ROGERS, W.  
F.; D/SIMPSON, W.; E/SANDERS, G. S.  
MAJS: /\*AGRICULTURAL AIRCRAFT/\*CONTROL EQUIPMENT/\*CROP  
DUSTING/\*DISPERSING/\*ENVIRONMENT PROTECTION  
MINS: / AUTOMATIC CONTROL/ ECONOMIC FACTORS/ FLOW REGULATORS  
/ HERBICIDES/ PESTICIDES  
ABS: Performance deficiencies in aerial liquid and dry  
dispersal systems are identified. Five control system  
concepts are explored: (1) end of field on/off  
control; (2) manual control of particle size and  
application rate from the aircraft; (3) manual control  
of deposit rate on the field; (4) automatic alarm and  
shut-off control; and (5) fully automatic control.  
Operational aspects of the concepts and specifications  
for improved control configurations are discussed in  
detail. A research plan to provide the technology  
needed to develop the proposed improvements is  
presented along with a flight program to verify the  
benefits achieved.

RPT#: NASA-CR-159796 ADL-83381-2  
80N18040

UTTL: Study of research and development requirements of  
small gas-turbine combustors  
AUTH: A/DEMETRI, E. P.; B/TOPPING, R. F.; C/WILSON, R. P.,  
JR.  
MAJS: /\*COMBUSTION CHAMBERS/\*GAS TURBINE ENGINES/\*GENERAL  
AVIATION AIRCRAFT/\*RESEARCH AND DEVELOPMENT  
MINS: / FUEL INJECTION/ LININGS/ OPTIMIZATION/ SIZE  
(DIMENSIONS)  
ABS: A survey is presented of the major small-engine  
manufacturers and governmental users. A consensus was  
undertaken regarding small-combustor requirements. The  
results presented are based on an evaluation of the  
information obtained in the course of the study. The  
current status of small-combustor technology is  
reviewed. The principal problems lie in liner cooling,  
fuel injection, part-power performance, and ignition.  
Projections of future engine requirements and their  
effect on the combustor are discussed. The major  
changes anticipated are significant increases in  
operating pressure and temperature levels and greater  
capability of using heavier alternative fuels. All  
aspects of combustor design are affected, but the  
principal impact is on liner durability. An R&D plan  
which addresses the critical combustor needs is  
described. The plan consists of 15 recommended  
programs for achieving necessary advances in the areas  
of liner thermal design, primary-zone performance.

fuel injection, dilution, analytical modeling, and alternative-fuel utilization.

RPT#: NASA-CR-162796 MSSU-EIRS-ASE-80-2  
BON17992

UTTL: Full scale visualization of the wing tip vortices generated by a typical agricultural aircraft  
AUTH: A/CROSS, E. J., JR.; B/BRIDGES, P. D.; C/BROWNLEE, J. A.; D/LIVINGSTON, W. W.  
MAJS: /\*AGRICULTURAL AIRCRAFT/\*CESSNA AIRCRAFT/\*FLOW VISUALIZATION/\*TRAJECTORY ANALYSIS/\*WING TIP VORTICES  
MINS: / FLIGHT TESTS/ GROUND EFFECT/ GROUND WIND/ PRESSURE MEASUREMENTS/ SCALE MODELS  
ABS: The trajectories of the wing tip vortices of a typical agricultural aircraft were experimentally determined by flight test. A flow visualization method, similar to the vapor screen method used in wind tunnels, was used to obtain trajectory data for a range of flight speeds, airplane configurations, and wing loadings. Detailed measurements of the spanwise surface pressure distribution were made for all test points. Further, a powered 1/8 scale model of the aircraft was designed, built, and used to obtain tip vortex trajectory data under conditions similar to that of the full scale test. The effects of light wind on the vortices were demonstrated, and the interaction of the flap vortex and the tip vortex was clearly shown in photographs and plotted trajectory data.

RPT#: NASA-CR-163001 JPL-PUB-79-75  
BON22430

UTTL: Ultralean combustion in general aviation piston engines  
AUTH: A/CHIRIVELLA, J. E.  
MAJS: /\*COMBUSTION EFFICIENCY/\*GENERAL AVIATION AIRCRAFT/\* PISTON ENGINES  
MINS: / ENGINE TESTS/ IGNITION/ INTERNAL COMBUSTION ENGINES/ THERMODYNAMICS  
ABS: The role of ultralean combustion in achieving fuel economy in general aviation piston engines was investigated. The aircraft internal combustion engine was reviewed with regard to general aviation requirements, engine thermodynamics and systems. Factors affecting fuel economy such as those connected with an ideal leanout to near the gasoline lean flammability limit (ultralean operation) were analyzed. A Lycoming T10-541E engine was tested in that program (both in the test cell and in flight). Test results indicate that hydrogen addition is not necessary to operate the engine ultralean. A 17 percent improvement in fuel economy was demonstrated in flight with the Beechcraft Duke B60 by simply

leaning the engine at constant cruiser power and adjusting the ignition for best timing. No detonation was encountered, and a 25,000 ft ceiling was available. Engine roughness was shown to be the limiting factor in the leanout.

RPT#: NASA-CR-163189 KU-FRL-399-2  
BON24295

UTTL: Comparison of theoretically predicted lateral-directional aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane  
AUTH: A/GRISWOLD, M.; B/ROSKAM, J.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*ATLIT PROJECT/\* PREDICTION ANALYSIS TECHNIQUES/\*WIND TUNNEL TESTS  
MINS: / ANGLE OF ATTACK/ PERFORMANCE PREDICTION/ SIDESLIP/ SPOILERS/ STABILITY DERIVATIVES  
ABS: An analytical method is presented for predicting lateral-directional aerodynamic characteristics of light twin engine propeller-driven airplanes. This method is applied to the Advanced Technology Light Twin Engine airplane. The calculated characteristics are correlated against full-scale wind tunnel data. The method predicts the sideslip derivatives fairly well, although angle of attack variations are not well predicted. Spoiler performance was predicted somewhat high but was still reasonable. The rudder derivatives were not well predicted, in particular the effect of angle of attack. The predicted dynamic derivatives could not be correlated due to lack of experimental data..

RPT#: NASA-CR-3100  
BON19030

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle-of-attack range of 8 deg to 90 deg. 1: Low-wing model A  
AUTH: A/HULTBERG, R. S.; B/MULCAY, W.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT DESIGN/\*FLUID FLOW/\*GENERAL AVIATION AIRCRAFT/\*VORTICES  
MINS: / AIRCRAFT MODELS/ GRAPHS (CHARTS)/ LEADING EDGES/ SPIN TESTS/ WIND TUNNEL TESTS  
ABS: Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance are presented in plotted form for a 1/5 scale, single engine, low-wing, general aviation airplane model. The configuration tested included the basic airplane, various control deflections, tail designs, fuselage shapes, and wing leading edges. Data are presented without analysis for an angle of attack range of 8 to 90 deg and clockwise and counterclockwise rotations covering a range from 0 to 0.85.

RPT#: NASA-CR-3102  
80N12060

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle-of-attack range of 8 degrees to 35 degrees. 3. Effect of wing leading-edge modifications, model A

AUTH: A/BIHRLE, W. JR.; B/MULCAY, W.

MAJS: /\*GENERAL AVIATION AIRCRAFT/\*LIGHT AIRCRAFT/\*ROTARY STABILITY/\*WIND TUNNEL TESTS

MINS: / AERODYNAMIC CONFIGURATIONS/ ANGLE OF ATTACK/ LEADING EDGES/ SPIN TESTS

ABS: Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/5 scale, single-engine, low-wing, general aviation airplane model. The configurations tested included the basic airplane, sixteen wing leading-edge modifications and lateral-directional control settings. Data are presented for all configurations without analysis for an angle of attack range of 8 deg to 35 deg and clockwise and counter-clockwise rotations covering an  $\Omega b/2v$  range from 0 to 0.85. Also, data are presented above 35 deg of attack for some configurations.

RPT#: NASA-CR-3199 D6-32872  
80N19791

UTTL: NASA TLA workload analysis support. Volume 1: Detailed task scenarios for general aviation and metering and spacing studies

AUTH: A/SUNDSTROM, J. L.

MAJS: /\*AIRCRAFT EQUIPMENT/\*AUTOMATIC PILOTS/\*WORKLOADS (PSYCHOPHYSIOLOGY)

MINS: / AIR TRAFFIC CONTROL/ FLIGHT CONTROL/ GENERAL AVIATION AIRCRAFT

ABS: The techniques required to produce and validate six detailed task timeline scenarios for crew workload studies are described. Specific emphasis is given to: general aviation single pilot instrument flight rules operations in a high density traffic area; fixed path metering and spacing operations; and comparative workload operation between the forward and aft-flight decks of the NASA terminal control vehicle. The validation efforts also provide a cursory examination of the resultant demand workload based on the operating procedures depicted in the detailed task scenarios.

RPT#: NASA-CR-3200  
80N33355

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle of attack range of 8 deg to 90 deg. 1: Low wing model C

AUTH: A/MULCAY, W. J.; B/ROSE, R. A.

MAJS: /\*AERODYNAMIC BALANCE/\*AIRCRAFT SPIN/\*ANGLE OF ATTACK /\*GENERAL AVIATION AIRCRAFT/\*WIND TUNNEL TESTS

MINS: / CENTER OF GRAVITY/ GRAPHS (CHARTS)/ HELICAL FLOW/ LEADING EDGES/ STABILITY DERIVATIVES/ STRAIN GAGES

ABS: Aerodynamic characteristics obtained in a helical flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/6 scale, single engine, low wing, general aviation model (model C). The configurations tested included the basic airplane and control deflections, wing leading edge and fuselage modification devices, tail designs and airplane components. Data are presented without analysis for an angle of attack range of 8 deg to 90 deg and clockwise and counter clockwise rotations covering an  $\Omega b/2v$  range from 0 to .9.

RPT#: NASA-CR-3201  
80N32335

UTTL: Rotary balance data for a typical single-engine general aviation design for an angle-of-attack range of 8 deg to 90 deg. 2: High-wing model C

AUTH: A/HULTBERG, R. S.; B/CHU, J.

MAJS: /\*GENERAL AVIATION AIRCRAFT/\*ROTARY STABILITY/\*SPIN TESTS/\*TABLES (DATA)/\*WIND TUNNEL TESTS

MINS: / ANGLE OF ATTACK/ LEADING EDGES

ABS: Aerodynamic characteristics obtained in a helical flow environment utilizing a rotary balance located in the Langley spin g tunnel are presented in plotted form for a 1/6 scale, single engine, high wing, general aviation model. The configurations tested included the basic airplane and control deflections, wing leading edge devices, tail designs, and airplane components. Data are presented without analysis for an angle of attack range of 8 deg to 90 deg and clockwise and counter clockwise rotations covering a spin coefficient range from 0 to 0.9.

RPT#: NASA-CR-3239  
80N27091

UTTL: NASA TLA workload analysis support. Volume 2: Metering and spacing studies validation data

AUTH: A/SUNDSTROM, J. L.

MAJS: /\*AIR TRAFFIC CONTROL/\*GENERAL AVIATION AIRCRAFT/\*MAN MACHINE SYSTEMS/\*TERMINAL CONFIGURED VEHICLE PROGRAM/\* WORKLOADS (PSYCHOPHYSIOLOGY)

MINS: / FLIGHT OPERATIONS/ GRAPHS (CHARTS)/ PILOT

airplanes. The performance data show a vast improvement over current gasoline-powered aircraft.

**PERFORMANCE/ TASKS/ TIME SERIES ANALYSIS**  
**ABS:** Four sets of graphic reports--one for each of the metering and spacing scenarios--are presented. The complete data file from which the reports were generated is also given. The data was used to validate the detail task of both the pilot and copilot for four metering and spacing scenarios. The output presents two measures of demand workload and a report showing task length and task interaction.

RPT#: NASA-CR-3240  
80N27093

**UTTL:** NASA TLA workload analysis support. Volume 3: FFD autopilot scenario validation data

**AUTH:** A/SUNDSTROM, J. L.

**MAJS:** /\*AIR TRAFFIC CONTROL/\*AUTOMATIC PILOTS/\*MAN MACHINE SYSTEMS/\*TERMINAL CONFIGURED VEHICLE PROGRAM/\* WORKLOADS (PSYCHOPHYSIOLOGY)

**MINS:** / FLIGHT OPERATIONS/ GENERAL AVIATION AIRCRAFT/ GRAPHS (CHARTS)/ PILOT PERFORMANCE/ TASKS/ TIME SERIES ANALYSIS

**ABS:** The data used to validate a seven time line analysis of forward flight deck autopilot mode for the pilot and copilot for NASA B737 terminal configured vehicle are presented. Demand workloads are given in two forms: workload histograms and workload summaries (bar graphs). A report showing task length and task interaction is also presented.

RPT#: NASA-CR-3260 REPT-756  
80N20271

**UTTL:** A 150 and 300 kW lightweight diesel aircraft engine design study

**AUTH:** A/BROUWERS, A. P.

**MAJS:** /\*AIRCRAFT ENGINES/\*DIESEL ENGINES/\*ENGINE DESIGN/\* GENERAL AVIATION AIRCRAFT

**MINS:** / AIRCRAFT PERFORMANCE/ CONFIGURATIONS/ COST ANALYSIS/ ENGINE TESTS/ ENGINEERING DRAWINGS

**ABS:** The diesel engine was reinvestigated as an aircraft powerplant through design study conducted to arrive at engine configurations and applicable advanced technologies. Two engines are discussed, a 300 kW six-cylinder engine for twin engine general aviation aircraft and a 150 kW four-cylinder engine for single engine aircraft. Descriptions of each engine include concept drawings, a performance analysis, stress and weight data, and a cost study. This information was used to develop two airplane concepts, a six-place twin and a four-place single engine aircraft. The aircraft study consists of installation drawings, computer generated performance data, aircraft operating costs, and drawings of the resulting

RPT#: NASA-CR-1E2390 FR-MTRD(CA)-80-13-VOL-2  
81N10019

UTTL: Civil helicopter wire strike assessment study. Volume 2: Accident analysis briefs

AUTH: A/TUOMELA, C. H.; B/BRENNAN, M. F.

MAJS: /\*AIRCRAFT HAZARDS/\*COLLISIONS/\*HELICOPTERS/\*PILOT ERROR/\*ROTARY WINGS/\*WIRE

MINS: / AIRCRAFT ACCIDENTS/ FLIGHT HAZARDS/ GENERAL AVIATION AIRCRAFT

ABS: A description and analysis of each of the 208 civil helicopter wire strike accidents reported to the National Transportation Safety Board (NTSB) for the ten year period 1970-1979 is given. The accident analysis briefs were based on pilot reports, FAA investigation reports, and such accident photographs as were made available. Briefs were grouped by year and, within year, by NTSB accident report number.

RPT#: NASA-CR-159328  
81N13941

UTTL: An assessment of General Aviation utilization of advanced avionics technology

AUTH: A/QUINBY, G. F.

MAJS: /\*AIRCRAFT INDUSTRY/\*AVIONICS/\*CIVIL AVIATION/\*GOVERNMENT/INDUSTRY RELATIONS/\*METEOROLOGICAL SERVICES/\*TECHNOLOGY TRANSFER

MINS: / AIRLINE OPERATIONS/ FLIGHT CONDITIONS/ GENERAL AVIATION AIRCRAFT/ NASA PROGRAMS/ WEATHER FORECASTING

ABS: Needs of the general aviation industry for services and facilities which might be supplied by NASA were examined. In the data collection phase, twenty-one individuals from nine manufacturing companies in general aviation were interviewed against a carefully prepared meeting format. General aviation avionics manufacturers were credited with a high degree of technology transfer from the forcing industries such as television, automotive, and computers and a demonstrated ability to apply advanced technology such as large scale integration and microprocessors to avionics functions in an innovative and cost effective manner. The industry's traditional resistance to any unnecessary regimentation or standardization was confirmed. Industry's self sufficiency in applying advanced technology to avionics product development was amply demonstrated. NASA research capability could be supportive in areas of basic mechanics of turbulence in weather and alternative means for its sensing.

RPT#: NASA-CR-159361  
81N11013

UTTL: Preliminary design characteristics of a subsonic business jet concept employing an aspect ratio 25 strut braced wing

AUTH: A/TURRIZIANI, R. V.; B/LOVELL, W. A.; C/MARTIN, G. L.; D/PRICE, J. E.; E/SWANSON, E. E.; F/WASHBURN, G. F.

MAJS: /\*AIRCRAFT DESIGN/\*HIGH ASPECT RATIO/\*JET AIRCRAFT/\*LIGHT AIRCRAFT/\*SLENDER WINGS/\*STRUTS

MINS: / AIRCRAFT PRODUCTION COSTS/ DRAG REDUCTION/ LIFT DRAG RATIO/ SUBSONIC SPEED/ WEIGHT REDUCTION

ABS: The advantages of replacing the conventional wing on a transatlantic business jet with a larger, strut braced wing of aspect ratio 25 were evaluated. The lifting struts reduce both the induced drag and structural weight of the heavier, high aspect ratio wing. Compared to the conventional airplane, the strut braced wing design offers significantly higher lift to drag ratios achieved at higher lift coefficients and, consequently, a combination of lower speeds and higher altitudes. The strut braced wing airplane provides fuel savings with an attendant increase in construction costs.

RPT#: NASA-CR-159371  
81N16066

UTTL: The state of the art of general aviation autopilots

AUTH: A/SEE, M. J.; B/LEVY, D.

MAJS: /\*AIRCRAFT EQUIPMENT/\*AUTOMATIC PILOTS/\*CIVIL AVIATION/\*RESEARCH AND DEVELOPMENT/\*TECHNOLOGY ASSESSMENT

MINS: / AIRCRAFT INDUSTRY/ AVIONICS/ FLIGHT CONTROL/ LANDING AIDS/ NAVIGATION AIDS

ABS: The study is based on the information obtained from a general literature search, product literature, and visitations and interviews with manufacturers, users, and service centers. State of the art autopilots are documented with respect to total systems, components, and functions. Recommendations concerning potential areas of further research are also presented.

RPT#: NASA-CR-159381 KU-FRL-414-1  
81N15974

UTTL: A feasibility study for advanced technology integration for general aviation

AUTH: A/KOHLMAN, D. L.; B/MATSUYAMA, G. T.; C/HAWLEY, K. E.; D/MEREDITH, P. T.

MAJS: /\*AERODYNAMICS/\*AERONAUTICAL ENGINEERING/\*AIRCRAFT DESIGN/\*AVIONICS/\*CIVIL AVIATION/\*FEASIBILITY ANALYSIS/\*FUEL CONSUMPTION/\*SAFETY MANAGEMENT/\*TECHNOLOGY UTILIZATION

MINS: / AERODYNAMIC CONFIGURATIONS/ AIRCRAFT INDUSTRY/

**AIRFOILS/ COMPOSITE MATERIALS/ ENGINE DESIGN/  
STRUCTURAL ENGINEERING/ TECHNOLOGY TRANSFER**

**ABS:** An investigation was conducted to identify candidate technologies and specific developments which offer greatest promise for improving safety, fuel efficiency, performance, and utility of general aviation airplanes. Interviews were conducted with general aviation airframe and systems manufacturers and NASA research centers. The following technologies were evaluated for use in airplane design tradeoff studies conducted during the study: avionics, aerodynamics, configurations, structures, flight controls, and propulsion. Based on industry interviews and design tradeoff studies, several recommendations were made for further high payoff research. The most attractive technologies for use by the general aviation industry appear to be advanced engines, composite materials, natural laminar flow airfoils, and advanced integrated avionics systems. The integration of these technologies in airplane design can yield significant increases in speeds, ranges, and payloads over present aircraft with 40 percent to 50 percent reductions in fuel used.

RPT#: NASA-CR-159382  
81N12019

**UTTL:** Full scale visualization of the wing tip vortices generated by a typical agricultural aircraft

**AUTH:** A/CROSS, E. J., JR.; B/BRIDGES, P. D.; C/BROWLEE, J. A.; D/LININGSTON, W. W.

**MAJS:** /\*AGRICULTURAL AIRCRAFT/\*AIRCRAFT WAKES/\*FLOW VISUALIZATION/\*VORTICES/\*WING TIPS

**MINS:** / FLIGHT TESTS/ FULL SCALE TESTS/ GENERAL AVIATION AIRCRAFT/ TRAJECTORY ANALYSIS

**ABS:** The trajectories of the wing tip vortices of a typical agricultural aircraft were experimentally determined by flight test. A flow visualization method, similar to the vapor screen method used in wind tunnels, was used to obtain trajectory data for a range of flight speeds, airplane configurations, and wing loadings. Detailed measurements of the spanwise surface pressure distribution were made for all test points. Further, a powered 1/8 scale model of the aircraft was designed, built, and used to obtain tip vortex trajectory data under conditions similar to that of the full-scale test. The effects of light wind on the vortices were demonstrated, and the interaction of the flap vortex and the tip vortex was clearly shown in photographs and plotted trajectory data.

RPT#: NASA-CR-160036 CRI-7846-14  
81N10020

**UTTL:** Systems analysis of the installation, mounting, and activation of emergency locator transmitters in general aviation aircraft

**AUTH:** A/HALL, D. S.

**MAJS:** /\*AIRCRAFT DETECTION/\*CIVIL AVIATION/\*CRASHES/\* INDICATING INSTRUMENTS/\*RESCUE OPERATIONS/\*SEARCHING/\* SIGNAL DETECTORS

**MINS:** / AIRCRAFT ACCIDENTS/ DITCHING (LANDING)/ MALFUNCTIONS / RADIO TRANSMITTERS/ SAFETY DEVICES

**ABS:** A development program was developed to design and improve the Emergency Locator Transmitter (ELT) transmitter and to improve the installation in the aircraft and its activation subsystem. There were 1135 general aviation fixed wing aircraft accident files reviewed. A detailed description of the damage to the aircraft was produced. The search aspects of these accidents were studied. As much information as possible about the ELT units in these cases was collected. The data should assist in establishing installation and mounting criteria, better design standards for activation subsystems, and requirements for the new ELT system design in the area of crashworthiness.

RPT#: NASA-CR-163920 MSSU-EIRS-ASE-81-3  
81N15986

**UTTL:** An application of wake survey rakes to the experimental determination of thrust for a propeller driven aircraft

**AUTH:** A/HALL, K. R.; B/MILEY, S. J.; C/TSAI, H. J.

**MAJS:** /\*AERODYNAMIC DRAG/\*AIRCRAFT WAKES/\*FLIGHT TESTS/\* GENERAL AVIATION AIRCRAFT/\*PROPELLER SLIPSTREAMS/\* THRUST

**MINS:** / CAVITATION FLOW/ DRAG MEASUREMENT/ FLOW CHARACTERISTICS/ GROUND EFFECT

**ABS:** The lack of slipstream static pressure distribution seriously affected the results but recommendations for removing the deficiency are discussed. The wake survey rake is shown to be a valuable tool in aircraft flight testing. Flow characteristics in the wake of the propeller were examined.

RPT#: NASA-CR-165185 LYC-80-27  
81N16057

**UTTL:** Design and evaluation of an integrated Quiet Clean General Aviation Turbofan (OCGAT) engine and aircraft propulsion system

**AUTH:** A/GERMAN, J.; B/FOGEL, P.; C/WILSON, C.

**MAJS:** /\*COMMERCIAL AIRCRAFT/\*ENGINE DESIGN/\*ENGINE NOISE/\* GENERAL AVIATION AIRCRAFT/\*JET AIRCRAFT/\*POLLUTION

CONTROL/\*TURBOFAN ENGINES

MINS: / CIVIL AVIATION/ EXHAUST EMISSION/ FUEL CONSUMPTION/  
JET AIRCRAFT NOISE/ NOISE REDUCTION

ABS: The engine and nacelle system design was to demonstrate the applicability of large turbofan engine technology to small turbofans suitable for the general aviation market. The design was based on the LTS-101 engine family for the core engine. A high bypass fan design (BPR=9.4) was incorporated to provide reduced fuel consumption for the design mission. All acoustic and pollutant emissions goals were achieved. A discussion of the preliminary design of a business jet suitable for the developed propulsion system is also included. Large engine technology can be successfully applied to small turbofans, and noise or pollutant levels need not be constraints for the design of future small general aviation turbofan engines.

RPT#: NASA-CR-165649 D6-44815-9 QTPR-9  
BIN16139

UTTL: Environmental exposure effects on composite materials for commercial aircraft

AUTH: A/HOFFMAN, D. J.

MAJS: /\*AIRFRAME MATERIALS/\*COMMERCIAL AIRCRAFT/\*COMPOSITE MATERIALS/\*FATIGUE LIFE/\*LONG TERM EFFECTS/\*MECHANICAL PROPERTIES

MINS: / ACCELERATED LIFE TESTS/ AIRCRAFT SURVIVABILITY/  
CIVIL AVIATION/ HUMIDITY/ STRUCTURAL FAILURE

ABS: The test program concentrates on three major areas: flight exposure; ground based exposure; and accelerated environmental effects and data correlation. Among the parameters investigated were: geographic location, flight profiles, solar heating effects, ultraviolet degradation, retrieval times, and test temperatures. Data from the tests can be used to effectively plan the cost of production and viable alternatives in materials selection.

ARTICLES AND MEETING PRESENTATIONS  
(AIAA, SAE, ETC.)

These are journal articles and papers from technical presentations made at Society and professional meetings.



RPT#: AIAA PAPER 75-271  
75A22494

UTTL: Simulation of aircraft crash and its validation  
AUTH: A/HAYDUK, R. J.; B/THOMSON, R. G.  
MAJS: /\*AIRCRAFT SAFETY/\*AIRFRAME MATERIALS/\*CRASH LANDING/\*  
DESTRUCTIVE TESTS/\*FULL SCALE TESTS/\*LANDING  
SIMULATION  
MINS: / DYNAMIC TESTS/ GENERAL AVIATION AIRCRAFT/ LOAD TESTS  
/ STRUCTURAL DESIGN  
ABS: NASA Langley Research Center is engaged in an  
extensive research and development task aimed at  
providing the general aviation industry with reliable  
crashworthy airframe design technology. This paper  
describes the full-scale crash tests of general  
aviation airplanes being conducted to generate data on  
simulated crashes and to study the nonlinear dynamic  
behavior of aircraft structures. Analytical techniques  
under development for predicting nonlinear behavior of  
general airframe structures under crash-loading  
conditions are also described. Data are presented from  
the full-scale crash tests as well as comparison of  
analytical predictions with experimental results on  
some simplified structures.

RPT#: AIAA PAPER 75-290  
75A25007

UTTL: NASA general aviation technology programs  
AUTH: A/WINBLADE, R. L.  
MAJS: /\*AIRCRAFT DESIGN/\*GENERAL AVIATION AIRCRAFT/\*NASA  
PROGRAMS/\*TECHNOLOGY ASSESSMENT  
MINS: / AIRCRAFT NOISE/ AIRCRAFT SAFETY/ AVIONICS/ CRASH  
LANDING/ ENVIRONMENT EFFECTS/ FULL SCALE TESTS/  
HYDROGEN FUELS/ PROPELLER EFFICIENCY  
ABS: This paper describes the status of the current NASA  
programs that are aimed at providing new technology  
for aircraft designs that will improve both safety and  
utility while reducing the environmental impact of  
general aviation to acceptable levels. Safety related  
areas that are discussed include the full scale crash  
test program and the stall/spin research effort. Among  
the programs addressing increased utility and  
performance, advanced airfoil developments and engine  
cooling drag reduction are discussed. Noise and  
emission reduction is a subject that is receiving  
significant emphasis within the NASA programs. Also  
included is a description of the current status of the  
hydrogen injection concept as a means of both lowering  
emissions and increasing fuel economy.

RPT#: AIAA PAPER 75-319  
75A22515

UTTL: Air transportation energy consumption - Yesterday,  
today, and tomorrow  
AUTH: A/MASCY, A. C.; B/WILLIAMS, L. J.  
MAJS: /\*AIR TRANSPORTATION/\*ENERGY CONSUMPTION/\*FUEL  
CONSUMPTION/\*TECHNOLOGY ASSESSMENT  
MINS: / AIRLINE OPERATIONS/ CIVIL AVIATION/ PASSENGER  
AIRCRAFT/ PROPULSIVE EFFICIENCY/ SURFACE VEHICLES/  
TECHNOLOGICAL FORECASTING  
ABS: The energy consumption by aviation is reviewed and  
projections of its growth are discussed. Forecasts of  
domestic passenger demand are presented, and the  
effect of restricted fuel supply and increased fuel  
prices is considered. The most promising sources for  
aircraft fuels, their availability and cost, and  
possible alternative fuels are reviewed. The energy  
consumption by various air and surface transportation  
modes is identified and compared on typical  
portal-to-portal trips. A measure of the indirect  
energy consumed by ground and air modes is defined.  
Historical trends in aircraft energy intensities are  
presented and the potential fuel savings with new  
technologies are discussed.

RPT#: AIAA PAPER 75-584  
75A26737

UTTL: Advanced computer technology - An aspect of the  
Terminal Configured Vehicle program  
AUTH: A/BERKSTRESSER, B. K.  
MAJS: /\*AIR TRANSPORTATION/\*AIRBORNE/SPACEBORNE COMPUTERS/\*  
COMPUTER SYSTEMS DESIGN/\*TERMINAL FACILITIES  
MINS: / AIRCRAFT NOISE/ AUTOMATIC CONTROL/ CIVIL AVIATION/  
COMPUTER TECHNIQUES/ NOISE REDUCTION/ REDUNDANT  
COMPONENTS/ RELIABILITY ANALYSIS/ RESEARCH AND  
DEVELOPMENT/ TECHNOLOGY ASSESSMENT  
ABS: NASA is conducting a Terminal Configured Vehicle  
program to provide improvements in the air  
transportation system such as increased system  
capacity and productivity, increased all-weather  
reliability, and reduced noise. A typical jet  
transport has been equipped with highly flexible  
digital display and automatic control equipment to  
study operational techniques for conventional takeoff  
and landing aircraft. The present airborne computer  
capability of this aircraft employs a multiple  
computer simple redundancy concept. The next step is  
to proceed from this concept to a reconfigurable  
computer system which can degrade gracefully in the  
event of a failure, adjust critical computations to  
remaining capacity, and reorder itself, in the case of  
transients, to the highest order of redundancy and  
reliability.

RPT#: SAE PAPER 750500  
75A36678

UTTL: NASA General Aviation Research overview - 1975  
AUTH: A/WINBLADE, R. L.; B/WESTFALL, J. A.  
MAJS: /\*AIRCRAFT DESIGN/\*BIBLIOGRAPHIES/\*GENERAL AVIATION  
AIRCRAFT/\*NASA PROGRAMS/\*RESEARCH AND DEVELOPMENT/\*  
TECHNOLOGY ASSESSMENT  
MINS: / AIR TRANSPORTATION/ AIRCRAFT PRODUCTION/ AIRCRAFT  
SAFETY/ CIVIL AVIATION/ ENVIRONMENTAL CONTROL  
ABS: An overview of the 1975 NASA Research and Technology  
efforts directly focused on general aviation is  
presented. Current status and accomplishments during  
of the past year are described. An updated bibliography  
of technical reports generated by the NASA program,  
including seven recently declassified reports on  
airplane noise reduction, is included as an Appendix  
to this report.

RPT#: SAE PAPER 750523  
75A36663

UTTL: Wind tunnel and flight development of spoilers for  
general aviation aircraft  
AUTH: A/WENTZ, W. H., JR.; B/SEETHARAM, H. C.; C/CALHOUN,  
J. T.  
MAJS: /\*AIRCRAFT CONTROL/\*AIRFOIL PROFILES/\*GENERAL AVIATION  
AIRCRAFT/\*LATERAL CONTROL/\*SPOILERS/\*WIND TUNNEL TESTS  
MINS: / AERODYNAMIC INTERFERENCE/ AIR FLOW/ AIRCRAFT DESIGN/  
AIRCRAFT PERFORMANCE/ FLAPS (CONTROL SURFACES)/ MANUAL  
CONTROL/ VENTILATION  
ABS: Wind tunnel tests have been carried out to develop a  
spoiler lateral control system for use with the  
GA(W)-1 airfoil with a 30% Fowler flap. Tests show  
that unfavorable aerodynamic interactions can occur  
between spoiler and flap for large flap deflections.  
Providing venting of lower surface air through the  
spoiler opening substantially improves performance.  
Results of tests with a number of spoiler and cavity  
shapes are presented and discussed. Applications of  
two-dimensional wind tunnel results to the design of  
satisfactory manual lateral control systems are  
discussed.

RPT#: SAE PAPER 750528  
75A36666

UTTL: An in-flight investigation of nonlinear roll control  
AUTH: A/ELLIS, D. R.; B/TILAK, N. W.  
MAJS: /\*AIRCRAFT CONTROL/\*CONTROL SIMULATION/\*IN-FLIGHT  
MONITORING/\*LATERAL CONTROL/\*ROLLING MOMENTS  
MINS: / FLIGHT STABILITY TESTS/ INSTRUMENT LANDING SYSTEMS/  
LIGHT AIRCRAFT/ NONLINEAR SYSTEMS/ PILOT PERFORMANCE/  
SPOILER SLOT AILERONS/ TOUCHDOWN  
ABS: An in-flight simulation was undertaken to study the

piloting problems associated with a type of nonlinear  
control effectiveness which is characteristic of  
spoiler roll control systems. Typically, the initial  
response is small or even zero, followed by a narrow  
region of highly effective control, and a final one of  
moderate effectiveness. Results for the landing flare  
and touchdown, which turned out to be the critical  
flight phase, indicate that a substantial amount of  
dead zone and changing effectiveness can be tolerated,  
but the best level of handling is obtained with  
linear, aileron-like control.

RPT#: SAE PAPER 750544  
75A36675

UTTL: Discussion of an aeromechanical gust alleviation  
system to improve the ride comfort of light airplanes  
AUTH: A/STEWART, E. C.  
MAJS: /\*AERODYNAMIC STABILITY/\*AIRCRAFT STABILITY/\*COMFORT/\*  
GUST ALLEVIATORS/\*LIGHT AIRCRAFT  
MINS: / AIRCRAFT MODELS/ NASA PROGRAMS/ WIND TUNNEL TESTS/  
WING FLAPS  
ABS: A discussion of an on-going NASA research project of a  
gust alleviation system to improve the ride comfort of a  
light airplane is presented. The discussion includes  
a description of the proposed system which uses  
auxiliary aerodynamic surfaces to drive the  
trailing-edge flaps. The results of analytical work on  
the effects of the system on stability and  
effectiveness of the system are presented. Static  
wind-tunnel tests of the system installed in a  
1/6-scale model of a popular light airplane are also  
described. Problem areas which may need future  
investigation are discussed.

RPT#: SAE PAPER 750592  
75A40507

UTTL: NASA refan program status  
AUTH: A/ABDALLA, K. L.; B/YUSKA, J. A.  
MAJS: /\*AIRCRAFT DESIGN/\*ENGINE NOISE/\*JET AIRCRAFT NOISE/\*  
NASA PROGRAMS/\*NOISE REDUCTION/\*TURBOFAN ENGINES  
MINS: / AIRFRAMES/ CIVIL AVIATION/ NOISE POLLUTION/  
POLLUTION CONTROL/ TECHNOLOGY ASSESSMENT  
ABS: The objective of the refan program is to demonstrate  
the technical feasibility of substantially reducing  
the noise levels of existing JT8D powered aircraft.  
The program consists of the design, manufacturing and  
testing of the refan engines and modified nacelles and  
airplanes. Experimental testing has been completed for  
the refan engine both at sea level and at altitude  
conditions. Ground testing for the B727 side- and  
center-engine installations and flight testing of the  
DC-9 with refan engines and acoustic nacelles have  
been performed. Analyses of the test results are in  
progress. Preliminary results presented in this paper  
show that substantial noise reductions were achieved.

RPT#: AIAA PAPER 76-572  
76A38085

UTTL: Noise comparisons of single and two stage demonstrator fans for advanced technology aircraft

AUTH: A/HEIDMANN, M. F.

MAJS: /\*AERODYNAMIC CONFIGURATIONS/\*AERODYNAMIC NOISE/\*AIRCRAFT CONFIGURATIONS/\*ATLIT PROJECT/\*NOISE REDUCTION/\*TURBOFANS

MINS: / ACOUSTIC PROPERTIES/ DIRECTIVITY/ GRAPHS (CHARTS)/ NOISE INTENSITY/ NOISE SPECTRA/ TIP SPEED

ABS: A high-speed single-stage and a low-speed two-stage fan were designed, fabricated and tested to demonstrate their predicted low noise performance for an advanced 0.85-0.90 cruise Mach number aircraft requiring a 1.8-1.9 pressure ratio fan. Acoustic tests were made with both unsuppressed and suppressed configurations. The two-stage fan demonstrated that quiet fan technology developed for low-speed single-stage fan is applicable to two-stage designs. The unsuppressed two-stage fan was 3-5 dB quieter than the high-speed single-stage fan at the same pressure ratio. The unsuppressed high-speed single-stage fan demonstrated that significant reductions in inlet noise can be achieved from the sonic blockage caused by supersonic flow in the rotor blading. Both fans demonstrated suppressed inlet noise levels with treated sonic inlets that met advanced technology goals. Suppressed aft noise levels did not meet expectations for either fan. The aft noise problem is attributed to both excessive source noise and ineffective treatment performance.

RPT#: AIAA PAPER 76-939  
76A45414

UTTL: Prospective markets and design concepts for civilian remotely piloted aircraft

AUTH: A/NELMS, W. P., JR.; B/GREGORY, T. J.; C/ADERHOLD, J. R.

MAJS: /\*AIRCRAFT DESIGN/\*CIVIL AVIATION/\*REMOTELY PILOTED VEHICLES/\*USER REQUIREMENTS/\*UTILITY AIRCRAFT

MINS: / COST EFFECTIVENESS/ ENVIRONMENT EFFECTS/ FOREST FIRES/ METEOROLOGICAL RESEARCH AIRCRAFT/ OBSERVATION AIRCRAFT/ PATROLS/ SAFETY FACTORS/ TECHNOLOGY ASSESSMENT

ABS: This paper summarizes a study that examines the technical, economic, and environmental aspects of remotely piloted vehicles (RPVs) in the civil environment. A market survey was conducted in which 35 civil applications of RPVs were identified. For a number of these uses, vehicle and system concepts were defined, benefit and cost comparisons were made with present methods, and the influence of safety and environmental implications was assessed. The results suggest a sizable potential demand for the use of RPVs in the civil sector, and some of the applications show promising cost savings over established methods. A focussed technology effort could provide the safety assurances needed for routine civilian operation of RPVs.

RPT#: AIAA PAPER 76-1720  
76A33650

UTTL: A visual motion simulator for general aviation compensated within the nonlinear adaptive washout for actuator lag

AUTH: A/ASHWORTH, B. R.; B/PARRISH, R. V.

MAJS: /\*ACTUATORS/\*ADAPTIVE CONTROL/\*GENERAL AVIATION AIRCRAFT/\*MOTION SIMULATORS/\*TIME LAG/\*VISUAL AIDS

MINS: / AIRCRAFT INSTRUMENTS/ COCKPITS/ COMPUTER TECHNIQUES/ DEGREES OF FREEDOM/ DYNAMIC RESPONSE/ FREQUENCY RESPONSE/ MAN MACHINE SYSTEMS/ STEEPEST DESCENT METHOD

ABS: A description is presented of the general aviation aircraft simulator recently acquired by the Langley Research Center, summarizing the complement of instruments, radio/navigation equipment, control loading, and other features. Emphasis is placed mainly on the two-degree-of-freedom motion drives developed for this simulator and the presentation of the dynamic response of the motion system (without washout) in terms of amplitude ratio and phase lag as a function of frequency. The nonlinear adaptive washout based on continuous steepest descent optimization presents cues in pitch rate, surge, roll rate, and sway, and allows for actuator lag compensation.

RPT#: AIAA 76-1987  
76A41486

UTTL: Omega navigation for general aviation

AUTH: A/HOLLISTER, W. M.

MAJS: /\*AIR NAVIGATION/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*INSTRUMENT ERRORS/\*OMEGA NAVIGATION SYSTEM/\*RADIO NAVIGATION

MINS: / CIVIL AVIATION/ FEASIBILITY ANALYSIS/ NOISE GENERATORS/ POSITION ERRORS/ SIGNAL TO NOISE RATIOS

ABS: A 70-hour flight test evaluation of an Omega navigation system was performed using a Piper Cherokee 180, to determine the feasibility of Omega for worldwide general aviation navigation. Measurements were made of position accuracy, noise phenomena, and signal to noise ratio. It was found that Omega accuracy is essentially insensitive to local geography, but that there are isolated local interference phenomena associated with radio transmitters, although the strongest noise source observed was due to the onboard power source for the

VHF comm/nav radio. An occurrence of lane jumps was observed when attempting to navigate with one weak station.

RPT#: AIAA 76-1991  
76A41489

UTTL: Flight test evaluation of a separate surface attitude command control system on a Beech 99 airplane

AUTH: A/GEE, S. W.; B/JENKS, G. E.; C/ROSKAM, J.;  
D/STONE, R. L.

MAJS: /\*AIRCRAFT CONTROL/\*ATTITUDE CONTROL/\*BEECHCRAFT  
AIRCRAFT/\*COMMAND AND CONTROL/\*CONTROL SURFACES/\*  
FLIGHT TESTS

MINS: /AILERONS/ BLOCK DIAGRAMS/ FLY BY WIRE CONTROL/  
GENERAL AVIATION AIRCRAFT/ LOW COST/ RIDING QUALITY

ABS: A joint NASA/university/industry program was conducted to flight evaluate a potentially low cost separate surface implementation of attitude command in a Beech 99 airplane. Saturation of the separate surfaces was the primary cause of many problems during development. Six experienced professional pilots made simulated instrument flight evaluations in light-to-moderate turbulence. They were favorably impressed with the system, particularly with the elimination of control force transients that accompanied configuration changes. For ride quality, quantitative data showed that the attitude command control system resulted in all cases of airplane motion being removed from the uncomfortable ride region.

RPT#: SAE PAPER 751086  
76A22305

UTTL: Variable cycle engines for advanced supersonic transports

AUTH: A/HOWLETT, R. A.; B/KOZLOWSKI, H.

MAJS: /\*AIRCRAFT ENGINES/\*CIVIL AVIATION/\*ENGINE DESIGN/\*  
SUPERSONIC TRANSPORTS

MINS: /FUEL CONSUMPTION/ FUEL CONTROL/ JET AIRCRAFT NOISE/  
NOISE REDUCTION/ TURBOFAN ENGINES

ABS: Variable Cycle Engines being studied for advanced commercial supersonic transports show potential for significant environmental and economic improvements relative to 1st generation SST engines. The two most promising concepts are: a Variable Stream Control Engine and a Variable Cycle Engine with a rear flow-control valve. Each concept utilizes variable components and separate burners to provide independent temperature and velocity control for two coannular flow streams. Unique fuel control techniques are combined with cycle characteristics that provide low fuel consumption, similar to a turbojet engine, for supersonic operation. This is accomplished while

retaining the good subsonic performance features of a turbofan engine. A two-stream coannular nozzle shows potential to reduce jet noise to below FAR Part 36 without suppressors. Advanced burner concepts have the potential for significant reductions in exhaust emissions. In total, these unique engine concepts have the potential for significant overall improvements to the environmental and economic characteristics of advanced supersonic transports.

RPT#: SAE PAPER 760454  
76A31954

UTTL: Progress report on propeller aircraft flyover noise research

AUTH: A/METZGER, F. B.; B/MAGLIOZZI, B.; C/PEGG, R. J.

MAJS: /\*ACOUSTIC MEASUREMENTS/\*AIRCRAFT NOISE/\*FLIGHT  
CHARACTERISTICS/\*PROPELLER BLADES

MINS: /FAR FIELDS/ FLIGHT TESTS/ LIGHT AIRCRAFT/ NOISE  
GENERATORS/ NOISE SPECTRA/ PRESSURE DISTRIBUTION/  
TURBULENCE EFFECTS

ABS: Initial results of a program to investigate the sources of noise in unshrouded propellers under forward flight conditions are reported. Tests were conducted using a three-blade full-scale instrumented propeller mounted on a twin-engine aircraft. Measurements included (1) far-field noise at fixed ground stations and at two aircraft wing tip locations, (2) blade surface pressures at seven locations on one of the propeller blades, (3) atmospheric turbulence encountered by the aircraft in flight, and (4) aircraft operating conditions. The results confirm that significantly lower levels of propeller noise are produced in forward flight than at static conditions. It is tentatively concluded that propeller noise generation in flight may be dominated by steady loading at blade passage frequency, but at higher frequencies unsteady loading due to interaction with natural atmospheric turbulence may be the dominant mechanism of noise generation. Under static conditions the total noise signature appears to be the result of interaction of the propeller with persistent turbulent eddies passing through the propeller disk.

RPT#: SAE PAPER 760458  
76A31957

UTTL: NASA general aviation research overview - 1976

AUTH: A/WINBLADE, R. L.; B/WESTFALL, J. A.

MAJS: /\*AIRCRAFT DESIGN/\*BIBLIOGRAPHIES/\*GENERAL AVIATION  
AIRCRAFT/\*NASA PROGRAMS

MINS: /AERODYNAMIC STALLING/ AIRCRAFT CONFIGURATIONS/  
AIRCRAFT DESIGN/ AVIONICS/ ENVIRONMENT EFFECTS/  
TECHNOLOGY ASSESSMENT

**ABS:** Recent accomplishments in the field of general aviation are reviewed which resulted from NASA's steadily improving communication with the industry and user community, both on a formal level and through more direct involvement in the research activities. Several NASA programs are examined whose aim is to provide new technologies across the board for improvements in safety, efficiency, and reduction of the impact of general aviation on the environment. The use of the results of some NASA programs in designing new aircraft is demonstrated. A list of technical reports generated by the NASA program is given in an appendix.

RPT#: SAE PAPER 760460  
76A31958

**UTTL:** NASA study of an automated Pilot Advisory System  
**AUTH:** A/PARKER, L. C.  
**MAJS:** /\*ACCIDENT PREVENTION/\*AIRCRAFT COMMUNICATION/\*AIRCRAFT PILOTS/\*AUTOMATION/\*GROUND-AIR-GROUND COMMUNICATIONS/\*NASA PROGRAMS/\*SYSTEMS ANALYSIS/\*VOICE COMMUNICATION

**MINS:** / AIR TRAFFIC CONTROL/ AIRCRAFT ACCIDENTS/ AIRPORTS/ GENERAL AVIATION AIRCRAFT/ MIDAIR COLLISIONS/ NASA PROGRAMS/ WARNING SYSTEMS

**ABS:** A Pilot Advisory System (PAS) concept for high-density uncontrolled airports is discussed where the general aviation pilots will be provided with automatic audio voice airport and air traffic advisories within two minute intervals and with mid-air collision warnings whenever such situations arise. Free of manual inputs, the PAS includes the options of fixed-base operator runway select, automatic restart and self-test, and remote inquiry of system status and messages.

RPT#: SAE PAPER 760463  
76A31961

**UTTL:** Business jet approach noise abatement techniques - Flight test results

**AUTH:** A/PUTNAM, T. W.; B/BURCHAM, F. W.  
**MAJS:** /\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*JET AIRCRAFT NOISE/\*NOISE REDUCTION

**MINS:** / ACOUSTIC MEASUREMENTS/ APPROACH/ GLIDE PATHS/ JET ENGINES

**ABS:** Operational techniques for reducing approach noise from business jet aircraft were evaluated in flight by measuring the noise generated by five such aircraft during modified approaches. Approaches with 4-deg glide slopes were approximately 4.0 EPNdB quieter than approaches with standard 3-deg glide slopes. Noise reductions for low-drag 3-deg approaches varied widely among the airplanes tested; the fleet-weighted

reduction was 8.5 EPNdB. Two-segment approaches resulted in noise reductions of 7.0 EPNdB to 8.5 EPNdB 3 nautical miles and 5 nautical miles from touchdown. Pilot workload increased progressively for the 4-deg, low-drag 3-deg, and two-segment approach.

RPT#: SAE PAPER 760466  
76A31962

**UTTL:** The impact of interior cabin noise on passenger acceptance

**AUTH:** A/RUDRAPATNA, A. N.; B/JACOBSON, I. D.  
**MAJS:** /\*AIRCRAFT COMPARTMENTS/\*AIRCRAFT NOISE/\*GENERAL AVIATION AIRCRAFT/\*HUMAN REACTIONS/\*NOISE TOLERANCE/\*PASSENGER AIRCRAFT

**MINS:** / COMFORT/ FLIGHT TESTS/ GRAPHS (CHARTS)/ HUMAN FACTORS ENGINEERING/ NOISE SPECTRA

**ABS:** Based on flight test data gathered in general aviation aircraft, a composite motion-noise passenger comfort model has been developed which enables the assessment of cabin interior noise impact on passenger acceptance. Relationships between special subject responses and passenger responses are given, as well as the effect of comfort on passenger acceptance. The importance of comfort and noise on the overall passenger reaction is discussed.

RPT#: SAE PAPER 760469  
76A31964

**UTTL:** New potentials for conventional aircraft when powered by hydrogen-enriched gasoline

**AUTH:** A/MENARD, W. A.; B/MOYNIHAN, P. I.; C/RUPE, J. H.  
**MAJS:** /\*AIRCRAFT FUELS/\*ENGINE TESTS/\*EXHAUST GASES/\*FUEL CONSUMPTION/\*GASOLINE/\*HYDROGEN FUELS/\*PISTON ENGINES  
**MINS:** / AIRCRAFT PERFORMANCE/ BEECHCRAFT AIRCRAFT/ GENERAL AVIATION AIRCRAFT/ HORSEPOWER/ NASA PROGRAMS/ POLLUTION CONTROL/ SYSTEMS ANALYSIS/ THERMODYNAMIC EFFICIENCY

**ABS:** Hydrogen enrichment for aircraft piston engines is under study in a new NASA program. The objective of the program is to determine the feasibility of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels. A catalytic hydrogen generator will be incorporated as part of the air induction system of a Lycoming turbocharged engine and will generate hydrogen by breaking down small amounts of the aviation gasoline used in the normal propulsion system. This hydrogen will then be mixed with gasoline and compressed air from the turbocharger before entering the engine combustion chamber. The special properties of the hydrogen-enriched gasoline allow the engine to operate at ultralean fuel/air ratios.

resulting in higher efficiencies and hence less fuel consumption. This paper summarizes the results of a systems analysis study. Calculations assuming a Beech Duke aircraft indicate that fuel savings on the order of 20% are possible. An estimate of the potential for the utilization of hydrogen enrichment to control exhaust emissions indicates that it may be possible to meet the 1979 Federal emission standards.

produce roll helix angles in excess of 0.11 rad. Flight testing is planned to document climb and cruise performance, and supercritical propeller performance and noise characteristics. The airplane is scheduled for testing in the NASA-Langley Research Center Full-Scale Tunnel.

RPT#: SAE PAPER 760476  
76A31968

UTTL: General aviation design synthesis utilizing interactive computer graphics  
AUTH: A/GALLOWAY, T. L.; B/SMITH, M. R.  
MAJS: /\*AIRCRAFT DESIGN/\*COMPUTER GRAPHICS/\*COMPUTERIZED DESIGN/\*GENERAL AVIATION AIRCRAFT/\*MAN MACHINE SYSTEMS  
MINS: / AIRCRAFT CONFIGURATIONS/ COMPUTER PROGRAMS/ DESIGN ANALYSIS/ INPUT/OUTPUT ROUTINES/ NASA PROGRAMS  
ABS: Interactive computer graphics is a fast growing area of computer application, due to such factors as substantial cost reductions in hardware, general availability of software, and expanded data communication networks. In addition to allowing faster and more meaningful input/output, computer graphics permits the use of data in graphic form to carry out parametric studies for configuration selection and for assessing the impact of advanced technologies on general aviation designs. The incorporation of interactive computer graphics into a NASA developed general aviation synthesis program is described, and the potential uses of the synthesis program in preliminary design are demonstrated.

RPT#: SAE PAPER 760497  
76A31976

UTTL: Preliminary flight-test results of an advanced technology light twin-engine airplane /ATLIT/  
AUTH: A/HOLMES, B. J.; B/KOHLMAN, D. L.; C/CRANE, H. L.  
MAJS: /\*AIRCRAFT PERFORMANCE/\*ATLIT PROJECT/\*FLIGHT TESTS/\* LIGHT AIRCRAFT/\*PIPER AIRCRAFT  
MINS: / AERODYNAMIC STALLING/ AIRCRAFT CONFIGURATIONS/ LATERAL CONTROL/ PA-34 SENECA AIRCRAFT/ ROLL/ SPOILERS  
ABS: The present status and flight-test results are presented for the ATLIT airplane. The ATLIT is a Piper PA-34 Seneca I modified by the installation of new wings incorporating the GA(W)-1 (Whitcomb) airfoil, reduced wing area, roll-control spoilers, and full-span Fowler flaps. Flight-test results on stall and spoiler roll characteristics show good agreement with wind-tunnel data. Maximum power-off lift coefficients are greater than 3.0 with flaps deflected 37 deg. With flaps down, spoiler deflections can

RPT#: AIAA PAPER 77-258  
77A18206

UTTL: The technical challenge of air transportation - A Government view

AUTH: A/ROBERTS, L.

MAJS: /\*AIR TRANSPORTATION/\*CIVIL AVIATION/\*  
GOVERNMENT/INDUSTRY RELATIONS/\*RESEARCH AND  
DEVELOPMENT/\*TECHNOLOGICAL FORECASTING

MINS: / ECONOMIC ANALYSIS/ FLIGHT SIMULATORS/ SUPERSONIC  
TRANSPORTS/ URBAN DEVELOPMENT

ABS: This paper reviews the research and technology that must be conducted, and the facility investments that must be made, in order to assure that the United States is adequately prepared to meet the challenges that air transportation will provide in the future. The technical focal points for the next decade are reviewed in the context of the emerging pattern of air transportation needs for the remainder of the Century and the prospects for satisfying these needs are discussed. Particular attention is given to the responsibility that the Government must assume in aviation R&T and to the relationship that must be encouraged between the Government, the Industry and the University Community.

RPT#: AIAA PAPER 77-312  
77A18237

UTTL: Technical highlights in general aviation

AUTH: A/STICKLE, J. W.

MAJS: /\*AIRCRAFT DESIGN/\*GENERAL AVIATION AIRCRAFT/\*  
PROPULSION SYSTEM PERFORMANCE/\*RESEARCH AND  
DEVELOPMENT

MINS: / AIR POLLUTION/ AIRCRAFT PERFORMANCE/ AIRCRAFT SAFETY  
/ AIRCRAFT STRUCTURES/ AIRFOIL PROFILES/ AVIONICS/  
DRAG REDUCTION/ NOISE REDUCTION/ POLLUTION CONTROL/  
PROPULSIVE EFFICIENCY/ TECHNOLOGY ASSESSMENT

ABS: Improvements in performance, safety, efficiency, and emissions control in general aviation craft are reviewed. While change is slow, the U.S. industries still account for the bulk (90%) of the world's general aviation fleet. Advances in general aviation aerodynamics, structures and materials, acoustics, avionics, and propulsion are described. Supercritical airfoils, drag reduction design, stall/spin studies, crashworthiness and passenger safety, fiberglass materials, flight noise abatement, interior noise and vibration reduction, navigation systems, quieter and cleaner (reciprocating, turboprop, turbofan) engines, and possible benefits of the Global Position Satellite System to general aviation navigation are covered in the discussion. Some of the developments are illustrated.

RPT#: AIAA 77-444  
77A25802

UTTL: Methods of reducing low frequency cabin noise and sonically induced stresses, based on the intrinsic structural tuning concept

AUTH: A/SENGUPTA, G.

MAJS: /\*ACOUSTIC ATTENUATION/\*AIRCRAFT NOISE/\*AIRCRAFT  
STRUCTURES/\*LOW FREQUENCIES/\*NOISE REDUCTION/\*TUNING

MINS: / AIRCRAFT COMPARTMENTS/ DAMPING TESTS/ DYNAMIC  
STRUCTURAL ANALYSIS/ FREQUENCY RESPONSE/ FUSELAGES/  
POWER SPECTRA/ STRINGERS/ STRUCTURAL STRAIN

ABS: Control of low frequency interior noise has been difficult in all commercial and general aviation aircraft, since the existing sound attenuation techniques are less effective at these frequencies. Therefore low frequency cabin noise and sonically induced stresses can be reduced mainly by a proper design of the fuselage structure. For this purpose, a concept based on intrinsic tuning and damping of fuselage structural elements has been under development at Boeing for the past three years. This paper describes the results of some laboratory and field tests that were conducted for evaluation of the concept.

RPT#: AIAA 77-1102  
77A42805

UTTL: Application of microelectronic technology to general aviation flight control

AUTH: A/SORENSEN, J. A.; B/TASHKER, M. G.; C/DEBRA, D. B.

MAJS: /\*AVIONICS/\*FEEDBACK CONTROL/\*FLIGHT CONTROL/\*GENERAL  
AVIATION AIRCRAFT/\*MICROELECTRONICS/\*TECHNOLOGY  
UTILIZATION

MINS: / ACCELEROMETERS/ AIRCRAFT CONTROL/ ATTITUDE CONTROL/  
ELECTRONIC CONTROL/ INSTRUMENT ERRORS/ MAGNETOMETERS/  
PRESSURE SENSORS/ SOLID STATE DEVICES

ABS: This paper presents several different methods that can be used to determine the aircraft orientation (attitude) without direct measurement. The methods combine state estimation techniques with measurements from solid state pressure sensors, accelerometers, and magnetometers to determine the aircraft state. The paper demonstrates how the estimation algorithms were validated and compared using flight test data, and it presents results of performance sensitivity analyses of sensor error, modeling inaccuracies, and wind disturbance effects on the attitude estimation errors. If implemented, the methods presented could make it possible to eliminate directional and vertical gyros and to change from many isolated sensors to an integrated, small, reliable sensing package for determining the aircraft state.

RPT#: AIAA PAPER 77-1217  
77A44319

UTTL: Flight test results for an advanced technology light airplane  
AUTH: A/KOHLMAN, D. L.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT DESIGN/\*FLIGHT TESTS/\*LIGHT AIRCRAFT  
MINS: / CESSNA AIRCRAFT/ DRAG REDUCTION/ DYNAMIC STABILITY/ FLAPS (CONTROL SURFACES)/ GUST LOADS/ WING LOADING/ WING PLANFORMS  
ABS: A single-engine light airplane was modified by the installation of a wing with reduced area, Fowler flaps, Kruger flaps, and spoilers. Flight test results show that zero-lift drag was reduced 13.8% and a trimmed maximum lift coefficient of 2.73 was achieved. Gust response was significantly reduced and excellent roll control was achieved with spoilers. Several design features employed in the new wings have excellent potential for incorporation in future light airplanes.

RPT#: AIAA PAPER 77-1248  
77A44337

UTTL: Optimum acoustic design of free-running low speed propellers  
AUTH: A/ORMSBEE, A. I.; B/WOAN, C. J.  
MAJS: /\*AERODYNAMIC LOADS/\*NOISE REDUCTION/\*PROPELLER BLADES /\*SOUND PRESSURE/\*STRUCTURAL DESIGN  
MINS: / AIRCRAFT WAKES/ GENERAL AVIATION AIRCRAFT/ NONLINEAR PROGRAMMING/ OPTIMIZATION/ THRUST/ TORQUE  
ABS: A theoretical analysis is conducted concerning the effect of blade loading on the noise output of a free-running propeller in axial motion. The minimization of the mean square sound pressure at a point in space is considered, taking into account constraints on propeller thrust and torque. Attention is given to aerodynamic equations, acoustic equations, the expansion of the aerodynamic variables, and the nonlinear programming formulation.

RPT#: AIAA 77-1494  
78A12243

UTTL: Advanced Digital Avionics System for general aviation  
AUTH: A/SMYTH, R. K.; B/HOH, R. H.; C/TEPER, G. L.  
MAJS: /\*AVIONICS/\*DIGITAL SYSTEMS/\*GENERAL AVIATION AIRCRAFT /\*SYSTEMS ENGINEERING  
MINS: / AIR NAVIGATION/ AIR TRAFFIC CONTROL/ AUTOMATIC FLIGHT CONTROL/ BLOCK DIAGRAMS/ CHANNELS (DATA TRANSMISSION)/ COMPUTER SYSTEMS PROGRAMS/ INSTRUMENT FLIGHT RULES/ MICROPROCESSORS  
ABS: Objectives and functions of the Advanced Digital Avionics System (ADAS) for general aviation are outlined with particular reference to navigation, flight control, engine management, ATC surveillance, flight management, communications, and the pilot controls and displays. The resulting ADAS design comprises the selection of off-the-shelf avionics to be integrated with ADAS-unique elements including new pilot displays and controls along with a microcomputer control complex (MCC). Reasons for which the ADAS achieves increased avionics capability are mentioned, including overall system integration through the MCC and pilot orientation from navigation map display.

RPT#: ASME PAPER 77-GT-36  
77A28551

UTTL: A study of commuter aircraft design  
AUTH: A/GALLOWAY, T. L.  
MAJS: /\*AIRCRAFT CONFIGURATIONS/\*AIRCRAFT DESIGN/\*PASSENGER  
AIRCRAFT/\*TURBOFAN AIRCRAFT/\*TURBOPROP AIRCRAFT  
MINS: / AIRCRAFT COMPARTMENTS/ AIRCRAFT NOISE/ AIRCRAFT  
PERFORMANCE/ AIRSPEED/ CIVIL AVIATION/ SIZING  
(SHAPING)/ WING PLANFORMS  
ABS: This paper investigates the impact of configuration  
considerations, mission requirements, and performance  
constraints on conceptual commuter aircraft designs.  
Emphasis is placed on direct comparisons between  
turbofan and turboprop powered aircraft in the 10-30  
passenger class. The analysis is accomplished using a  
computerized aircraft synthesis model that simulates  
the aircraft design and mission. The resulting  
conceptual aircraft are similar in size and  
performance regardless of engine type but the  
turboprop offers more mission flexibility

RPT#: ASME PAPER 77-GT-70  
77A28581

UTTL: Some measured and calculated effects of forward  
velocity on propeller noise  
AUTH: A/PEGG, R. J.; B/FARASSAT, F.; C/MAGLIOZZI, B.  
MAJS: /\*AIRCRAFT NOISE/\*AIRSPEED/\*NOISE MEASUREMENT/\*  
PROPELLERS/\*SHORT TAKEOFF AIRCRAFT  
MINS: / FLIGHT TESTS/ GENERAL AVIATION AIRCRAFT/ NOISE  
INTENSITY/ NOISE SPECTRA/ PREDICTION ANALYSIS  
TECHNIQUES/ STATIC TESTS/ TURBULENCE EFFECTS  
ABS: Test flights using a twin-engine, high-wing, light  
STOL transport plane powered by free turbine engines  
driving three-bladed propellers, were conducted at the  
NASA Wallops Flight Center. A ground-based acoustic  
measuring range was set up, and aircraft tracking  
information was supplied by a radar system. The noise  
of the unshrouded propeller was measured under static  
and forward flight conditions, and the measurements  
were compared with theory. Under static conditions,  
the principal noise is related to the unsteady loading  
associated with the interaction of the propeller with  
persistent turbulent eddies passing through the  
propeller disk. Through the use of existing prediction  
techniques, it was shown that changes in the geometry  
such as different airfoil thickness distribution can  
affect the radiated acoustic pressure signatures. This  
test program confirmed that lower propeller noise  
levels are produced in forward flight than under  
static conditions and that the most significant  
reductions occur at the midfrequencies which dominate  
perceived and A-weighted noise levels.

RPT#: ASME PAPER 77-GT-77  
77A28588

UTTL: NASA Quiet, Clean General Aviation Turbofan /QCGAT/  
program status  
AUTH: A/BRESNAHAN, D. L.; B/SIEVERS, G. K.  
MAJS: /\*ENGINE NOISE/\*GENERAL AVIATION AIRCRAFT/\*QUIET  
ENGINE PROGRAM/\*TURBOFAN ENGINES  
MINS: / AIR POLLUTION/ ENGINE DESIGN/ FUEL CONSUMPTION/  
NOISE POLLUTION/ POLLUTION CONTROL  
ABS: Emissions pollution studies, noise studies, and engine  
performance studies and their place in QCGAT  
developmental program status are reported. The  
Lycoming TFE 731 turbofan engine, the GE T700-GE-700  
high bypass ratio turbofan, and the AVCO-Lycoming LTS  
101 turboshaft engine are prominent candidates in the  
tests for urban quiet turbofan service. Two phases in  
the program are characterized. Engine quieting,  
polluting emissions abatement, and fuel economies are  
particularly important for the anticipated rise in  
number of jet propulsion craft using smaller airports  
adjacent to communities accustomed to low  
noise/pollution backgrounds.

RPT#: SAE PAPER 760928  
77A28233

UTTL: Technology outlook for aviation  
AUTH: A/ROBERTS, L.  
MAJS: /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*CIVIL AVIATION  
/\*TECHNOLOGICAL FORECASTING  
MINS: / AIRCRAFT CONFIGURATIONS/ HELICOPTER DESIGN/ ROTARY  
WINGS/ V/STOL AIRCRAFT  
ABS: Growth projections for aviation technology are put  
forth for a quarter-century ahead. Three main trends  
envisaged are towards: great efficiency and economy  
and longer range and endurance for subsonic aircraft;  
new generations of short-range fixed-wing craft and  
rotorcraft with versatile applicability; supersonic  
and hypersonic speeds. Improvements in lift/drag  
ratio, specific fuel consumption, structural weight  
factor, aerodynamic improvements (laminar flow  
control, increased wing aspect ratio, drag reduction  
for specified lift, propulsion efficiency, higher  
bypass ratios, composite structures) are discussed  
along with V/STOL, controllable twist rotors,  
circulation control rotors, variable-cycle engines,  
and higher structural efficiencies.

RPT#: SAE PAPER 770441  
77A37062

UTTL: Flight test data for light aircraft spoiler roll  
control systems  
AUTH: A/KOHLMAN, D. L.  
MAJS: /\*AIRCRAFT CONTROL/\*FLIGHT TESTS/\*LATERAL CONTROL/\*  
LIGHT AIRCRAFT/\*SPOILERS  
MINS: / AIRCRAFT DESIGN/ FLAPS (CONTROL SURFACES)/ ROLLING  
MOMENTS/ WIND TUNNEL TESTS/ YAW  
ABS: The results of flight tests to determine the  
characteristics of spoiler roll control systems on  
three different light aircraft are summarized.  
Comparisons are made with wind tunnel data where  
available. Flight tests indicate that excellent roll  
characteristics can be achieved with spoilers. Yaw  
coupling with roll control inputs is virtually  
eliminated. Roll rates remain high when flaps are  
deployed at low speed. Very mild nonlinearities in  
control effectiveness exist and there was no deadband  
or lag detected.

RPT#: SAE PAPER 770445  
77A37066

UTTL: Interior noise analysis and control for light aircraft  
AUTH: A/MIXSON, J. S.; B/BARTON, C. K.; C/VAICAITIS, R.  
MAJS: /\*AIRCRAFT NOISE/\*ENGINE NOISE/\*LIGHT AIRCRAFT/\*NOISE  
REDUCTION/\*NOISE SPECTRA  
MINS: / AIRCRAFT DESIGN/ NOISE MEASUREMENT/ NOISE

PROPAGATION/ PRESSURE DISTRIBUTION/ PROPELLER DRIVE/  
SOUND PRESSURE/ STRINGERS

ABS: This paper describes experimental and analytical  
studies of the interior noise of twin-engine,  
propeller-driven, light aircraft. Experimental results  
indicate that interior noise levels due to propeller  
noise can be reduced by reduction of engine rpm at  
constant airspeed (about 3 dB), by synchronization of  
the twin engines/propellers (up to 12 dB), and by  
increasing the distances from propeller tip to  
fuselage. The analytical model described uses modal  
methods and incorporates the flat-sided geometrical  
and skin-stringer structural features of light  
aircraft. Initial results show good agreement with  
measured noise transmitted into a rectangular box  
through a flat panel.

RPT#: SAE PAPER 770446  
77A37067

UTTL: Noise effects on passenger communication in light  
aircraft  
AUTH: A/RUPF, J. A.  
MAJS: /\*AIRCRAFT NOISE/\*CONVERSION/\*HUMAN REACTIONS/\*LIGHT  
AIRCRAFT/\*NOISE POLLUTION/\*VERBAL COMMUNICATION  
MINS: / GENERAL AVIATION AIRCRAFT/ LOW FREQUENCIES/ NOISE  
INTENSITY/ NOISE MEASUREMENT/ NOISE SPECTRA/  
PASSENGERS  
ABS: This paper considers the effect of noise on  
conversation between two persons seated in a close,  
side-by-side position such as in a small aircraft.  
Twelve pairs of subjects were required to converse  
while being exposed to noises of various levels and  
spectra similar to those currently found in general  
aviation aircraft. After a period of noise exposure,  
subjects rated the disruptive effect of the noise on  
conversation and judged the acceptability of the  
noise. Subjective estimates of the maximum times for  
pleasant conversation in the noises were also  
obtained.

RPT#: SAE PAPER 770471  
77A37089

UTTL: Utilization of separate surface control systems on  
general aviation aircraft  
AUTH: A/ROSKAM, J.  
MAJS: /\*AIRCRAFT CONTROL/\*CONTROL SURFACES/\*GENERAL AVIATION  
AIRCRAFT/\*SERVOCONTROL/\*SYSTEMS ANALYSIS  
MINS: / ACTUATORS/ AERODYNAMIC STABILITY/ AUTOMATIC FLIGHT  
CONTROL/ AUTOMATIC PILOTS/ BLOCK DIAGRAMS/ FEEDBACK  
CONTROL/ GRAPHS (CHARTS)/ STABILITY AUGMENTATION  
ABS: The application of separate surface control systems to  
general aviation aircraft is discussed. Block diagrams

of a conventional control system with autopilot tie-in and of a separate surface control system are presented, and the advantages and disadvantages of the two systems are compared. Theoretical descriptions of pilot-in-the-loop operation and operation in the autopilot mode are presented. The application of separate surface stability augmentation in yaw dampers, wing levelers, and static longitudinal stability augmentation is examined. The state-of-the-art of separate control surface technology is summarized.

RPT#: SAE PAPER 770473  
77A37091

UTTL: Investigation of a stall deterrent system utilizing an acoustic stall sensor

AUTH: A/BENNETT, A. G.; B/OWENS, J. K.; C/HARRIS, R. L.

MAJS: /\*AERODYNAMIC STALLING/\*AIRCRAFT CONTROL/\*GENERAL

AVIATION AIRCRAFT/\*WARNING SYSTEMS

MINS: / AIRCRAFT INSTRUMENTS/ ANGLE OF ATTACK/ CESSNA  
AIRCRAFT/ FLIGHT TESTS/ TIME RESPONSE

ABS: A simple rugged acoustic stall sensor which has an output proportional to angle of attack near wing stall has been evaluated on a Cessna 319 aircraft. A sensor position has been found on the wing where the sensor output is only slightly affected by engine power level, yaw angle, flap position and wing roughness. The NASA LRC General Aviation Simulator has been used to evaluate the acoustic sensor output as a control signal for active stall deterrent systems. It has been found that a simple control algorithm is sufficient for stall deterrence.

RPT#: SAE PAPER 770481  
77A37097

UTTL: Use of simplified flow separation criteria for slotted flap preliminary design

AUTH: A/WENTZ, W. H., JR.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*FLAPS (CONTROL SURFACES)/\*GENERAL AVIATION AIRCRAFT/\*SEPARATED FLOW

MINS: / ANGLE OF ATTACK/ DESIGN ANALYSIS/ INVISCID FLOW/  
PRESSURE DISTRIBUTION/ PRESSURE RECOVERY

ABS: From experimental correlations of airfoil and flap pressure distributions, it is observed that flow separation is likely to occur when the canonical pressure recovery coefficient ( $C_{sub pr}$ ) exceeds a critical value. A procedure is described for obtaining the  $C_{sub pr}$  parameter from modified inviscid analysis. The procedure has been applied to preliminary design studies of a new slotted flap to determine the influence of shape and location. Experiments are planned to evaluate the flap designed

by this procedure.

RPT#: SAE PAPER 1124  
77A12192

UTTL: Air transportation energy efficiency - Alternatives and implications

AUTH: A/WILLIAMS, L. J.

MAJS: /\*AIR TRANSPORTATION/\*AIRCRAFT FUELS/\*ENERGY CONSERVATION/\*TRANSPORTATION ENERGY

MINS: / AIRCRAFT DESIGN/ AIRLINE OPERATIONS/ CIVIL AVIATION/  
ENERGY REQUIREMENTS/ FUEL CONSUMPTION/ TECHNOLOGICAL FORECASTING

ABS: Results from recent studies of air transportation energy efficiency alternatives are discussed, along with some of the implications of these alternatives. The fuel-saving alternatives considered include aircraft operation, aircraft modification, derivative aircraft, and new aircraft. In the near-term, energy efficiency improvements should be possible through small improvements in fuel-saving flight procedures, higher density seating, and higher load factors. Additional small near-term improvements could be obtained through aircraft modifications, such as the relatively inexpensive drag reduction modifications. Derivatives of existing aircraft could meet the requirements for new aircraft and provide energy improvements until advanced technology is available to justify the cost of a completely new design. In order to obtain significant improvements in energy efficiency, new aircraft must truly exploit advanced technology in such areas as aerodynamics, composite structures, active controls, and advanced propulsion.

RPT#: AIAA PAPER 78-43  
78A20651

UTTL: A review of NASA's propulsion programs for civil aviation  
AUTH: A/STEWART, W. L.; B/JOHNSON, H. W.; C/WEBER, R. J.  
MAJS: /\*AIRCRAFT ENGINES/\*CIVIL AVIATION/\*ENGINE DESIGN/\*  
NASA PROGRAMS/\*PROPULSION SYSTEM PERFORMANCE  
MINS: / AIRCRAFT DESIGN/ ENERGY CONSERVATION/ POWERED LIFT  
AIRCRAFT/ RESEARCH AND DEVELOPMENT/ SUBSONIC AIRCRAFT/  
SUPERSONIC AIRCRAFT/ TURBOFAN AIRCRAFT  
ABS: Five NASA engine-oriented propulsion programs of major importance to civil aviation are presented and discussed. Included are programs directed at exploring propulsion-system concepts for (1) energy-conservative subsonic aircraft (improved current turbofans, advanced turbofans, and advanced turboprops), (2) supersonic cruise aircraft (variable-cycle engines), (3) general aviation aircraft (improved reciprocating engines and small gas turbines), (4) powered-lift aircraft (advanced turbofans), and (5) advanced rotorcraft. These programs reflect the opportunities still existing for significant improvements in civil aviation through the application of advanced propulsion concepts

RPT#: AIAA PAPER 78-197  
78A20739

UTTL: Noise transmission into a light aircraft  
AUTH: A/VAICAITIS, R.; B/MCDONALD, W.  
MAJS: /\*ACOUSTIC PROPAGATION/\*AIRCRAFT NOISE/\*LIGHT AIRCRAFT  
/\*NOISE PROPAGATION/\*NOISE REDUCTION  
MINS: / AIRCRAFT COMPARTMENTS/ GRAPHS (CHARTS)/ SOUND  
PRESSURE/ WAVE EQUATIONS  
ABS: An analytical study on noise transmission into a cabin of a twin engine G/A aircraft is presented. The solution of the governing acoustic-structural equations of motion is developed utilizing modal expansions and a Galerkin type procedure. The exterior noise pressure inputs are taken from available experimental data. A direct comparison between theory and experiments on cabin noise levels is given. Interior noise reduction by stiffening, mass addition, and damping treatments is investigated. It is shown that a combination of added mass and damping could significantly reduce interior noise levels for this aircraft.

RPT#: AIAA 78-553  
78A32895

UTTL: Search and rescue by satellite  
AUTH: A/EHRLICH, E.; B/WILDER, F. N.  
MAJS: /\*COMMUNICATION SATELLITES/\*GROUND STATIONS/\*RESCUE  
OPERATIONS/\*SATELLITE OBSERVATION/\*SEARCHING  
MINS: / AIRCRAFT DETECTION/ GENERAL AVIATION AIRCRAFT/  
INTERNATIONAL COOPERATION/ MARINE ENVIRONMENTS/ RADIO  
BEACONS/ TRANSPONDERS  
ABS: A system of satellites, ground stations and user equipments is proposed to provide an operational demonstration, using existing technology, for the timely detection and position location of general aviation aircraft and marine distress incidents so that rescue efforts can be started as soon as possible. The spaceborne equipment will consist of a transponder capable of receiving signals from existing and planned distress beacons at 121.5, 243.0 and 406.0 MHz, and transmitting at 1543 MHz. The program has generated international interest with Canada, France and the USSR presently planning to participate jointly with the U.S. in the development of the space and ground hardware.

RPT#: AIAA 78-835  
78A32386

UTTL: New rotation-balance apparatus for measuring airplane spin aerodynamics in the wind tunnel  
AUTH: A/MALCOLM, G. N.  
MAJS: /\*AERODYNAMIC BALANCE/\*AIRCRAFT CONTROL/\*ROTARY  
STABILITY/\*SPIN DYNAMICS/\*WIND TUNNEL APPARATUS  
MINS: / AERODYNAMIC CHARACTERISTICS/ ANGLE OF ATTACK/  
ANGULAR VELOCITY/ FIGHTER AIRCRAFT/ GRAPHS (CHARTS)/  
REYNOLDS NUMBER/ SPIN STABILIZATION  
ABS: An advanced rotation-balance apparatus has been developed for the Ames 12-ft pressure tunnel to study the effects of spin rate, angles of attack and sideslip, and, particularly, Reynolds number on the aerodynamics of fighter and general aviation aircraft in a steady spin. Angles of attack to 100 deg and angles of sideslip to 30 deg are possible with spin rates to 42 rad/sec (400 rpm) and Reynolds numbers to 30 million/m on fighter models with wing spans that are typically 0.7 m. A complete description of the new rotation-balance apparatus, the sting/balance/model assembly, and the operational capabilities is given.

RPT#: AIAA PAPER 78-1476  
78A49787

**UTTL:** A method for localizing wing flow separation at stall to alleviate spin entry tendencies  
**AUTH:** A/FEISTEL, T. W.; B/ANDERSON, S. B.; C/KROEGER, R. A.  
**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT DESIGN/\*LEADING EDGES /\*LIGHT AIRCRAFT/\*SEPARATED FLOW/\*WING FLOW METHOD TESTS  
**MINS:** / FULL SCALE TESTS/ LIFT/ SPIN STABILIZATION/ VORTICES / WIND TUNNEL TESTS  
**ABS:** A wing leading-edge modification has been developed, applicable at present to single-engine light aircraft, which produces stabilizing vortices at stall and beyond. These vortices have the effect of fixing the stall pattern of the wing such that the various portions of the wing upper surface stall nearly symmetrically. The lift coefficient produced is essentially constant to very high angles of attack above the stall angle of the unmodified wing. It is hypothesized that these characteristics will help prevent inadvertent spin entry after a stall. Results are presented from recent large-scale wind-tunnel tests of a complete light aircraft, both with and without the modification.

RPT#: AIAA PAPER 78-1477  
78A47922

**UTTL:** Correlation of model and airplane spin characteristics for a low-wing general aviation research airplane  
**AUTH:** A/BOWMAN, J. S., JR.; B/STOUGH, H. P.; C/BURK, S. M., JR.; D/PATTON, J. M., JR.  
**MAJS:** /\*AERODYNAMIC CONFIGURATIONS/\*GENERAL AVIATION AIRCRAFT/\*LOW WING AIRCRAFT/\*SPIN TESTS/\*TAIL ASSEMBLIES  
**MINS:** / AERODYNAMIC COEFFICIENTS/ CIVIL AVIATION/ MILITARY AVIATION/ RADIO CONTROL/ REMOTELY PILOTED VEHICLES/ TABLES (DATA)/ WIND TUNNEL TESTS

RPT#: AIAA PAPER 78-1480  
78A47925

**UTTL:** Some sound transmission loss characteristics of typical general aviation structural materials  
**AUTH:** A/ROSKAM, J.; B/VAN DAM, C.; C/GROSVELD, F.; D/DURENBERGER, D.  
**MAJS:** /\*AIRCRAFT CONSTRUCTION MATERIALS/\*ALUMINUM/\*FLAT PLATES/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\* SOUND TRANSMISSION/\*TRANSMISSION LOSS  
**MINS:** / ACOUSTIC MEASUREMENTS/ ACOUSTIC PROPAGATION/ GRAPHS (CHARTS)/ PANELS/ PLANE WAVES/ PRESSURE EFFECTS/ STIFFNESS/ TEST FACILITIES/ VIBRATION DAMPING  
**ABS:** Experimentally measured sound transmission loss characteristics of flat aluminum panels with and without damping and stiffness treatment are presented and discussed. The effect of pressurization on sound transmission loss of flat aluminum panels is shown to be significant.

RPT#: AIAA PAPER 78-1482  
78A47927

**UTTL:** Integrated avionics for future general aviation aircraft  
**AUTH:** A/DENERY, D. G.; B/JACKSON, C. T., JR.; C/CALLAS, G. P.; D/BERKSTRESSER, B. K.; E/HARDY, G. H.  
**MAJS:** /\*AIR TRAFFIC CONTROL/\*AIRCRAFT RELIABILITY/\*AVIONICS /\*GENERAL AVIATION AIRCRAFT/\*SYSTEMS ENGINEERING  
**MINS:** / AIRCRAFT DESIGN/ AIRCRAFT MAINTENANCE/ CHANNELS (DATA TRANSMISSION)/ COST EFFECTIVENESS/ DISPLAY DEVICES/ ELECTRONIC MODULES/ MICROPROCESSORS  
**ABS:** The program described was initiated in 1975 to provide the critical information for the design of an advanced avionics system suitable for general aviation. Emphasis is on the use of data busing, distributed microsensors, shared electronic displays and pilot entry devices, innovative low-cost sensors, and improved functional characteristics. Design considerations include cost, reliability, maintainability, and modularity.

RPT#: AIAA PAPER 78-1551  
78A46514

UTTL: A historical overview of stall/spin characteristics of  
general aviation aircraft

AUTH: A/ANDERSON, S. B.

MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*AERODYNAMIC STALLING/\*  
AIRCRAFT STABILITY/\*GENERAL AVIATION AIRCRAFT/\*SPIN  
STABILIZATION

MINS: / AERODYNAMIC COEFFICIENTS/ AERODYNAMIC STABILITY/  
AIRSPEED/ ANGLE OF ATTACK/ LIFT/ LONGITUDINAL  
STABILITY/ LOW SPEED STABILITY/ PITCH (INCLINATION)/  
STATIC STABILITY/ TURBULENCE EFFECTS

ABS: Even today, stall/spin accidents involving general  
aviation aircraft account for more fatal and serious  
injuries than any other kind of accident. The classic  
stall/spin accident is one in which the pilot stalls  
the aircraft at too low an altitude to affect  
recovery. The primary attention in the investigation  
is given to aerodynamic considerations, although it is  
recognized that human factors and pilot training are  
also very important aspects of the total problem. A  
review of some 70 years of flight indicates that  
incorporation of the proper combination of aerodynamic  
parameters to provide good stall/spin avoidance has  
persistently remained an elusive goal for designers of  
general aviation aircraft.

RPT#: AIAA PAPER 79-0561  
79A25870

UTTL: NASA research on general aviation power plants  
AUTH: A/STEWART, W. L.; B/WEBER, R. J.; C/WILLIS, E. A.;  
D/SIEVERS, G. K.  
MAJS: /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION  
AIRCRAFT/\*NASA PROGRAMS/\*RESEARCH AND DEVELOPMENT  
MINS: / DIESEL ENGINES/ FUEL CONSUMPTION/ PISTON ENGINES/  
PROPELLER EFFICIENCY/ PROPELLER FANS/ PROPULSION  
SYSTEM CONFIGURATIONS/ TURBOFAN ENGINES/ TURBOPROP  
ENGINES/ WANKEL ENGINES  
ABS: Research activities within NASA to support general  
aviation industry in improving propulsion engines are  
described. Near-term objectives include improvements  
of gasoline piston engines to achieve fuel savings and  
reduce emissions well below EPA levels. To meet the  
longer term goals, advanced combustion research has  
been considered as essential in obtaining further  
improvements in BSFC (break-specific fuel  
consumption). Modifications of an aircraft rotary  
engine were tested and it was found that by increasing  
the compression ratio and other refinements the BSFC  
was improved by 15%. The applicability of available  
large turbofan engine technology to small engines in  
order to obtain significant reductions in noise and  
pollutant emissions is being tested. Studies have been  
conducted at exploring the possibility of achieving  
high improvements in cost and performance for  
turboprop engines of less than 1000 horsepower.

RPT#: AIAA PAPER 79-0646  
79A26932

UTTL: Characteristics of propeller noise on an aircraft  
fuselage related to interior noise transmission  
AUTH: A/MIXSON, J. S.; B/BARTON, C. K.; C/PIERSOL, A. G.;  
D/WILBY, J. F.  
MAJS: /\*AIRCRAFT NOISE/\*FUSELAGES/\*LIGHT AIRCRAFT/\*NOISE  
PROPAGATION/\*NOISE SPECTRA/\*PROPELLERS  
MINS: / CORRELATION/ HARMONIC OSCILLATION/ NOISE INTENSITY/  
NOISE REDUCTION/ PROPELLER BLADES/ STATIC TESTS  
ABS: Exterior noise was measured on the fuselage of a  
twin-engine, light aircraft at four values of engine  
rpm in ground static tests and at forward speeds up to  
36 m/s in taxi tests. Propeller noise levels, spectra,  
and correlations were determined using a horizontal  
array of seven flush-mounted microphones and a  
vertical array of four flush-mounted microphones in  
the propeller plane. The measured levels and spectra  
are compared with predictions based on empirical and  
analytical methods for static and taxi conditions.  
Trace wavelengths of the propeller noise field,  
obtained from point-to-point correlations, are  
compared with the aircraft sidewall structural  
dimensions, and some analytical results are presented  
that suggest the sensitivity of interior noise  
transmission to variations of the propeller noise  
characteristics.

RPT#: AIAA 79-0780  
79A29024

UTTL: NASA/FAA general aviation crash dynamics program - A status report  
AUTH: A/THOMSON, R. G.; B/GOETZ, R. C.  
MAJS: /\*AIRCRAFT SAFETY/\*CRASHES/\*FULL SCALE TESTS/\*GENERAL AVIATION AIRCRAFT/\*IMPACT TESTS/\*NASA PROGRAMS/\* STRUCTURAL ANALYSIS  
MINS: / AIRCRAFT SURVIVABILITY/ DYNAMIC RESPONSE/ ELASTOPLASTICITY/ IMPACT LOADS/ LIGHT AIRCRAFT/ NASA PROGRAMS/ NONLINEAR SYSTEMS/ SAFETY DEVICES/ SEATS  
ABS: The objective of the Langley Research Center general aviation crash dynamics program is to develop technology for improved crash safety and occupant survivability in general aviation aircraft. The program involves three basic areas of research: controlled full-scale crash testing, nonlinear structural analyses to predict large deflection elasto-plastic response, and load attenuating concepts for use in improved seat and subfloor structure. Both analytical and experimental methods are used to develop expertise in these areas. Analyses include simplified procedures for estimating energy dissipating capabilities and complex computerized procedures for predicting airframe response. These analyses are being developed to provide designers with methods for predicting accelerations, loads, and displacements of collapsing structure. Tests on typical full-scale aircraft and on full- and sub-scale structural components are being performed to verify the analyses and to demonstrate load attenuating concepts.

RPT#: AIAA PAPER 79-1157  
79A38964

UTTL: General aviation turbine engine /GATE/ concepts  
AUTH: A/LAYS, E. J.; B/MURRAY, D. L.  
MAJS: /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT/\*PRODUCT DEVELOPMENT/\*TURBINE ENGINES  
MINS: / AIRCRAFT CONFIGURATIONS/ FUEL CONSUMPTION/ GRAPHS (CHARTS)/ LIFE CYCLE COSTS/ MARKET RESEARCH/ PISTON ENGINES/ TECHNOLOGY UTILIZATION  
ABS: The paper deals with only a portion of the work done by Williams Research Corporation for NASA. It provides a look at possible new-generation powerplants that offer the potential for remarkable airplane performance gains with attendant safety, utility, productivity and life cycle cost benefits. Attention is given to a turboprop engine concept and applications. A turbofan engine having core components in common with the turboprop is also discussed and an airplane application shown. Some of the more important findings are presented.

RPT#: AIAA 79-1625  
79A45307

UTTL: Application of the equilibrium spin technique to a typical low-wing general aviation design  
AUTH: A/TISCHLER, M. B.; B/BARLOW, J. B.  
MAJS: /\*AIRCRAFT DESIGN/\*EQUILIBRIUM METHODS/\*FULL SCALE TESTS/\*GENERAL AVIATION AIRCRAFT/\*LOW WING AIRCRAFT/\* SPIN REDUCTION  
MINS: / AERODYNAMIC FORCES/ ANGULAR MOMENTUM/ CENTER OF GRAVITY/ DATA REDUCTION/ DYNAMIC CHARACTERISTICS  
ABS: A graphical implementation of the equilibrium technique for obtaining spin modes from rotary balance data is presented. Using this technique, spin modes were computed for the NASA Low-Wing General Aviation Aircraft. The computed angles of attack are within 10 degrees of the NASA spin tunnel results. The method also provides information on the dynamic nature of spin modes. This technique offers the capability of providing a great deal of information on spin modes and recovery, using data from a single experimental installation. Such a technique could be utilized in the preliminary design phase in order to provide basic information on aircraft spin and recovery characteristics. Results, advantages and limitations of the application of this technique are discussed.

RPT#: AIAA 79-1775  
79A45403

UTTL: Preliminary study of pilot lateral control of two light airplanes near the stall  
AUTH: A/MOUL, M. T.; B/BROWN, L. W.  
MAJS: /\*AIRCRAFT PILOTS/\*FLIGHT CONDITIONS/\*LATERAL CONTROL /\*LATERAL STABILITY/\*LIGHT AIRCRAFT  
MINS: / AERIAL RUDDERS/ AERODYNAMIC CHARACTERISTICS/ AERODYNAMIC STALLING/ ANGLE OF ATTACK/ APPROACH CONTROL/ DIVERGENCE/ EQUATIONS OF MOTION/ TRANSFER FUNCTIONS/ TURNING FLIGHT  
ABS: For two representative light, single-engine airplanes the single-axis piloting task of controlling bank angle with combined aileron and rudder, and a two-axis task of controlling bank angle with aileron and sideslip with rudder have been studied. For these tasks existing divergence criteria have been applied to determine conditions for closed-loop stability for selected flight conditions near the stall; in addition closed-loop stability characteristics and airplane response to bank angle command were calculated. Results obtained from applying the divergence criterion and from calculations of airplane responses

to bank angle command indicate that aileron-alone bank angle control is marginally acceptable at high angle of attack. Of the two rudder control techniques considered, rudder used with the aileron in controlling bank angle increased stability and produced satisfactory responses; the combined bank angle and sideslip control task does not warrant further consideration because of the task difficulty and the small improvement indicated in airplane closed-loop response with this technique.

RPT#: AIAA PAPER 79-1786  
79A47876

**UTTL:** The effects of configuration changes on spin and recovery characteristics of a low-wing general aviation research airplane

**AUTH:** A/STOUGH, H. P., III; B/PATTON, J. M., JR.

**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT CONFIGURATIONS/\*AIRCRAFT SPIN/\*GENERAL AVIATION AIRCRAFT/\*RESEARCH AIRCRAFT/\*SPIN TESTS

**MINS:** / AIRCRAFT ACCIDENTS/ AIRFOIL PROFILES/ CONFIGURATION MANAGEMENT/ CONTROL SURFACES/ FLIGHT TESTS/ GRAPHS (CHARTS)/ NASA PROGRAMS/ REYNOLDS NUMBER/ TABLES (DATA)

**ABS:** A fully instrumented, low-wing, single-engine general aviation airplane has been spin tested. Several tail configurations, wing leading-edge modifications, fuselage modifications, moment-of-inertia variations, center-of-gravity positions, and control inputs have been tested to determine their effect on spinning and spin recovery. Results indicate that wing airfoil design can significantly influence airplane spin and recovery characteristics and can overpower the effects of tail design. Results also point out a need to determine limitations of such factors as Reynolds number in model spin test techniques and high angle-of-attack aerodynamics.

RPT#: AIAA PAPER 79-1790  
79A47879

**UTTL:** Some results from the use of a control augmentation system to study the developed spin of a light plane

**AUTH:** A/OBRYAN, I. C.; B/GLOVER, K. E.; C/EDWARDS, T. E.

**MAJS:** /\*AIRCRAFT CONTROL/\*LIGHT AIRCRAFT/\*ROCKET THRUST/\*SPIN DYNAMICS/\*SPIN TESTS/\*THRUST CONTROL

**MINS:** / AERODYNAMIC STALLING/ ANGLE OF ATTACK/ HYDROGEN PEROXIDE/ WING TIPS

**ABS:** A control augmentation system consisting of hydrogen peroxide rockets mounted on the wing tips of a light airplane has been developed and used to study spin recovery characteristics. Recovery from spins that were unrecoverable with aerodynamic controls was accomplished in less than one turn at maximum thrust in about three turns at minimum thrust. The rocket system at maximum thrust produced spin recovery characteristics similar to those obtained using a parachute. An advantage of using the control augmentation system on any airplane being used in a spin test program is its capability to demonstrate configuration effects on stall/spin characteristics at very high angles of attack and clearly determine the existence of all possible spin modes.

RPT#: AIAA PAPER 79-1802  
79A47887

**UTTL:** Some flight data extraction techniques used on a general aviation spin research aircraft

**AUTH:** A/SLIWA, S. M.

**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT SPIN/\*DATA ACQUISITION/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*IN-FLIGHT MONITORING/\*RESEARCH AIRCRAFT/\*SPIN TESTS

**MINS:** / AERODYNAMIC LOADS/ AIRCRAFT CONTROL/ DATA COLLECTION PLATFORMS/ DATA REDUCTION/ DYNAMIC STRUCTURAL ANALYSIS / LOAD DISTRIBUTION (FORCES)/ NASA PROGRAMS/ STRUCTURAL DESIGN CRITERIA

**ABS:** Some methods for obtaining flight data from a highly instrumented general aviation spin research aircraft are developed and illustrated. The required correction terms for the measurement of body accelerations, body velocities, and aircraft orientation are presented. In addition, the equations of motion are utilized to derive total aerodynamic coefficients for comparison with model tests and for analysis. Flight test experience is used to evaluate the utility of various instruments and calculation techniques for spin research.

RPT#: AIAA PAPER 79-1820  
79A47900

UTTL: Full-scale wind tunnel study of nacelle shape on cooling drag  
AUTH: A/CORSIGLIA, V. R.; B/KATZ, J.; C/KROEGER, R. A.  
MAJS: /\*AIR COOLING/\*DRAG REDUCTION/\*EXHAUST SYSTEMS/\*GENERAL AVIATION AIRCRAFT/\*NACELLES/\*WIND TUNNEL TESTS  
MINS: / AERODYNAMIC DRAG/ AIRCRAFT DESIGN/ GRAPHS (CHARTS)/ PISTON ENGINES/ PLENUM CHAMBERS/ PRESSURE DISTRIBUTION / TEST EQUIPMENT  
ABS: Tests were made in the NASA-Ares 40- by 80 Foot Wind Tunnel of a wing semispan with a nacelle (no propeller) from a typical, general aviation twin-engine aircraft. Measurements were made of the effect on drag of the cooling air flow through the nacelle. Internal and external nacelle pressures were measured. It was found that the cooling flow accounts for about 13% of the estimated airplane drag and about 42% of the cooling flow drag is associated with the internal flow. It was concluded that improvements could be made by relocating both the inlet and the outlet of the cooling air.

RPT#: AIAA PAPER 79-1824  
79A53750

UTTL: An overview of NASA research on positive displacement type general aviation engines  
AUTH: A/KEMPKE, E. E.; B/WILLIS, E. A.  
MAJS: /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS/\*RESEARCH AND DEVELOPMENT  
MINS: / AIRCRAFT DESIGN/ COMBUSTION EFFICIENCY/ DIESEL ENGINES/ FUEL INJECTION/ SPARK IGNITION/ TURBINE ENGINES/ WEIGHT REDUCTION  
ABS: The paper surveys the current status of the aviation positive displacement engine programs underway at the NASA Lewis Research Center. The program encompasses conventional, lightweight diesel, and rotary combustion engines. Attention is given to topics such as current production type engine improvement, cooling drag reduction, fuel injection, and experimental and theoretical combustion studies. It is shown that the program's two major technical thrusts are directed toward lean operation of current production type spark ignition engines and advanced alternative engine concepts. Finally, an Otto cycle computer model is also covered.

RPT#: AIAA PAPER 79-1837  
79A47908

UTTL: Exploratory study of the influence of wing leading-edge modifications on the spin characteristics of a low-wing single-engine general aviation airplane  
AUTH: A/DICARLO, D. J.; B/JOHNSON, J. L., JR.  
MAJS: /\*AIRCRAFT DESIGN/\*GENERAL AVIATION AIRCRAFT/\*LEADING EDGES/\*SPIN/\*WINGS  
MINS: / AERODYNAMIC STALLING/ AIRCRAFT CONFIGURATIONS/ RESEARCH AIRCRAFT/ TIME RESPONSE/ WIND TUNNEL MODELS  
ABS: A wide variety of model and airplane tests were conducted to explore the effects of wing leading-edge modifications on the stalling and spinning characteristics of a low-wing general aviation research airplane configuration. The results presented herein discuss the effects of leading-edge airfoil modifications applied to the full wing span and to partial-span locations. The results obtained in the study indicate that the wing modifications can produce large effects (both favorable or unfavorable) on spin resistance, developed spin characteristics, and spin recovery.

RPT#: ASAE PAPER 78-1506  
79A16723

UTTL: Analytical prediction of agricultural aircraft wakes

AUTH: A/MORRIS, D. J.

MAJS: /\*AIRCRAFT WAKES/\*COMPUTERIZED SIMULATION/\*GROUND  
EFFECT (AERODYNAMICS)/\*PREDICTION ANALYSIS TECHNIQUES  
/\*UTILITY AIRCRAFT/\*VORTICES

MINS: / AGRICULTURE/ AIRCRAFT GUIDANCE/ FLIGHT TESTS/  
MONOPLANES/ WIND TUNNEL TESTS

ABS: An analytical technique has been developed to understand the formation, interaction, and decay of lift-generated vortices. It is possible, by use of a computer code, to give a complete description of the viscous rollup of individual vortices from a wing. That the interaction of the vortex wake with the ground is a viscous interaction is demonstrated. Comparisons are given of experimental model data and predictions of vortex location for agricultural aircraft. The future of these codes in guiding wind-tunnel and flight research and in providing operational mission guidance is discussed.

RPT#: ASAE PAPER 78-1507  
79A16724

UTTL: NASA Agricultural Aircraft Research Program in the Langley Vortex Research Facility and the Langley Full Scale Wind Tunnel

AUTH: A/JORDAN, F. L., JR.; B/MCLEMORE, H. C.; C/BRAGG, M. B.

MAJS: /\*AGRICULTURE/\*AIRCRAFT WAKES/\*COMPUTERIZED SIMULATION  
/\*UTILITY AIRCRAFT/\*WIND TUNNEL TESTS

MINS: / AIRCRAFT MODELS/ DISPERSIONS/ DRIFT RATE/ FULL SCALE  
TESTS/ NASA PROGRAMS/ PARTICLES

ABS: The current status of aerial applications technology research at the Langley's Vortex Research Facility and Full-Scale Wind Tunnel is reviewed. Efforts have been directed mainly toward developing and validating the required experimental and theoretical research tools. A capability to simulate aerial dispersal of materials from agricultural airplanes with small-scale airplane models, numerical methods, and dynamically scaled test

particles was demonstrated. Tests on wake modification concepts have proved the feasibility of tailoring wake properties aerodynamically to produce favorable changes in deposition and to provide drift control. An aerodynamic evaluation of the Trush Commander 800 agricultural airplane with various dispersal systems installed is described. A number of modifications intended to provide system improvement to both airplane and dispersal system are examined, and a technique for documenting near-field spray characteristics is evaluated.

RPT#: SAE PAPER 790565  
79A36706

UTTL: Spin flight research summary  
AUTH: A/PATTON, J. M., JR.; B/STOUGH, H. P., III;  
C/DICARLO, D. J.  
MAJS: /\*AERODYNAMIC STALLING/\*AIRCRAFT CONFIGURATIONS/\*  
AIRCRAFT CONTROL/\*BODY-WING AND TAIL CONFIGURATIONS/\*  
FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*SPIN  
STABILIZATION  
MINS: / AIRFOIL PROFILES/ HORIZONTAL TAIL SURFACES/ LEADING  
EDGES/ LIGHT AIRCRAFT/ MASS DISTRIBUTION  
ABS: An extensive general aviation stall/spin research  
program is underway at the NASA Langley Research  
Center. Flight tests have examined the effects of tail  
design, wing leading edge design, mass distribution,  
and minor airframe modifications on spin and recovery  
characteristics. Results and observations on test  
techniques are presented for the first airplane in the  
program. Configuration changes produced spins varying  
from easily recoverable slow, steep spins to  
unrecoverable, fast flat spins.

RPT#: SAE PAPER 790569  
79A36709

UTTL: A Demonstration Advanced Avionics System for general  
aviation  
AUTH: A/DENERY, D. G.; B/CALLAS, G. P.; C/JACKSON, C. T.;  
D/BERKSTRESSER, B. K.; E/HARDY, G. H.  
MAJS: /\*AVIONICS/\*GENERAL AVIATION AIRCRAFT/\*SYSTEMS  
ENGINEERING  
MINS: / AIRFRAMES/ ARCHITECTURE (COMPUTERS)/ DISPLAY DEVICES  
/ LOW COST/ MICROPROCESSORS/ TECHNOLOGICAL FORECASTING  
ABS: A program initiated within NASA has emphasized the use  
of a data bus, microprocessors, electronic displays  
and data entry devices for general aviation. A  
Demonstration Advanced Avionics System (DAAS) capable  
of evaluating critical and promising elements of an  
integrating system that will perform the functions of  
(1) automated guidance and navigation; (2) flight  
planning; (3) weight and balance performance

computations; (4) monitoring and warning; and (5)  
storage of normal and emergency check lists and  
operational limitations is described. Consideration is  
given to two major parts of the DAAS instrument panel:  
the integrated data control center and an electronic  
horizontal situation indicator, and to the system  
architecture. The system is to be installed in the  
Ames Research Center's Cessna 402B in the latter part  
of 1980; engineering flight testing will begin in the  
first part of 1981.

RPT#: SAE PAPER 790576  
79A36712

UTTL: The analysis of propellers including interaction  
effects  
AUTH: A/MCCORMICK, B. W.; B/ALJABRI, A. S.; C/JUMPER, S.  
J.; D/MARTINOVIC, Z. N.  
MAJS: /\*AERODYNAMIC LOADS/\*DYNAMIC RESPONSE/\*GENERAL  
AVIATION AIRCRAFT/\*PERFORMANCE PREDICTION/\*PROPELLER  
BLADES/\*UNSTEADY FLOW  
MINS: / AERODYNAMIC INTERFERENCE/ AERODYNAMIC STABILITY/  
AIRCRAFT CONFIGURATIONS/ GRAPHS (CHARTS)/ THRUST/  
TORQUE/ VELOCITY DISTRIBUTION  
ABS: Analytical and experimental studies have been  
undertaken on propellers operating in the unsteady  
flow field produced by interaction effects due to the  
fuselage, wing, and nacelles. Methods have been  
developed and verified experimentally for determining  
the velocity field in which a propeller operates as  
well as its aerodynamic and dynamic response to this  
unsteady environment. Methods are presented for  
predicting the net thrust of a propeller-wing-body  
combination as well as the unsteady thrust and torque  
acting on the propeller. Sample calculations as well  
as wind tunnel and flight test results are presented  
which illustrates the sensitivity of a propeller to  
flow field in which it is operating.

RPT#: SAE PAPER 790584  
79A36719

UTTL: Design of quiet efficient propellers  
AUTH: A/SUCCI, G. P.  
MAJS: /\*AERODYNAMIC NOISE/\*DESIGN ANALYSIS/\*GENERAL AVIATION  
AIRCRAFT/\*MATHEMATICAL MODELS/\*NOISE REDUCTION/\*  
PROPELLERS  
MINS: / CESSNA 172 AIRCRAFT/ FLIGHT TESTS/ GRAPHS (CHARTS)/  
LOAD DISTRIBUTION (FORCES)/ NOISE SPECTRA/ PROPELLER  
EFFICIENCY/ RADIAL DISTRIBUTION/ SOUND PROPAGATION  
ABS: A numerical computation scheme has been developed to  
determine the sound generated by propellers. A  
comparison of these calculations to the noise data  
taken in the flight test of a propeller driven

aircraft shows good agreement. The method is then applied in a parametric study of fixed pitch propellers designed to reduce noise. All these techniques reduce noise while maintaining shaft speed so that the method presented here may be used in a retrofit option for the general aviation fleet.

RPT#: SAE PAPER 790588  
79A36722

UTTL: Nonlinear structural crash dynamics analyses  
AUTH: A/HAYDUK, R. J.; B/THOMSON, R. G.; C/WITTLIN, G.;  
D/KAMAT, M. P.

MAJS: /\*AIRCRAFT STRUCTURES/\*COMPUTERIZED SIMULATION/\*  
CRASHES/\*DROP TESTS/\*DYNAMIC RESPONSE/\*DYNAMIC  
STRUCTURAL ANALYSIS/\*FINITE ELEMENT METHOD/\*LIGHT  
AIRCRAFT

MINS: / ACCELEROMETERS/ AIRCRAFT ACCIDENTS/ COMPUTERIZED  
SIMULATION/ DESTRUCTIVE TESTS/ FUSELAGES/ GENERAL  
AVIATION AIRCRAFT/ GRAPHS (CHARTS)/ IMPACT DAMAGE/  
IMPACT LOADS/ LANDING SPEED/ MATHEMATICAL MODELS

ABS: Presented in this paper are the results of three nonlinear computer programs, KRASH, ACTION and DYCAST used to analyze the dynamic response of a twin-engine, low-wing airplane section subjected to a 8.38 m/s (27.5 ft/s) vertical impact velocity crash condition. This impact condition simulates the vertical sink rate in a shallow aircraft landing or takeoff accident. The three distinct analysis techniques for nonlinear dynamic response of aircraft structures are briefly examined and compared versus each other and the experimental data. The report contains brief descriptions of the three computer programs, the respective aircraft section mathematical models, pertinent data from the experimental test performed at NASA Langley, and a comparison of the analyses versus test results. Cost and accuracy comparisons between the three analyses are made to illustrate the possible uses of the different nonlinear programs and their future potential.

RPT#: SAE PAPER 790591  
79A36725

UTTL: NASA general aviation crashworthiness seat development  
AUTH: A/FASANELLA, E. L.; B/ALFARO-BOU, E.

MAJS: /\*ACCELERATION PROTECTION/\*GENERAL AVIATION AIRCRAFT/\*  
HUMAN FACTORS ENGINEERING/\*IMPACT TESTS/\*NASA PROGRAMS  
/\*SEATS

MINS: / ACCELERATION STRESSES (PHYSIOLOGY)/ ACCELERATION  
TOLERANCE/ COMPUTER GRAPHICS/ COMPUTERIZED SIMULATION/  
FULL SCALE TESTS/ HARNESSSES/ LIGHT AIRCRAFT/ SAFETY  
DEVICES

ABS: Three load limiting seat concepts for general aviation

aircraft designed to lower the deceleration of the occupant in the event of a crash were sled tested and evaluated with reference to a standard seat. Dummy pelvis accelerations were reduced up to 50 percent with one of the concepts. Computer program MSOMLA (Modified Seat Occupant Model for Light Aircraft) was used to simulate the behavior of a dummy passenger in a NASA full-scale crash test of a twin engine light aircraft. A computer graphics package MANPLOT was developed to pictorially represent the occupant and seat motion.

RPT#: SAE PAPER 790596  
79A36729

UTTL: Preliminary QCGAT program test results  
AUTH: A/KOENIG, R. W.; B/SIEVERS, G. K.

MAJS: /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION  
AIRCRAFT/\*NOISE REDUCTION/\*QUIET ENGINE PROGRAM/\*  
TURBOFAN ENGINES

MINS: / AIR POLLUTION/ AIRCRAFT DESIGN/ COMBUSTION CHAMBERS/  
EXHAUST GASES/ POLLUTION CONTROL

ABS: The paper presents the NASA Lewis program to demonstrate that large engine technology can be applied to general aviation engines to reduce noise, emissions, and fuel consumption. After a Phase I study, two Contractors, Garrett AiResearch and AVCO-Lycoming, were selected to design, manufacture, assemble, test, and deliver their Quiet, Clean, General Aviation Turbofan (QCGAT) engines to NASA. Noise, emission, and performance goals and how well they were met are discussed. Noise goals involve take off noise 3.5 n. mi. from runway threshold, sideline noise at .25 n mi. and approach noise 1 n mi. from the runway at an altitude of 370 ft. The AiResearch engines power a stretched Learjet 35 and the Lycoming a specially conceived Beech executive jet, resulting in differing power goals. Thus the thrust goal for the Lycoming was 1622 lb. while the AiResearch goal was 3937 lb. Cruise thrust goals were 485 lb. at Mach 0.6 at 25,000 ft. and 903 lb. at Mach 0.8 at 40,000 ft. respectively. The design of both engines, based on existing cores, is studied, noting such special QCGAT features as new reduction gears, combustor and power turbine. Test results are given, indicating that while the goals for noise and thrust were met those for emissions were only partially met.

RPT#: SAE PAPER 790605  
79A36737

**UTTL:** Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine

**AUTH:** A/REZY, B. J.; B/STUCKAS, K. J.; C/TUCKER, J. R.; D/MEYERS, J. E.

**MAJS:** /\*AIRCRAFT ENGINES/\*EXHAUST GASES/\*FUEL CONSUMPTION/\*GENERAL AVIATION AIRCRAFT/\*PISTON ENGINES/\*POLLUTION CONTROL

**MINS:** / CARBON MONOXIDE/ COMBUSTION CHAMBERS/ COOLING SYSTEMS/ COST EFFECTIVENESS/ FUEL INJECTION/ HYDROCARBONS/ IGNITION SYSTEMS/ LININGS/ NITROGEN OXIDES/ TEMPERATURE EFFECTS

**ABS:** A study was made to reduce exhaust emissions and fuel consumption of a general aviation aircraft piston engine by applying known technology. Fourteen promising concepts such as stratified charge combustion chambers, cooling cylinder head improvements, and ignition system changes were evaluated for emission reduction and cost effectiveness. A combination of three concepts, improved fuel injection system, improved cylinder head with exhaust port liners and exhaust air injection was projected as the most cost effective and safe means of meeting the EPA standards for CO, HC and NO. The fuel economy improvement of 4.6% over a typical single engine aircraft flight profile does not though justify the added cost of the three concepts, and significant reductions in fuel consumption must be applied to the cruise mode where most of the fuel is used. The use of exhaust air injection in combination with exhaust port liners reduces exhaust valve stem temperatures which can result in longer valve guide life. The use of exhaust port liners alone can reduce engine cooling air requirements by 11% which is the equivalent of a 1.5% increase in propulsive power. The EPA standards for CO, HC and NO can be met in the IO-520 engine using air injection alone or the Simmonds improved fuel injection system.

RPT#: SAE PAPER 790607  
79A36760

**UTTL:** Effects of air injection on a turbocharged Teledyne Continental Motors TS10-360-C engine

**AUTH:** A/COSGROVE, D. V.; B/KEMPKE, E. E.

**MAJS:** /\*AIRCRAFT ENGINES/\*GAS INJECTION/\*GAS TURBINE ENGINES /\*SUPERCHARGERS/\*TURBOCOMPRESSORS

**MINS:** / AIR FLOW/ COMBUSTION EFFICIENCY/ ENGINE DESIGN/ FUEL-AIR RATIO/ GENERAL AVIATION AIRCRAFT/ HYDROCARBON COMBUSTION

**ABS:** Results are presented for tests performed to assess the effects of exhaust manifold injection air flow rate on emissions and on exhaust gas temperature and

turbine inlet temperature for a range of engine operating conditions (speed, torque, and fuel-air ratios) of a fuel-injected turbocharged six-cylinder air-cooled Teledyne Continental Motors TS10-360-C engine. Air injection into the exhaust gas at 80 F resulted in a decrease in hydrocarbons and carbon monoxide while exceeding the maximum recommended turbine inlet temperature of 1650 F at the full rich mixture of the engine. The EPA standards could be met within present turbine inlet temperature limits using commercially available air pumps, provided that the fuel-air ratios were leaned in the taxi, climb, and approach modes.

RPT#: SAE PAPER 790618  
79A36746

**UTTL:** Full-scale wind-tunnel investigation of an Ayres S2R-800 Thrush Agricultural Airplane

**AUTH:** A/JOHNSON, J. L., JR.; B/MCLEMORE, H. C.; C/WHITE, R.; D/JORDAN, F. L., JR.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*AGRICULTURAL AIRCRAFT/\*FULL SCALE TESTS/\*WIND TUNNEL TESTS

**MINS:** / AERODYNAMIC INTERFERENCE/ AIRCRAFT PERFORMANCE/ AIRCRAFT STABILITY/ AIRCRAFT WAKES/ BUFFETING/ DISPERSING/ DRAG REDUCTION/ GRAPHS (CHARTS)/ PERFORMANCE PREDICTION/ SLIPSTREAMS/ THRUST LOADS/ WING TIP VORTICES

**ABS:** This paper summarizes the significant results of recent full-scale wind tunnel tests at the NASA-Langley Research Center of the Ayres S2R-800 Thrush Agricultural Aircraft. The purpose of the tests was to provide fundamental aerodynamic, performance, and stability and control information of the airplane and dispersal equipment; and to study near-field wake interaction characteristics behind the aircraft. The aerodynamic tests included the use of a propeller thrust-torque balance to measure the efficiency of the propeller in the presence of the engine and to provide data for determining slipstream interference effects and slip-stream drag.

RPT#: SAE PAPER 790619  
79A36747

**UTTL:** New opportunities for future small civil turbine engines - Overiewing the GATE studies

**AUTH:** A/STRACK, W. C.

**MAJS:** /\*ECONOMIC FACTORS/\*GENERAL AVIATION AIRCRAFT/\*TECHNOLOGY ASSESSMENT/\*TURBINE ENGINES

**MINS:** / COST REDUCTION/ FUEL CONSUMPTION/ GRAPHS (CHARTS)/ LOW COST/ PISTON ENGINES/ THERMODYNAMIC CYCLES/ TURBOFAN ENGINES/ TURBOMACHINE BLADES/ TURBOMACHINERY/ TURBOPROP ENGINES/ TURBOSHAFTS

**ABS:** This paper presents an overview of four independent studies that explore the opportunities for future General Aviation Turbine Engines (GATE) in the 150-1000 SHP class. Detroit Diesel Allison, Garrett/AiResearch, Teledyne CAE, and Williams Research participated along with several airframers. These studies forecasted the potential impact of advanced technology turbine engines in the post-1988 market, identified important aircraft and missions, desirable engine sizes, engine performance and cost goals. Parametric evaluations of various engine cycles, configurations, design features, and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis. Both fixed-wing and helicopter aircraft, and turboshaft, turboprop, and turboprop engines were considered. All four companies predicted sizable performance gains (e.g., 20% SFC decrease), and three predicted large engine cost reductions of sufficient magnitude to challenge the reciprocating engine in the 300-500 SHP class. Key technology areas were recommended for NASA support in order to realize these improvements.

RPT#: SAE PAPER 790621  
79A36749

**UTTL:** A review of Curtiss-Wright rotary engine developments with respect to general aviation potential

**AUTH:** A/JONES, C.

**MAJS:** /\*AIRCRAFT ENGINES/\*ENGINE TESTS/\*GENERAL AVIATION AIRCRAFT/\*RESEARCH AND DEVELOPMENT/\*WANKEL ENGINES

**MINS:** / AIR COOLING/ AUTOMOBILE FUELS/ COMBUSTION CHAMBERS/ CURTISS-WRIGHT AIRCRAFT/ DIESEL ENGINES/ EXHAUST GASES / FUEL CONSUMPTION/ HIGH SPEED/ HYDROCARBONS/ SPARK IGNITION/ TURBOSHAFTS

**ABS:** Aviation related rotary (Wankel-type) engine tests, possible growth directions and relevant developments at Curtiss-Wright have been reviewed. Automotive rotary engines including stratified charge are described and flight test results of rotary aircraft engines are presented. The current 300 HP engine prototype shows basic durability and competitive performance potential. Related parallel developments have separately confirmed the geometric advantages of the rotary engine for direct injected unthrottled stratified charge. Specific fuel consumption equal to or better than pre- or swirl-chamber diesels, low emission and multi-fuel capability have been shown by rig tests of similar rotary engine.

RPT#: SAE PAPER 790623  
79A36751

**UTTL:** A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls

**AUTH:** A/ROSKAM, J.; B/RICE, M.; C/EYSINK, H.

**MAJS:** /\*ACTUATORS/\*ELECTROMECHANICAL DEVICES/\*FLIGHT CONTROL /\*GENERAL AVIATION AIRCRAFT/\*MATHEMATICAL MODELS/\* PNEUMATIC CONTROL

**MINS:** / AIRCRAFT HYDRAULIC SYSTEMS/ ELECTRIC POWER SUPPLIES/ GRAPHS (CHARTS)/ MAGNETIC MATERIALS/ PNEUMATIC EQUIPMENT

**ABS:** Mathematical models for electromechanical (EM), pneumatic and hydraulic actuators are discussed. It is shown that EM and hydraulic actuators provide better and faster time responses than pneumatic actuators but EM actuators utilizing the recently developed samarium-cobalt technology have significant advantages in terms of size, weight and power requirements. In terms of ease and flexibility of installation EM actuators apparently have several advantages over hydraulic actuators, and cost is a primary reason for the popularity of EM actuation for secondary control function since no additional systems need to be added to the aircraft. While new rare earth magnets are currently in developmental stage, costs are relatively high; but continued research should bring prices down.

RPT#: SAE PAPER 790625  
79A36753

**UTTL:** An experimental study of propeller-induced structural vibration and interior noise

**AUTH:** A/HOWLETT, J. T.; B/SCHOENSTER, J. A.

**MAJS:** /\*AIRCRAFT COMPARTMENTS/\*AIRCRAFT NOISE/\*LIGHT AIRCRAFT/\*NOISE PROPAGATION/\*PERFORMANCE TESTS/\* PROPELLER BLADES/\*STRUCTURAL VIBRATION

**MINS:** / DYNAMIC RESPONSE/ FREQUENCY SCANNING/ GRAPHS (CHARTS)/ GROUND TESTS/ HARMONIC EXCITATION/ NOISE REDUCTION/ NOISE SPECTRA/ SOUND TRANSMISSION/ SPECTRUM ANALYSIS

**ABS:** This paper presents results of tests conducted to study fuselage sidewall dynamics and their effects on the cabin interior noise of a twin-engine, propeller-driven, light aircraft. Data on the dynamic behavior were obtained by slowly sweeping the RPM of one of the engines while the aircraft was stationary on the ground. This technique allowed frequency response plots of the sidewall structural accelerations to be obtained. These accelerations are compared to similar results from a test using a mechanical shaker in order to evaluate the structural dynamic response caused by the harmonics of the

propeller blade passage tone. The dynamic response of the fuselage sidewall is also discussed as a noise transmission mechanism. A second mechanism for noise transmission through the fuselage sidewall was investigated by opening the copilot's window. The results illustrate the complex nature of the noise transmission mechanisms and the importance of correctly assessing noise paths.

discussed based on the results.

RPT#: SAE PAPER 790626  
79A36754

**UTTL:** Engine induced structural-borne noise in a general aviation aircraft

**AUTH:** A/UNRUH, J. F.; B/SCHIEDT, D. C.

**MAJS:** /\*AIRCRAFT ENGINES/\*AIRCRAFT NOISE/\*ENGINE TESTS/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*VIBRATION EFFECTS

**MINS:** / CABINS/ FUSELAGES/ GROUND TESTS/ LIGHT AIRCRAFT/ NOISE MEASUREMENT/ NOISE SPECTRA/ STRUCTURAL VIBRATION / VIBRATIONAL SPECTRA

**ABS:** This paper describes a study of engine induced structural-borne noise in a single engine light aircraft. Cabin noise and fuselage vibration levels were recorded during ground tests for engine-attached, engine-detached, interior-installed, and interior-removed configurations. By comparisons of the data, engine induced structure-borne noise is shown to be a primary source of cabin noise. Corresponding fuselage vibration levels were quite high with energy concentrated mainly in the lower frequencies. A measure of the noise control effectiveness of the interior trim was also obtained.

RPT#: SAE PAPER 790627  
79A36755

**UTTL:** Summary of noise reduction characteristics of typical general aviation materials

**AUTH:** A/ROSKAM, J.; B/GROSVELD, F.; C/VAN AKEN, J.

**MAJS:** /\*AIRCRAFT NOISE/\*GENERAL AVIATION AIRCRAFT/\*HONEYCOMB STRUCTURES/\*LIGHT AIRCRAFT/\*NOISE MEASUREMENT/\*NOISE REDUCTION

**MINS:** / ACOUSTIC ATTENUATION/ CABINS/ ENERGY ABSORPTION/ PRESSURE EFFECTS/ RESONANT FREQUENCIES/ SOUND PRESSURE / TEST FACILITIES/ VIBRATION DAMPING

**ABS:** The paper presents the results of a large number of systematic tests to determine noise reduction characteristics of general aviation materials. Effects of material type (metallic and composite), thickness, panel stiffening, vibration damping materials, sound absorption materials and pressurization on noise reduction are included. Several promising methods for reducing cabin interior noise in light airplanes are

RPT#: AIAA PAPER 80-0169  
80A18351

**UTTL:** Determination of the spin and recovery characteristics of a typical low-wing general aviation design

**AUTH:** A/TISCHLER, M. B.; B/BARLOW, J. B.

**MAJS:** /\*AERODYNAMIC STABILITY/\*AERODYNAMIC STALLING/\*  
AIRCRAFT SPIN/\*GENERAL AVIATION AIRCRAFT/\*PERFORMANCE  
PREDICTION

**MINS:** / AIRCRAFT CONTROL/ AIRCRAFT PERFORMANCE/ AIRCRAFT  
STABILITY

**ABS:** The equilibrium spin technique implemented in a graphical form for obtaining spin and recovery characteristics from rotary balance data is outlined. Results of its application to recent rotary balance tests of the NASA Low-Wing General Aviation Aircraft are discussed. The present results, which are an extension of previously published findings, indicate the ability of the equilibrium method to accurately evaluate spin modes and recovery control effectiveness. A comparison of the calculated results with available spin tunnel and full scale findings is presented. The technique is suitable for preliminary design applications as determined from the available results and data base requirements. A full discussion of implementation considerations and a summary of the results obtained from this method to date are presented.

RPT#: AIAA 80-0427  
80A26939

**UTTL:** Development of test methods for scale model simulation of aerial applications in the NASA Langley Vortex Facility

**AUTH:** A/JORDAN, F. L., JR.

**MAJS:** /\*AGRICULTURAL AIRCRAFT/\*AIRCRAFT MODELS/\*FLOW  
VISUALIZATION/\*SCALE MODELS/\*VORTICES/\*WING FLOW  
METHOD TESTS

**MINS:** / CROP DUSTING/ GRANULAR MATERIALS/ PARTICLE SIZE  
DISTRIBUTION/ PARTICLE TRAJECTORIES/ SPRAYING

**ABS:** Methods have been developed at the Langley Vortex Research Facility to simulate and measure the deposition patterns of aerially applied sprays and granular materials by means of tests with small-scale models of agricultural and dynamically scaled test particles. Interactions between the aircraft wake and the dispersed particles are studied with the aim of modifying wake characteristics and dispersal techniques in order to increase swath width, improve deposition pattern uniformity, and minimize drift. This paper examines the particle sizing analysis, test methods for particle dispersal from the model aircraft, and measurement and computer analysis of test deposition patterns. Results that indicate improved control of chemical drift by winglets are presented to demonstrate test methods.

RPT#: AIAA 80-0455  
80A26955

**UTTL:** The influence of wing, fuselage and tail design on rotational flow aerodynamics data obtained beyond maximum lift with general aviation configurations

**AUTH:** A/BIHRLE, W., JR.; B/BOWMAN, J. S., JR.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT DESIGN/\*  
FUSELAGES/\*GENERAL AVIATION AIRCRAFT/\*HORIZONTAL TAIL  
SURFACES/\*WING PROFILES

**MINS:** / AERODYNAMIC CONFIGURATIONS/ ANGLE OF ATTACK/  
FEEDBACK CONTROL/ FLUID FLOW/ ROTARY WINGS/ TEST  
EQUIPMENT/ VORTICES/ YAWING MOMENTS

**ABS:** The NASA Langley Research Center has initiated a broad general aviation stall/spin research program. A rotary balance system was developed to support this effort. Located in the Langley spin tunnel, this system makes it possible to identify an airplane's aerodynamic characteristics in a rotational flow environment, and thereby permits prediction of spins. This paper presents a brief description of the experimental set-up, testing technique, five model programs conducted to date, and an overview of the rotary balance results and their correlation with spin tunnel free-spinning model results. It is shown, for example, that there is a large, nonlinear dependency of the aerodynamic moments on rotational rate and that these moments are pronouncedly configuration-dependent. Fuselage shape, horizontal tail and, in some instances, wing location are shown to appreciably influence the yawing moment characteristics above an angle of attack of 45 deg.

RPT#: AIAA PAPER 80-0914  
80A32887

UTTL: Aeropropulsion in year 2000  
AUTH: A/WEBER, R. J.  
MAJS: /\*AIRCRAFT INDUSTRY/\*PROPULSION SYSTEM CONFIGURATIONS  
/\*RESEARCH AND DEVELOPMENT/\*TECHNOLOGY ASSESSMENT  
MINS: / ELECTRONIC CONTROL/ ENGINE DESIGN/ GENERAL AVIATION  
AIRCRAFT/ HELICOPTER ENGINES/ NOISE REDUCTION/  
PROPELLERS/ SUPERSONIC AIRCRAFT/ TURBOPROP ENGINES  
ABS: The paper demonstrates that many advances can be  
anticipated in propulsion systems for aircraft in the  
next 20 years. A survey is presented of probable  
future engine types, including convertible engines for  
helicopters, turboprops for fuel efficient airliners,  
and variable cycle engines for supersonic transports.  
Also examined is the use of rotary engines in general  
aviation aircraft. Finally, a review is given of  
related technology improvements in propellers,  
materials, noise suppression, and digital electronic  
controls.

RPT#: AIAA PAPER 80-0932  
80A32895

UTTL: Vehicle expectations in air transportation for the  
year 2000  
AUTH: A/HEARTH, D. P.  
MAJS: /\*AIR TRANSPORTATION/\*AIRLINE OPERATIONS/\*CIVIL  
AVIATION/\*PERFORMANCE PREDICTION/\*TECHNOLOGICAL  
FORECASTING/\*TECHNOLOGY ASSESSMENT  
MINS: / AEROSPACE INDUSTRY/ AIR TRAFFIC CONTROL/ ECONOMIC  
FACTORS/ EXPECTATION/ FUEL CONSUMPTION/ SKIN FRICTION  
ABS: This paper is intended to provide an overview of the  
air transportation system for the year 2000 in terms  
of vehicle expectations. Emphasis is placed on civil  
air transportation with the time period approached  
from the standpoint of evolutionary changes for the  
near term and also with the assumption of more  
revolutionary changes for the far term. The view along  
the evolutionary path begins with a historical review  
of airline market growth and the impact that  
technologies have had on airplane designs. Projections  
of the life expectancy of existing, derivative, and  
new airplanes are examined in terms of their  
productivity and fuel efficiency in view of the  
present and projected fuel usage and availability. The  
factors influencing airline growth are outlined and  
some views on whether another new generation of  
subsonic airplanes are in the offing are given along  
with an assessment of the economic viability of an  
advanced commercial supersonic transport in terms of

its higher speed, higher productivity, and higher fuel  
usage. With regard to revolutionary changes, major  
technology breakthroughs are assumed to occur at a  
specified date. As an example, the impact of a  
dramatic reduction in skin friction drag is examined  
in terms of its effect on the airplane configuration,  
its propulsion systems, its projected fuel usage, and  
the air transportation system in which it must  
operate.

RPT#: AIAA PAPER 80-1036  
80A35984

UTTL: Noise transmission and control for a light,  
twin-engine aircraft  
AUTH: A/BARTON, C. K.; B/MIXSON, J. S.  
MAJS: /\*AIRCRAFT NOISE/\*FUSELAGES/\*LIGHT AIRCRAFT/\*NOISE  
REDUCTION/\*SOUND TRANSMISSION  
MINS: / AIRCRAFT COMPARTMENTS/ ENGINE NOISE/ HONEYCOMB  
STRUCTURES/ SKIN (STRUCTURAL MEMBER)/ STATIC TESTS/  
STIFFNESS/ STRUCTURAL WEIGHT  
ABS: One of the dominant source-path combinations for cabin  
noise in light, twin-engine aircraft is propeller  
noise being transmitted through the fuselage sidewall.  
This source-path was investigated and candidate  
sidewall add-on treatment were installed and tested  
using both an external sound source and the propeller  
in a ground static runup. Results indicate that adding  
either mass or stiffness to the fuselage skin would  
improve sidewall attenuation and that the honeycomb  
stiffness treatment used generally provided more  
improvement than an equal amount of added mass. It is  
proposed that double-wall construction in conjunction  
with skin stiffening should provide a good weight  
efficient combination for the aircraft studied.

RPT#: AIAA PAPER 80-1240  
80A43283

UTTL: A theoretical and experimental investigation of  
propeller performance methodologies  
AUTH: A/KORKAN, K. D.; B/GREGOREK, G. M.; C/MIKKELSON, D.  
C.  
MAJS: /\*AIRCRAFT PERFORMANCE/\*GENERAL AVIATION AIRCRAFT/\*  
PERFORMANCE PREDICTION/\*PROPELLERS/\*WIND TUNNEL TESTS  
MINS: / AERODYNAMIC DRAG/ AIRCRAFT DESIGN/ AIRFOIL PROFILES/  
FLIGHT TESTS/ METHODOLOGY/ RADIAL DISTRIBUTION/  
SYSTEMS ANALYSIS  
ABS: This paper briefly covers aspects related to propeller  
performance by means of a review of propeller  
methodologies; presentation of wind tunnel propeller  
performance data taken in the NASA Lewis Research  
Center 10 x 10 wind tunnel; discussion of the  
predominant limitations of existing propeller  
performance methodologies; and a brief review of  
airfoil developments appropriate for propeller  
applications.

RPT#: AIAA 80-1562  
80A45861

**UTTL:** A study of stall deterrent systems for general aviation aircraft

**AUTH:** A/BENNETT, A. G.; B/OWENS, J. K.; C/BULL, G.

**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT CONTROL/\*FLIGHT SIMULATION/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT

**MINS:** / ACCIDENT PREVENTION/ ACOUSTIC PROPERTIES/ AIRCRAFT CONFIGURATIONS/ AIRCRAFT LANDING/ AIRCRAFT PILOTS/ SYSTEM EFFECTIVENESS

**ABS:** Stall deterrent concepts for general aviation aircraft have been investigated using simulation studies and flight test experiments. It was found that the simulator was suitable for the development of deterrent system concepts, but the simulator was unacceptable for pilot evaluation of system effectiveness under typical stall/spin accident conditions. A Cessna 319 was outfitted with sensors, servoactuators, and analog control logic necessary to investigate a wide range of stall deterrent systems. It was found that an acoustic stall sensor and an error control law were sufficient for stall deterrence. The pitch intervention control system prevented aircraft stall for all aircraft configurations and pilot inputs. The variable up elevator stop concept was found to be effective for slow decelerations to aircraft stall. The stall deterrent systems were evaluated by four professional pilots and three low time pilots.

RPT#: AIAA 80-1565  
80A45864

**UTTL:** A dynamic analysis of the motion of a low-wing general aviation aircraft about its calculated equilibrium flat spin mode

**AUTH:** A/TISCHLER, M. B.; B/BARLOW, J. B.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*ROTARY STABILITY/\*SPIN STABILIZATION

**MINS:** / AIRCRAFT MODELS/ DEGREES OF FREEDOM/ DYNAMIC STABILITY/ MATHEMATICAL MODELS/ PERTURBATION THEORY/ PREDICTION ANALYSIS TECHNIQUES/ YAWING MOMENTS

**ABS:** The properties of the flat spin mode of a general aviation configuration have been studied through analysis of rotary balance data, numerical simulation, and analytical study of the equilibrium state. The equilibrium state is predicted well from rotary balance data. The variations of yawing moment and pitching moment as functions of sideslip have been shown to be of great importance in obtaining accurate modeling. These dependencies are not presently available with sufficient accuracy from previous tests or theories. The stability of the flat spin mode has been examined extensively using numerical linearization, classical perturbation methods, and reduced order modeling. The stability exhibited by the time histories and the eigenvalue analyses is shown to be strongly dependent on certain static cross derivatives and more so on the dynamic derivatives. Explicit stability criteria are obtained from the reduced order models.

RPT#: AIAA PAPER 80-1580  
BOA50099

**UTTL:** Overview of stall/spin technology  
**AUTH:** A/CHAMBERS, J. R.  
**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT MANEUVERS/\*FLIGHT CONTROL/\*GENERAL AVIATION AIRCRAFT/\*MILITARY AIRCRAFT /\*SPIN DYNAMICS  
**MINS:** / AIRCRAFT DESIGN/ LIGHT AIRCRAFT/ PERFORMANCE PREDICTION/ TECHNOLOGY ASSESSMENT/ WIND TUNNEL TESTS  
**ABS:** A general overview of the current state of the art in stall/spin technology for highly-maneuverable military configurations and light general aviation configurations is presented. The key areas of predictive methods, aerodynamics, and flight controls are discussed, using illustrations of results obtained during recent studies. In addition, some of the more-pertinent near-term and future challenges and opportunities in stall/spin technology are discussed. This survey of the existing technology shows that rapid progress has been achieved in each of the key technical areas during the last decade, especially for military airplanes. However, a significant amount of innovative research is urgently required in order to improve the productivity and capabilities of existing predictive techniques, and to provide the technology required for advanced, unconventional configurations.

RPT#: AIAA PAPER 80-1843  
BOA43301

**UTTL:** Effects of discontinuous drooped wing leading-edge modifications on the spinning characteristics of a low-wing general aviation airplane  
**AUTH:** A/DICARLO, D. J.; B/STOUGH, H. P., III; C/PATTON, J. M., JR.  
**MAJS:** /\*DROOPED AIRFOILS/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*LEADING EDGES/\*RESEARCH AIRCRAFT/\*SPIN TESTS /\*WIND TUNNEL TESTS  
**MINS:** / AERODYNAMIC CHARACTERISTICS/ AERODYNAMIC STALLING/ AIRCRAFT CONFIGURATIONS/ AIRCRAFT DESIGN/ AIRCRAFT MODELS/ LIGHT AIRCRAFT/ STATIC TESTS/ WING SPAN/ WINGS  
**ABS:** Wind tunnel and flight tests were conducted to determine the effects of several discontinuous drooped wing leading-edge configurations on the spinning characteristics of a light, single-engine, low-wing research airplane. Particular emphasis was placed on the identification of modifications which would improve the spinning characteristics. The spanwise length of a discontinuous outboard droop was varied

and several additional inboard segments were added to determine the influence of such leading-edge configurations on the spin behavior. Results of the study indicated that the use of only the discontinuous outboard droop, over a specific spanwise area, was most effective towards improving spin and spin recovery characteristics, whereas the segmented configurations having both inboard and outboard droop exhibited a tendency to enter a flat spin.

RPT#: AIAA PAPER 80-1844  
BOA43302

**UTTL:** Full-scale wind-tunnel investigation of the effects of wing leading-edge modifications on the high angle-of-attack aerodynamic characteristics of a low-wing general aviation airplane  
**AUTH:** A/JOHNSON, J. L., JR.; B/NEWSOM, W. A.; C/SATRAN, D. R.  
**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*BODY-WING CONFIGURATIONS/\*DROOPED AIRFOILS/\*GENERAL AVIATION AIRCRAFT/\*LEADING EDGE SLATS/\*WIND TUNNEL TESTS  
**MINS:** / AERODYNAMIC DRAG/ ANGLE OF ATTACK/ FLIGHT TESTS/ FLOW VISUALIZATION/ FULL SCALE TESTS/ LIFT  
**ABS:** The paper presents the results of a recent investigation to determine the effects of wing leading-edge modifications on the high angle-of-attack aerodynamic characteristics of a low-wing general aviation airplane in the Langley Full-Scale Wind Tunnel. The investigation was conducted to provide aerodynamic information for correlation and analysis of flight-test results obtained for the configuration. The wind-tunnel investigation consisted of force and moment measurements, wing pressure measurements, flow surveys, and flow visualization studies utilizing a tuft grid. Smoke and nonintrusive mini-tufts which were illuminated by ultra-violet light. In addition to the tunnel scale system which measured overall forces and moments, the model was equipped with an auxiliary strain-gage balance within the left wing panel to measure lift and drag forces on the outer wing panel independent of the tunnel scale system. The leading-edge modifications studied included partial- and full-span leading-edge droop arrangements as well as leading-edge slats.

RPT#: AIAA PAPER 80-1845  
BOA43303

**UTTL:** Determination of an angle of attack sensor correction for a general aviation airplane at large angles of attack as determined from wind tunnel and flight tests  
**AUTH:** A/MOUL, T. M.; B/TAYLOR, L. W., JR.  
**MAJS:** /\*ANGLE OF ATTACK/\*ERROR CORRECTING DEVICES/\*FLIGHT

TESTS/\*FLOW DIRECTION INDICATORS/\*GENERAL AVIATION  
AIRCRAFT/\*WIND TUNNEL TESTS

**MINS:** /AILERONS/ AIRCRAFT CONFIGURATIONS/ FULL SCALE TESTS/  
LEADING EDGES/ PARAMETER IDENTIFICATION/ RESEARCH  
AIRCRAFT/ SCALE MODELS

**ABS:** A comprehensive investigation into the flow correction for an angle of attack sensor mounted ahead of the wing tip of a general aviation research airplane has been conducted at the Langley Research Center. This correction has been determined in wind tunnels using a full-scale model up to angles of attack of 45 deg and a 1/5-scale model up to 80 deg angle of attack. The flow correction has also been obtained in flight by using a standard technique at low angles of attack and in spinning flight at larger angles of attack, by using both a simple approximate technique and a parameter estimation technique. The results show the correction is significant, reaching 10 deg at a measured angle of attack of about 90 deg. The flow correction was sensitive to the angle of sideslip at measured angles of attack greater than 60 deg and was not influenced by wing leading-edge modifications or aileron deflections.

RPT#: AIAA PAPER 80-1846  
80A43304

**UTTL:** Aerodynamic design optimization of a fuel efficient high-performance, single-engine, business airplane

**AUTH:** A/HOLMES, B. J.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*AIRCRAFT DESIGN/\*AIRCRAFT PERFORMANCE/\*FUEL CONSUMPTION/\*GENERAL AVIATION AIRCRAFT/\*POWER EFFICIENCY

**MINS:** / AERODYNAMIC STALLING/ AIRCRAFT ENGINES/ AIRSPEED/ CRUISING FLIGHT/ ENGINE DESIGN/ FLIGHT ALTITUDE/ FLIGHT CHARACTERISTICS/ PASSENGERS/ PAYLOADS/ WINGS

**ABS:** A design study has been conducted to optimize a single-engine airplane for a high-performance cruise mission. The mission analyzed included a cruise speed of about 300 knots, a cruise range of about 1300 nautical miles, and a six-passenger payload (5340 N (1200 lb)). The purpose of the study is to investigate the combinations of wing design, engine, and operating altitude required for the mission. The results show that these mission performance characteristics can be achieved with fuel efficiencies competitive with present-day high-performance, single- and twin-engine, business airplanes. It is noted that relaxation of the present Federal Aviation Regulation, Part 23, stall-speed requirement for single-engine airplanes facilitates the optimization of the airplane for fuel efficiency.

RPT#: AIAA PAPER 80-1862  
80A43309

**UTTL:** Preliminary design of a very advanced technology light twin for the mid-80's

**AUTH:** A/ROSKAM, J.; B/GROSVELD, F.; C/VAN KEPPEL, B.; D/EIJUSINK, J.; E/HOEVEN, A. V. D.

**MAJS:** /\*AIRCRAFT DESIGN/\*AIRCRAFT ENGINES/\*ATLIT PROJECT/\*DESIGN ANALYSIS/\*RESEARCH AND DEVELOPMENT/\*STRUCTURAL WEIGHT

**MINS:** / AERODYNAMICS/ AIRCRAFT CONTROL/ AIRCRAFT PERFORMANCE / AIRCRAFT STABILITY/ AIRCRAFT STRUCTURES/ ALUMINUM/ FUEL CONSUMPTION/ GUST LOADS/ PROPELLER FANS/ TURBOPROP AIRCRAFT

**ABS:** A preliminary design analysis was performed on a specification that called for a twin-engine business aircraft with performance nearing that of a jet airplane, coupled with the fuel efficiency of a turboprop. Use was made of advanced technologies in the areas of aerodynamics, propulsion, construction and stability and control. Results are presented which indicate a significant improvement in performance compared to turboprop airplanes currently in use.

RPT#: AIAA PAPER 80-1870  
80A43314

**UTTL:** Effect of winglets on performance and handling qualities of general aviation aircraft

**AUTH:** A/VAN DAM, C. P.; B/HOLMES, B. J.; C/PITTS, C.

**MAJS:** /\*AIRCRAFT PERFORMANCE/\*CLIMBING FLIGHT/\*CRUISING FLIGHT/\*GENERAL AVIATION AIRCRAFT/\*TURNING FLIGHT/\*WINGLETS

**MINS:** / AERODYNAMIC STALLING/ AILERONS/ AIRCRAFT CONFIGURATIONS/ AIRCRAFT CONTROL/ AIRCRAFT STABILITY/ FLIGHT TESTS/ FUEL CONSUMPTION/ RETROFITTING/ STRUCTURAL WEIGHT/ WIND TUNNEL TESTS/ YAW

**ABS:** Recent flight and wind tunnel evaluations of winglets mounted on general aviation airplanes have shown improvements in cruise fuel efficiency, and climbing and turning performance. Some of these analyses have also uncovered various effects of winglets on airplane handling qualities. Retrofitting an airplane with winglets can result in reduced cross wind take-off and landing capabilities. Also, winglets can have a detrimental effect on the lateral directional response characteristics of aircraft which have a moderate to high level of adverse yaw due to aileron. Introduction of an aileron-rudder-interconnect, and reduction of the effective dihedral by canting-in of the winglets, or addition of a lower winglet can eliminate these flying quality problems.

RPT#: AIAA PAPER 80-1871  
80A50191

**UTTL:** An acoustic sensitivity study of general aviation propellers

**AUTH:** A/KORKAN, K. D.; B/GREGOREK, G. M.; C/KEITER, I.

**MAJS:** /\*ACOUSTIC PROPERTIES/\*AIRCRAFT NOISE/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*PROPELLERS

**MINS:** / AIRFOILS/ PERFORMANCE TESTS/ PROPELLER BLADES/ SENSITIVITY

**ABS:** This paper describes the results of a study in which a systematic approach has been taken in studying the effect of selected propeller parameters on the character and magnitude of propeller noise. Four general aviation aircraft were chosen, i.e., a Cessna 172, Cessna 210, Cessna 441, and a 19 passenger commuter concept, to provide a range in flight velocity, engine horsepower, and gross weight. The propeller parameters selected for examination consisted of number of blades, rpm reduction, thickness/chord reduction, activity factor reduction, proplets, airfoil improvement, sweep, position of maximum blade loading, and diameter reduction.

RPT#: AIAA PAPER 80-1872  
80A43315

**UTTL:** Effect of propeller slipstream on the drag and performance of the engine cooling system for a general aviation twin-engine aircraft

**AUTH:** A/KATZ, J.; B/CORSIGLIA, V. R.; C/BARLOW, P. R.

**MAJS:** /\*AERODYNAMIC DRAG/\*AIRCRAFT ENGINES/\*COOLING SYSTEMS /\*GENERAL AVIATION AIRCRAFT/\*PERFORMANCE TESTS/\* PROPELLER SLIPSTREAMS

**MINS:** / ANGLE OF ATTACK/ CLIMBING FLIGHT/ COLD FLOW TESTS/ CRUISING FLIGHT/ FUEL CONSUMPTION/ INLET PRESSURE/ NACELLES/ PRESSURE RECOVERY/ REATTACHED FLOW/ SEMISPAN MODELS/ STRUCTURAL VIBRATION/ WIND TUNNEL TESTS

**ABS:** The pressure recovery of incoming cooling air and the drag associated with engine cooling of a typical general aviation twin-engine aircraft was investigated experimentally. The semispan model was mounted vertically in the 40- by 80-Foot Wind Tunnel at Ames Research Center. The propeller was driven by an electric motor to provide thrust with low vibration levels for the cold-flow configuration. It was found that the propeller slipstream reduces the frontal air spillage around the blunt nacelle shape. Consequently, this slipstream effect promotes flow reattachment at the rear section of the engine nacelle and improves inlet pressure recovery. These effects are most pronounced at high angles of attack, that is, climb condition. For the cruise condition those improvements were more moderate.

RPT#: AIAA PAPER 80-1874  
80A43317

**UTTL:** Noise reduction characteristics of general aviation type dual-pane windows

**AUTH:** A/GROSVELD, F.; B/NAVANEETHAN, R.; C/ROSKAM, J.

**MAJS:** /\*AIRCRAFT CONSTRUCTION MATERIALS/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*POLYMETHYL METHACRYLATE/\* WINDOWS (APERTURES)

**MINS:** / AIRCRAFT NOISE/ ATMOSPHERIC PRESSURE/ EDGES/ MECHANICAL PROPERTIES/ PRESSURE REDUCTION/ RESONANT FREQUENCIES/ THICKNESS RATIO

**ABS:** The noise reduction characteristics of general-aviation-type, dual-pane windows in various configurations have been experimentally investigated. The effects of inner and outer pane thickness, spacing between the panes, edge conditions, inclination of the inner pane and depressurization of the air in between the panes are presented. The space in between the two window panes is sealed airtight in all cases. Results show that increasing the mass of a 'floating' window pane does not increase the noise reduction below the fundamental resonance frequency. It is concluded that the concept of depressurization of the air between thin (1/8 in) Plexiglas panes and application of multiple-freedom edge conditions for the inner pane are promising to reduce noise levels in general aviation airplanes.

RPT#: ASAE PAPER AA 79-001  
80A15220

**UTTL:** Data and analysis procedures for improved aerial applications mission performance

**AUTH:** A/HOLMES, B. J.; B/MORRIS, D. K.; C/RAZAK, K.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*AGRICULTURAL AIRCRAFT/\* VORTICES/\*WINGS

**MINS:** / AIRCRAFT DESIGN/ ASPECT RATIO/ CROP DUSTING/ PARTICLE MOTION/ WING FLAPS/ WING LOADING

**ABS:** An analysis procedure is given and cases analyzed for the effects of wing geometry on lateral transport of a variety of agricultural particles released in the wake of an agricultural airplane. The cases analyzed simulate the release of particles from a fuselage centerline-mounted dry material spreader; however, the procedure applies to particles released anywhere along the wing span. Consideration is given to the effects of taper ratio, aspect ratio, wing loading, and deflected flaps. It is noted that significant lateral transport of large particles can be achieved using high-lift devices positioned to create a strong vortex near the location of particle release.

RPT#: AIAA PAPER 81-0403  
81A20810

UTTL: An analytical approach to airfoil icing  
AUTH: A/BRAGG, M. B.; B/GREGOREK, G. M.; C/SHAW, R. J.  
MAJS: /\*AIRFOIL PROFILES/\*FLIGHT HAZARDS/\*GENERAL AVIATION  
AIRCRAFT/\*ICE FORMATION/\*PERFORMANCE PREDICTION  
MINS: / AERODYNAMIC DRAG/ FREEZING/ FULL SCALE TESTS/  
MATHEMATICAL MODELS/ PARTICLE TRAJECTORIES  
ABS: An analytical procedure has been developed to predict  
rime ice growth on unprotected airfoil sections and to  
evaluate the aerodynamic performance. A time stepping  
method is used in which: (1) water droplet  
trajectories are calculated, (2) a rime ice shape  
determined, (3) the flowfield around the iced airfoil  
is recalculated, and (4) the build-up process iterated  
upon until the desired icing time is reached. The  
performance of the iced airfoil shapes are then  
determined from existing analytic methods. Rime ice  
shapes determined in the NASA Lewis Icing Research  
Tunnel on a modified NACA 64 series airfoil agree well  
with the shapes predicted by the analytical method.  
Measured and predicted increases in drag due to the  
rime ice also agree favorably. A simplified scaling  
analysis is also presented and verified which provides  
the duplication of full scale results of rime ice  
accretions in small scale model tests.

RPT#: AIAA PAPER 81-0404  
81A20811

UTTL: Simulated aircraft takeoff performance with frosted  
wings  
AUTH: A/DIETENBERGER, M. A.  
MAJS: /\*AIRCRAFT HAZARDS/\*AIRCRAFT PERFORMANCE/\*COMPUTERIZED  
SIMULATION/\*ICE FORMATION/\*TAKEOFF/\*WING PANELS  
MINS: / AERODYNAMIC DRAG/ AIRCRAFT PILOTS/ FREEZING/ GENERAL  
AVIATION AIRCRAFT/ PENALTIES/ SAFETY FACTORS/  
TRANSPORT AIRCRAFT  
ABS: The absolute and relative safety of certain nocturnal  
frost formations on general aviation and transport  
type airfoils is evaluated by a computer simulation  
program. The frost layer aerodynamic penalty and  
takeoff program was used to calculate the frost  
thickness distribution on an airfoil with time, as  
well as the aerodynamic penalties associated with the  
frost layer during takeoff. The program was validated  
by nocturnal frost formation experiments on an  
inclined flat plate and by comparisons with documented  
aerodynamic penalties of an arbitrarily roughened  
airfoil. For various meteorological conditions and  
runway take-off velocities, a frost layer can be  
determined that produces no aerodynamic penalty, thus  
inferring the absolute safety of the airfoil with  
respect to frost. The relative safety of a frosted  
airfoil depends on the ability of the engine power  
reserve to overcome both as much as doubling of  
airfoil drag and an increased stall speed due to lift  
penalties.

RPT#: AIAA PAPER 81-0405  
81A20837

UTTL: Icing tunnel tests of a glycol-exuding porous leading  
edge ice protection system on a general aviation  
airfoil  
AUTH: A/KOHLMAN, D. L.; B/SCHWEIKHARD, W. G.; C/EVANICH,  
P.  
MAJS: /\*AIRFOIL PROFILES/\*FLUID FLOW/\*GENERAL AVIATION  
AIRCRAFT/\*GLYCOLS/\*ICE PREVENTION/\*LEADING EDGES  
MINS: / AERODYNAMIC CHARACTERISTICS/ FLIGHT CONDITIONS/ WIND  
TUNNEL TESTS/ WING PANELS  
ABS: Tests were conducted in the Icing Research Tunnel at  
the NASA Lewis Research Center to determine the  
characteristics of an ice protection system that  
distributes a glycol solution onto the leading edge of  
an airfoil through a porous surface material. Minimum  
fluid flow rates required to achieve anti-icing (no  
ice formation) were determined for various flight  
conditions and angles of attack. The ability of the  
system to remove ice formed on the airfoil before  
system activation was also investigated.



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75A25713  
**UTTL:** NASA's role in aeronautics  
 AIAA Student Journal, vol. 12, Oct. 1974, p. 10-12.  
**AUTH:** A/JONES, J. L.  
**MAJS:** /\*AIRCRAFT DESIGN/\*NASA PROGRAMS/\*RESEARCH PROJECTS  
**MINS:** / CIVIL AVIATION/ FLY BY WIRE CONTROL/ GENERAL  
 AVIATION AIRCRAFT/ JET AIRCRAFT NOISE/ MILITARY  
 TECHNOLOGY/ NOISE REDUCTION/ REMOTELY PILOTED VEHICLES  
 / SUPERCRITICAL WINGS  
**ABS:** NASA civil aviation research efforts in regard to  
 noise reduction, development of very quiet engines,  
 fuel conservation, and aircraft efficiency and safety  
 are outlined. Specific projects discussed include the  
 supercritical wing program, the fly-by-wire control  
 system, the modified JT8D jet engine, the two-segment  
 noise abatement landing procedure, the general  
 aviation safety program, the GAW-1 low speed airfoil,  
 the Army/NASA tilt rotor flight research project, and  
 the remotely piloted research vehicle program.

75A26006  
**UTTL:** A semibuoyant vehicle for general transportation  
 missions  
 In: Interagency Workshop on Lighter than Air Vehicles,  
 Monterey, Calif., September 9-13, 1974, Proceedings.  
 (A75-25969 10-05) Cambridge, Mass., MIT Flight  
 Transportation Laboratory, 1975, p. 431-439.  
**AUTH:** A/HAVILL, C. D.; B/HARPER, M.  
**MAJS:** /\*AIR TRANSPORTATION/\*AIRSHIPS/\*GENERAL AVIATION  
 AIRCRAFT/\*LIFTING BODIES  
**MINS:** / BUOYANCY/ COST ANALYSIS/ DESIGN ANALYSIS/ FLIGHT  
 VEHICLES/ FUEL CONSUMPTION/ PAYLOADS/ PERFORMANCE  
 PREDICTION/ REENTRY VEHICLES/ WIND TUNNEL TESTS  
**ABS:** The concept of small, semibuoyant, lifting-body  
 airships is discussed. Estimates of important  
 performance characteristics are made and compared with  
 other flight vehicle systems.

75A36960  
**UTTL:** An evaluation of differential Omega for general  
 aviation area navigation  
 In: Omega Symposium, 2nd, Washington, D.C., November  
 5-7, 1974, Proceedings. (A75-36951 17-04) Washington,  
 D.C., Institute of Navigation, 1974, p. 85-95.  
**AUTH:** A/HOLLISTER, W. M.; B/DODGE, S. M.  
**MAJS:** /\*AREA NAVIGATION/\*COST EFFECTIVENESS/\*GENERAL  
 AVIATION AIRCRAFT/\*OMEGA NAVIGATION SYSTEM/\*SYSTEM  
 EFFECTIVENESS/\*TECHNOLOGY ASSESSMENT  
**MINS:** / AIR NAVIGATION/ INSTRUMENT ERRORS/ LORAN C/ POSITION  
 ERRORS/ VHF OMNIRANGE NAVIGATION  
**ABS:** This paper reports on a study which compared the

expected cost and performance of Differential Omega  
 with that of Loran-C and VORTAC for general aviation  
 area navigation. Analysis is directed toward a  
 comparison of the systems with respect to specified  
 performance parameters and the cost-effectiveness of  
 each system in relation to the specifications. Loran-C  
 offers the highest performance with respect to  
 accuracy. Differential Omega requires the least  
 expenditure. It was found cost ineffective to attempt  
 to obtain complete coverage by expanding the existing  
 VORTAC system.

75A36968  
**UTTL:** Binary phase locked loops for Omega receivers  
 In: Omega Symposium, 2nd, Washington, D.C., November  
 5-7, 1974, Proceedings. (A75-36951 17-04) Washington,  
 D.C., Institute of Navigation, 1974, p. 154-159.  
**AUTH:** A/CHAMBERLIN, K.  
**MAJS:** /\*BINARY DATA/\*DIGITAL SYSTEMS/\*OMEGA NAVIGATION  
 SYSTEM/\*PHASE LOCKED SYSTEMS/\*RADIO RECEIVERS  
**MINS:** / ADAPTIVE FILTERS/ AIR NAVIGATION/ GENERAL AVIATION  
 AIRCRAFT/ PHASE DETECTORS/ PHASE ERROR/ VERY LOW  
 FREQUENCIES  
**ABS:** An all-digital phase lock loop (PLL) is considered  
 because of a number of problems inherent in an  
 employment of analog PLL. The digital PLL design  
 presented solves these problems. A single loop  
 measures all eight Omega time slots. Memory-aiding  
 leads to the name of this design, the memory-aided  
 phase lock loop (MAPLL). Basic operating principles  
 are discussed and the superiority of MAPLL over the  
 conventional digital phase lock loop with regard to  
 the operational efficiency for Omega applications is  
 demonstrated.

75A46477  
**UTTL:** Civil aircraft  
 In: Composite materials. Volume 3. (A75-46476 24-05)  
 New York, Academic Press, Inc., 1974, p. 23-68.  
**AUTH:** A/MAYER, N. J.  
**MAJS:** /\*AIRCRAFT STRUCTURES/\*AIRFRAME MATERIALS/\*CIVIL  
 AVIATION/\*COMPOSITE MATERIALS/\*ENGINE DESIGN  
**MINS:** / AIRCRAFT DESIGN/ COST EFFECTIVENESS/ DESIGN ANALYSIS  
 / ECONOMIC ANALYSIS/ FATIGUE LIFE/ MECHANICAL  
 PROPERTIES/ STRUCTURAL WEIGHT  
**ABS:** This study deals with aircraft material and structural  
 requirements, advantages of composites, airframe and  
 engine applications, design procedures, problem areas,  
 and future trends in civil aircraft. The selection of  
 materials and design of structure for any given  
 component or part must be made not only on the basis  
 of the mechanical and structural functions, but must

also consider the operational and cost parameters for civil aircraft. Composites have caused the orientation to shift from a metal-based philosophy for design, where only incremental improvements could be anticipated, to one where substantial changes in design approaches are possible. Future designs are likely to include a combination of new approaches and composite materials.

76A10095  
**UTTL:** Interior noise levels of two propeller driven light aircraft  
 In: NOISEXPO '75; National Noise and Vibration Control Conference, 3rd, Atlanta, Ga., April 30-May 2, 1975, Proceedings of the Technical Program. (A76-10091 01-45) Bay Village, Ohio, NOISEXPO, 1975, p. 335-338.  
**AUTH:** A/CATHERINES, J. J.; B/MAYES, W. H.  
**MAJS:** /\*AIRCRAFT NOISE/\*ENGINE NOISE/\*LIGHT AIRCRAFT/\*NOISE REDUCTION  
**MINS:** / FLIGHT TESTS/ GROUND TESTS/ NOISE INTENSITY/ NOISE SPECTRA/ PROPELLER EFFICIENCY  
**ABS:** A test program is described with the objective of determining the relationship between aircraft operating conditions and interior noise and of determining the degree to which ground testing can be used in lieu of flight testing for performing interior noise research. Measurements are presented for single and twin engine aircraft for 2 or 4 passengers. It was found that noise levels are strongly influenced by the rotational speed of the engine and propeller. Both the overall noise and low frequency spectra levels were observed to decrease with increasing high speed rpm operation during flight. Comparison of spectra obtained in flight with spectra obtained on the ground suggests that identification of frequency components and relative amplitude of propeller and engine noise sources may be evaluated on stationary aircraft.

76A10393  
**UTTL:** Review of NASA short-haul studies  
 In: International air transportation; Proceedings of the Conference, San Francisco, Calif., March 24-26, 1975. (A76-10389 01-03) San Francisco, American Society of Civil Engineers, 1975, p. 41-65.  
**AUTH:** A/KENYON, G. C.  
**MAJS:** /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*ECONOMIC ANALYSIS/\*NASA PROGRAMS/\*SHORT HAUL AIRCRAFT  
**MINS:** / AIRPORT PLANNING/ COST EFFECTIVENESS/ ENGINE DESIGN/ NOISE REDUCTION/ TURBOFAN ENGINES  
**ABS:** The paper summarizes the results of NASA-conducted technological and economic studies of low, medium, and high density short-haul transportation systems. Aircraft concepts considered included CTOL, RTOL, STOL, and general aviation aircraft. For low density systems, it was found that viable air service becomes possible if city pairs are at least 100 km apart and a two-way total travel demand of at least 200 daily passengers exists. Currently available aircraft were found suitable. The medium-density study showed that a 60-passenger twin engine turbofan was the best suited aircraft. For high density systems, STOL appears to be

an economically viable means of reducing noise and congestion at major hub airports. Adequate runways 914 m in length or greater either already exist or could be added to most existing major hub airports.

76A10603  
**UTTL:** Evaluation of several navigation algorithms for application to general aviation  
 In: National Aerospace Meeting, Alamogordo, N. Mex., May 12, 13, 1975, Proceedings. (A76-10601 01-04) Washington, D.C., Institute of Navigation, 1975, p. 7-12.  
**AUTH:** A/CONRAD, B.; B/KORSACK, A. J.; C/JACKSON, C. T., JR.  
**MAJS:** /\*AIR NAVIGATION/\*ALGORITHMS/\*DISTANCE MEASURING EQUIPMENT/\*GENERAL AVIATION AIRCRAFT/\*NAVIGATION AIDS  
**MINS:** / AIRCRAFT DETECTION/ COMPUTER PROGRAMS/ FLIGHT TESTS/ POSITION (LOCATION)  
**ABS:** Using data obtained in flight, three position determining algorithms for use by general aviation aircraft were evaluated representing increasing software requirements. These were a DME only, DME/air data and blended DME/air data. Although each step represented additional software with resultant increase in position accuracy, all could be performed on a programmable electronic desk calculator. Results from the computation of aircraft position using the three algorithms are presented. The algorithms employed can be extended to accept VOR, TACAN bearing, ADF, or other NAVAID Data. To obtain the flight data an experimental system was configured and flown on a general aviation aircraft. Principal hardware elements (all with low-cost potential) were a programmable calculator, a single DME receiver (multiplexed for multiple DME use) and a low-cost air speed sensor (shed-vortex principle). The flight test demonstrated satisfactory performance of these principal elements.

76A15775  
**UTTL:** General aviation and community development; Summer Faculty Fellowship Program in Engineering Systems Design, Hampton, Va., June 2-August 15, 1975, Report Program sponsored by NASA and American Society for Engineering Education; Norfolk, Va., Old Dominion University, 1975, 271 p.  
**AUTH:** A/SINCOFF, M. Z.; B/DAJANI, J. S.  
**MAJS:** /\*AIRPORT PLANNING/\*AVIONICS/\*LAND USE/\*RESEARCH AND DEVELOPMENT/\*URBAN DEVELOPMENT  
**MINS:** / AIR TRAFFIC CONTROL/ AIR TRANSPORTATION/ AIRCRAFT COMMUNICATION/ DECISION MAKING/ ECONOMIC ANALYSIS/ ENERGY TECHNOLOGY/ GENERAL AVIATION AIRCRAFT/ HUMAN FACTORS ENGINEERING/ NAVIGATION AIDS  
**ABS:** The document summarizes the results of a faculty

program in engineering systems design whose primary aim was to provide a framework for communication and collaboration between academic personnel, research engineers, and scientists in government agencies and private industry. Other objectives were to provide a useful study of a broadly based societal problem, requiring the coordinated efforts of a multidisciplinary team, and to generate experience in the development of systems design and multidisciplinary activities. The success of the program is evidenced by the resulting study of general aviation and community development, characterized by thorough scrutiny of ideas, philosophies, and academic perspectives.

76A23156

**UTTL:** Optimizing airport runway improvement program - A dynamic programming approach  
In: Modeling and simulation, Volume 6 - Proceedings of the Sixth Annual Pittsburgh Conference, Pittsburgh, Pa., April 24, 25, 1975. Part 2. (A76-23110 09-59) Pittsburgh, Pa., Instrument Society of America, 1975, p. 693-697.

**AUTH:** A/YU, J. C.; B/GIBSON, D. R.

**MAJS:** /\*AIR TRAFFIC CONTROL/\*AIRPORT PLANNING/\*COMPUTERIZED SIMULATION/\*DYNAMIC PROGRAMMING/\*RUNWAYS

**MINS:** / AIRLINE OPERATIONS/ ALGORITHMS/ CIVIL AVIATION/ FLOW CHARTS/ MATHEMATICAL MODELS/ OPTIMIZATION

**ABS:** In order to reduce the air traffic delay in the terminal area, an immediate remedy is to increase airport capacity by an expansion of the existing runway system. The runway expansion program is often limited by budgetary constraints; the expensive facilities for a long-term improvement cannot be built at once. When a runway improvement strategy is being considered for a longer planning horizon, the investment decision depends upon the interrelations of its composite periods. The problem, therefore, is to determine how time factor and investment decisions interact to yield an optimal improvement scheme that meets demand at a minimum cost. With this objective in mind, a dynamic programming methodology is employed to determine the optimal planning scheme. Also, an example runway improvement problem is tested to illustrate how a dynamic programming model is practical in actual application.

76A34157

**UTTL:** Simulation of aircraft crash and its validation  
In: Aircraft crashworthiness; Proceedings of the Symposium, Cincinnati, Ohio, October 6-8, 1975. (A76-34132 16-03) Charlottesville, University Press of Virginia, 1975, p. 485-497.

**AUTH:** A/ALFARO-BOU, E.; B/HAYDUK, R. J.; C/THOMSON, R. G.; D/VAUGHAN, V. L., JR.

**MAJS:** /\*AIRCRAFT ACCIDENTS/\*AIRCRAFT DESIGN/\*AIRCRAFT SURVIVABILITY/\*CRASH LANDING/\*FLIGHT SIMULATION/\*LIGHT AIRCRAFT

**MINS:** / AIRCRAFT RELIABILITY/ AIRFRAMES/ DYNAMIC STRUCTURAL ANALYSIS/ FREE FLIGHT TEST APPARATUS/ FULL SCALE TESTS / IMPACT ACCELERATION/ IMPACT LOADS/ MATHEMATICAL MODELS/ NASA PROGRAMS/ SAFETY DEVICES/ STRUCTURAL STABILITY

**ABS:** A joint FAA/NASA program is discussed which is aimed at developing a reliable technology for the design of crashworthy light aircraft. This program encompasses the development of analytical methods, the definition of a survivable crash envelope, and the design of improved seat and restraint systems. A facility for full-scale crash-simulation testing is described along with the test method and results of five full-scale crash tests of twin-engine light aircraft. The major goals of the analytical portion of the program are outlined, including the development and validation of the analytical technique using simplified structural specimens that approximate aircraft components, as well as the mathematical modeling of the complete airframe and its subsequent dynamic analysis by substructuring and matrix reduction techniques.

76A36924

**UTTL:** The effects of aircraft design and atmospheric turbulence on handling and ride qualities  
In: Atmospheric Flight Mechanics Conference, 3rd, Arlington, Tex., June 7-9, 1976, Proceedings. (A76-36901 17-08) New York, American Institute of Aeronautics and Astronautics, Inc., 1976, p. 210-219.

**AUTH:** A/JONES, C. R.; B/JACOBSON, I. D.

**MAJS:** /\*AIRCRAFT DESIGN/\*ATMOSPHERIC TURBULENCE/\*COMMERCIAL AIRCRAFT/\*CONTROLLABILITY/\*RIDING QUALITY/\*TURBULENCE EFFECTS

**MINS:** / FLIGHT SIMULATORS/ GENERAL AVIATION AIRCRAFT/ MATHEMATICAL MODELS/ ROLL/ SHORT TAKEOFF AIRCRAFT

**ABS:** The effects of aircraft dynamic characteristics on passenger ride quality were investigated to determine ride-quality isocontours similar to aircraft handling-quality contours. Measurements were made on a motion-base simulator while varying the aircraft short-period and Dutch Roll frequencies and dampings. Both pilot ratings and subjective ride-quality ratings

were obtained during simulator flight. Ride and handling qualities were found to be complimentary for the Dutch Roll mode, but not for the short-period mode. Regions of optimal ride and handling qualities were defined for the short-period mode, and the effects of changes in turbulence level studied using mathematical models.

76A45776

- UTTL:** The future of aeronautical transportation; Proceedings of the Princeton University Conference, Princeton, N.J., November 10, 11, 1975  
Conference supported by the Boeing Co., Grumman Corp., McDonnell Douglas Corp., NASA, Northrop Corp., and United Technologies Corp. Princeton, N.J., Princeton University, 1976. 480 p
- MAJS:** /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*AIRLINE OPERATIONS/\*TECHNOLOGICAL FORECASTING
- MINS:** / AIR POLLUTION/ AIRCRAFT ENGINES/ AIRCRAFT NOISE/ CIVIL AVIATION/ ECONOMIC FACTORS/ ENGINE DESIGN/ FINANCE/ GOVERNMENT/INDUSTRY RELATIONS/ NOISE REDUCTION/ SUPERSONIC TRANSPORTS
- ABS:** Papers are presented on first and second generation supersonic transports, the Supersonic Cruise Aircraft Research Program, wide-body subsonic transports and vertical and short takeoff and landing transports. Aspects of aircraft design are examined including the airframe, propulsion and electronics. Government regulation, cost/benefit analysis of research and development, airline economics and aircraft financing are also considered. The environmental impact of air transportation is discussed with emphasis on atmospheric emissions (including stratospheric pollution) and noise pollution. Individual items are announced in this issue.

77A17067

**UTTL:** Sources and characteristics of interior noise in general aviation aircraft  
Acoustical Society of America, Annual Meeting, 91st, Washington, D.C., Apr. 5-9, 1976, Paper. 23 p.  
NASA-sponsored research.

**AUTH:** A/CATHERINES, J. J.; B/JHA, S. K.

**MAJS:** /\*AIRCRAFT NOISE/\*ENGINE NOISE/\*GENERAL AVIATION AIRCRAFT/\*LIGHT AIRCRAFT/\*NOISE GENERATORS/\*PROPELLER BLADES

**MINS:** / AERODYNAMIC NOISE/ BROADBAND/ GROUND TESTS/ LOW FREQUENCIES/ NOISE MEASUREMENT/ NOISE REDUCTION/ SAFETY FACTORS/ STRUCTURAL VIBRATION

**ABS:** A field study has been conducted to examine the interior noise characteristics of a general aviation aircraft. The purposes of the study were to identify the major noise sources and their relative contribution and to establish the noise transmission paths and their relative importance. Tests were performed on an aircraft operating under stationary conditions on the ground. The results show that the interior noise level of light aircraft is dominated by broadband, low frequencies (below 1,000 Hz). Both the propeller and the engine are dominant sources; however, the contribution from the propeller is significantly more than the engine at its fundamental blade passage frequency. The data suggests that the airborne path is more dominant than the structure-borne path in the transmission of broadband, low-frequency noise which apparently results from the exhaust.

77A17069

**UTTL:** Prediction of light aircraft interior noise  
Acoustical Society of America, Annual Meeting, 91st, Washington, D.C., Apr. 5-9, 1976, Paper. 20 p.  
NASA-sponsored research.

**AUTH:** A/HOWLETT, J. T.; B/MORALES, D. A.

**MAJS:** /\*AIRCRAFT DESIGN/\*AIRCRAFT NOISE/\*COMPUTERIZED DESIGN /\*LIGHT AIRCRAFT/\*NOISE REDUCTION/\*PERFORMANCE PREDICTION

**MINS:** / ACOUSTICS/ COMPUTER PROGRAMS/ NOISE INTENSITY/ NOISE SPECTRA/ RESONANT FREQUENCIES/ STRUCTURAL DESIGN

**ABS:** At the present time, predictions of aircraft interior noise depend heavily on empirical correction factors derived from previous flight measurements. However, to design for acceptable interior noise levels and to optimize acoustic treatments, analytical techniques which do not depend on empirical data are needed. This paper describes a computerized interior noise prediction method for light aircraft. An existing analytical program (developed for commercial jets by

Cockburn and Jolly in 1968) forms the basis of some modal analysis work which is described. The accuracy of this modal analysis technique for predicting low-frequency coupled acoustic-structural natural frequencies is discussed along with trends indicating the effects of varying parameters such as fuselage length and diameter, structural stiffness, and interior acoustic absorption.

77A20721

**UTTL:** Air transportation beyond the 1980's  
In: Air transportation for the 1980's. (A77-20712 07-01) College Park, Md., University of Maryland, 1976, p. 353-380.

**AUTH:** A/KAYTEN, G. G.

**MAJS:** /\*AIR TRANSPORTATION/\*AIRLINE OPERATIONS/\*CIVIL AVIATION/\*TECHNOLOGICAL FORECASTING

**MINS:** / AIR CARGO/ ECONOMIC FACTORS/ GENERAL AVIATION AIRCRAFT/ NOISE REDUCTION/ SHORT HAUL AIRCRAFT/ SUPERSONIC TRANSPORTS/ VERTICAL TAKEOFF AIRCRAFT

**ABS:** This work is a preview of the air transportation sections of the NASA 'Outlook for Aeronautics' study report (1976). Attention is given to future directions and opportunities for civil aviation taking account of economic and demographic factors, and resources. Technical objectives for the period 1976-1985 are summarized with consideration of research in the low-speed, high-speed, and long-range flight regimes.

77A21931

**UTTL:** Recollections from an earlier period in American aeronautics  
In: Annual review of fluid mechanics, Volume 9, (A77-21930 08-34) Palo Alto, Calif., Annual Reviews, Inc., 1977, p. 1-11.

**AUTH:** A/JONES, R. T.

**MAJS:** /\*AERONAUTICAL ENGINEERING/\*AIRCRAFT INDUSTRY/\* HISTORIES

**MINS:** / AERODYNAMICS/ CIVIL AVIATION/ RESEARCH AND DEVELOPMENT/ WIND TUNNELS

**ABS:** The situation of American aeronautics in the year 1929 is examined. In that year manufacturers all over the U.S. were bringing out new aircraft models to capture an assured market. Earlier developments in aviation in the U.S. after World War I are also considered along with the conditions of American aeronautics in the 1930s. Attention is given to the introduction of the Barling NB-3 with its all-metal construction, efforts of NACA to collect and disseminate in a uniform notation aerodynamic characteristics of airfoils from laboratories around the world, and the invention of the variable-density wind tunnel.

77A24936

**UTTL:** Investigation of the influence of simulated turbulence on handling qualities

Journal of Aircraft, vol. 14, Mar. 1977, p. 272-275.

**AUTH:** A/JACOBSON, I. D.; B/JOSHI, D. S.

**MAJS:** /\*AIRCRAFT CONTROL/\*CONTROLLABILITY/\*ENVIRONMENT SIMULATION/\*FLIGHT SIMULATION/\*PILOT PERFORMANCE/\*TURBULENCE EFFECTS

**MINS:** / ATMOSPHERIC MODELS/ ATMOSPHERIC TURBULENCE/ DEGREES OF FREEDOM/ LIGHT AIRCRAFT/ MOTION SIMULATORS/ VISUAL PERCEPTION

**ABS:** Pilot opinion of the handling quality of a light general aviation aircraft was evaluated in a simulated turbulence environment. The turbulence is described in terms of rms intensity and scale length and their variation with time. Significant changes in pilot opinion ratings were obtained with variation in turbulence models and these are discussed in terms of complexity and suitability for handling-quality studies.

77A30006

**UTTL:** Directions in civil aviation 1980-2000

Acta Astronautica, vol. 4, Jan.-Feb. 1977, p. 7-14.

**AUTH:** A/ROBERTS, L.

**MAJS:** /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*CIVIL AVIATION /\*TECHNOLOGICAL FORECASTING

**MINS:** / COMMERCIAL AIRCRAFT/ GENERAL AVIATION AIRCRAFT/ HYPERSONIC AIRCRAFT/ PASSENGER AIRCRAFT/ RESEARCH AND DEVELOPMENT/ SUBSONIC AIRCRAFT/ SUPERSONIC AIRCRAFT

**ABS:** The following future directions in civil aviation are considered: (1) greater economy and efficiency in passenger and cargo air service at subsonic speeds, and improved utility and safety for general aviation, (2) greatly improved short haul air transportation using turbofan or turboprop aircraft, and subsequently, rotorcraft and V/STOL aircraft, and (3) supersonic, and ultimately hypersonic, air transportation for transoceanic long range flight. Attention is also given to new directions in research and technology.

77A31588

**UTTL:** Worth assessments of approach to landing

IEEE Transactions on Systems, Man, and Cybernetics, vol. SMC-7, May 1977, p. 395-398.

**AUTH:** A/CURRY, R. E.

**MAJS:** /\*AIRCRAFT CARRIERS/\*AIRCRAFT LANDING/\*GENERAL AVIATION AIRCRAFT/\*MAN MACHINE SYSTEMS/\*PILOT PERFORMANCE

**MINS:** / HUMAN FACTORS ENGINEERING/ MARKET RESEARCH/ REGRESSION ANALYSIS/ VALUE ENGINEERING/ VARIANCE

(STATISTICS)

**ABS:** The objective of worth assessment is to determine a descriptive model of how attributes of a set of objects are combined into preferences for the objects. The technique is described and is applied to the assessment of worth functions in approach to landing for general aviation and air carrier pilots.

77A33392

**UTTL:** New potentials for conventional aircraft when powered by hydrogen-enriched gasoline

In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings, Volume 3. (A77-33326 14-44) Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5C-59 to 5C-86.

**AUTH:** A/MENARD, W. A.; B/MOYNIHAN, P. I.; C/RUPE, J. H.

**MAJS:** /\*ADDITIVES/\*AIRCRAFT FUELS/\*FUEL CONSUMPTION/\*GASOLINE/\*HYDROGEN-BASED ENERGY/\*POLLUTION CONTROL

**MINS:** / AIR POLLUTION/ AIRCRAFT ENGINES/ CATALYTIC ACTIVITY/ COST EFFECTIVENESS/ ENGINE DESIGN/ EXHAUST GASES/ GENERAL AVIATION AIRCRAFT/ LIQUID HYDROGEN/ SYSTEMS ANALYSIS

**ABS:** Hydrogen enrichment for aircraft piston engines is under study in a new NASA program. The objective of the program is to determine the feasibility of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels. A catalytic hydrogen generator will be incorporated as part of the air induction system of a Lycoming turbocharged engine and will generate hydrogen by breaking down small amounts of the aviation gasoline used in the normal propulsion system. This hydrogen will then be mixed with gasoline and compressed air from the turbocharger before entering the engine combustion chamber. The paper summarizes the results of a systems analysis study. Calculations assuming a Beech Duke aircraft indicate that fuel savings on the order of 20% are possible. An estimate of the potential for the utilization of hydrogen enrichment to control exhaust emissions indicates that it may be possible to meet the 1979 Federal emission standards.

78A13416  
**UTTL:** Feasibility of modern airships - Preliminary assessment  
 Journal of Aircraft, vol. 14, Nov. 1977, p. 1140-1148.  
**AUTH:** A/ARDEMA, M. D.  
**MAJS:** /\*AIRSHIPS/\*CIVIL AVIATION/\*FEASIBILITY ANALYSIS/\*NASA PROGRAMS  
**MINS:** / AERODYNAMIC CHARACTERISTICS/ AIR CARGO/ AIRCRAFT CONFIGURATIONS/ ECONOMIC FACTORS/ MISSION PLANNING/ TECHNOLOGICAL FORECASTING  
**ABS:** Attention is given to the NASA program, Feasibility Study of Modern Airships, initiated to investigate potential research and technology programs associated with airship development. A historical survey of the program is presented, including the development of past airship concepts, aerodynamical and design improvements, structure and material concepts, and research in controls, avionics, instrumentation, flight operations, and ground handling. A mission analysis was carried out which considered passenger and cargo transportation, heavy-lift, short-haul applications, surveillance missions, and the transportation of natural gas. A vehicle parametric analysis examined the entire range of airship concepts, discussing both conventional airships and hybrids. Various design options were evaluated, such as choice of structural materials, use of boundary-layer control, and choice of lifting gas.

78A16184  
**UTTL:** Radiation safety in high-altitude air traffic  
 Journal of Aircraft, vol. 14, Dec. 1977, p. 1226-1233.  
**AUTH:** A/FOELSCH, T.  
**MAJS:** /\*AIR TRAFFIC/\*FLIGHT HAZARDS/\*HIGH ALTITUDE ENVIRONMENTS/\*PASSENGER AIRCRAFT/\*RADIATION HAZARDS  
**MINS:** / CIVIL AVIATION/ COSMIC RAYS/ HEALTH PHYSICS/ PASSENGERS/ RADIATION DOSAGE/ SOLAR RADIATION/ SUPERSONIC TRANSPORTS  
**ABS:** Results of an experimental and theoretical study on dose equivalent rates at high altitudes are presented. The flight personnel flying 500 hours per year at SST cruise altitude in high latitudes (maximum of radiation) would be exposed to less than 14% of the maximum permissible dose rate (MPD) for radiation workers (5 rem/yr), averaged over the solar cycle. One-half or more is due to energetic secondary neutrons that are penetrant and highly biologically effective. Passengers would, in general, be exposed only to the low-level galactic cosmic rays, except for a relative few who encounter rare, intense, and energetic solar-particle events. If the airplane descends to subsonic altitudes during events such as

that of Feb. 23, 1956 - the most intense and unique giant energy event of the last 35 years - passenger exposure even then remains at or below permissible levels (0.5 rem for the general population). Systems of radiation monitoring are briefly discussed which will prevent false alarms and which would be useful in disproving overexposure in potential malpractice suits against the airlines. In subsonic jet transports the exposure of the crews is lower by a factor 3 to 4; for passengers it is about the same for the same distance traveled. Solar events, except for giant energy events, will yield only a minor fraction of the MPD of the general population.

78A28218  
**UTTL:** The year for shaping a digital operations R&D program  
 Astronautics and Aeronautics, vol. 16, Mar. 1978, p. 41-46, 63.  
**AUTH:** A/REID, H. J. E., JR.  
**MAJS:** /\*AIR TRAFFIC CONTROL/\*AIRCRAFT COMMUNICATION/\*CIVIL AVIATION/\*DIGITAL SYSTEMS/\*RESEARCH AND DEVELOPMENT  
**MINS:** / AIR NAVIGATION/ GLOBAL POSITIONING SYSTEM/ NAVSTAR SATELLITES/ TIME DIVISION MULTIPLE ACCESS  
**ABS:** Digital systems which deal with functions outside the aircraft in commercial aviation are discussed with attention to navigation and communication. New systems of air traffic control (ATC) are described, including time division multiple access (TDMA) to ground-based ATC units and to the Navstar/GPS (global positioning system). Such innovations are expected to come on-line before the mid-1980s, and greatly increase air safety, while at the same time making a pilot's work easier.

78A29330  
**UTTL:** General aviation energy-conservation research programs at NASA-Lewis Research Center  
 Western Michigan University, Conference on Energy Conservation in General Aviation, Kalamazoo, Mich., Oct. 10, 11, 1977, Paper, 23 p.  
**AUTH:** A/WILLIS, E. A.  
**MAJS:** /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*FUEL CONSUMPTION/\*GENERAL AVIATION AIRCRAFT/\*TECHNOLOGICAL FORECASTING  
**MINS:** / AIR POLLUTION/ AUTOMOBILE ENGINES/ COMBUSTION EFFICIENCY/ ENGINE TESTS/ POLLUTION CONTROL  
**ABS:** A review is presented of non-turbine general aviation engine programs underway at the NASA-Lewis Research Center in Cleveland, Ohio. The program encompasses conventional, lightweight diesel and rotary engines. Its three major thrusts are, in order of priority: (1) reduced SFCs; (2) improved fuels tolerance; and (3) reducing emissions. Current and planned future programs in such areas as lean operation, improved

fuel management, advanced cooling techniques and advanced engine concepts, are described. These are expected to lay the technology base, by the mid to latter 1980s, for engines whose total fuel costs are as much as 30% lower than today's conventional engines.

78A29641

**UTTL:** Investigation of interior noise in a twin-engine light aircraft

Journal of Aircraft, vol. 15, Apr. 1978, p. 227-233.

**AUTH:** A/MIXSON, J. S.; B/BARTON, C. K.; C/VAICAITIS, R.

**MAJS:** /\*AIRCRAFT NOISE/\*AIRCRAFT STRUCTURES/\*ENGINE NOISE/\* LIGHT AIRCRAFT/\*NOISE MEASUREMENT

**MINS:** / AIRCRAFT DESIGN/ AIRCRAFT ENGINES/ NOISE SPECTRA

**ABS:** This paper describes experimental studies of interior noise in a twin-engine, propeller-driven, light aircraft. An analytical model for this type of aircraft is also discussed. Results indicate that interior noise levels in this aircraft due to propeller noise can be reduced by reducing engine rpm at constant airspeed (about 3 dB), and by synchronizing the twin engines/propellers (perhaps up to 12 dB). Ground tests show that the exterior noise pressure imposed on the fuselage consists of a complex combination of narrow-band harmonics due to propeller and engine exhaust sources. This noise is reduced by about 20-40 dB (depending on the frequency) by transmission through the sidewall to the cabin interior. The analytical model described uses modal methods and incorporates the flat-side geometrical and skin-stringer structural features of this light aircraft.

78A30506

**UTTL:** Remotely piloted aircraft in the civil environment  
Mechanism and Machine Theory, vol. 12, no. 5, 1977, p. 471-479.

**AUTH:** A/GREGORY, T. J.; B/NELMS, W. P.; C/KARMARKAR, J. S.

**MAJS:** /\*AIRCRAFT DESIGN/\*CIVIL AVIATION/\*COST REDUCTION/\* REMOTELY PILOTED VEHICLES/\*TECHNOLOGY TRANSFER/\*WEIGHT REDUCTION

**MINS:** / AIR TRANSPORTATION/ MATERIALS HANDLING/ MINIATURIZATION/ NASA PROGRAMS/ REMOTE CONTROL/ REMOTE SENSORS/ RESCUE OPERATIONS

**ABS:** Improved remotely piloted aircraft (RPAs), i.e., incorporating reductions in size, weight, and cost, are becoming available for civilian applications. Existing RPA programs are described and predicted into the future. Attention is given to the NASA Mini-Sniffer, which will fly to altitudes of more than 20,000 m, sample the atmosphere behind supersonic

cruise aircraft, and telemeter the data to ground stations. Design and operating parameters of the aircraft are given, especially the optical sensing systems, and civilian RPA uses are outlined, including airborne research, remote mapping, rescue, message relay, and transportation of need materials. Civil regulatory factors are also dealt with.

78A32396

**UTTL:** A spectroradiometer for airborne remote sensing  
Photogrammetric Engineering and Remote Sensing, vol. 44, Apr. 1978, p. 507-517. NASA-supported research.

**AUTH:** A/CHIU, H.-Y.; B/COLLINS, W.

**MAJS:** /\*AIRBORNE EQUIPMENT/\*REMOTE SENSORS/\* SPECTRORADIOMETERS

**MINS:** / DIGITAL SYSTEMS/ GEOLOGICAL SURVEYS/ HIGH RESOLUTION / HYDROLOGY/ LIGHT AIRCRAFT/ VEGETATION/ VIDICONS

**ABS:** A remote sensing system for use in light aircraft is discussed with attention to its applications in measuring geologic zones of alteration, vegetation canopies, and the spectral properties of water bodies. A parallel electro-optical input spectroradiometer configuration with 500 channels operating in the 400-1100 nm region is described. A resolution of 18 meters square from an altitude of 600 m at 200 kmh is obtained with 4-digit spectral radiance data at 2.5 spectra/sec on a 9-track tape in computer compatible format.

78A42721

**UTTL:** Interior noise studies for general aviation types of aircraft. I - Field studies. II - Laboratory studies  
Journal of Sound and Vibration, vol. 58, June 8, 1978, p. 375-406.

**AUTH:** A/JHA, S. K.; B/CATHERINES, J. J.

**MAJS:** /\*AIRCRAFT NOISE/\*FREQUENCY ANALYZERS/\*GENERAL AVIATION AIRCRAFT/\*NOISE INTENSITY

**MINS:** / ACOUSTIC ATTENUATION/ FAR FIELDS/ FLIGHT TESTS/ FUSELAGES/ GROUND TESTS/ HARMONIC ANALYSIS/ NEAR FIELDS

**ABS:** Sources of the interior noise level of typical light aircraft are identified for stationary conditions on the ground and in flight. In addition, the relationship between the exterior near- and far-field noise around an aircraft and the interior noise field is examined. The sound transmission paths of a light aircraft fuselage are investigated, and the relative effectiveness of several components of the fuselage for sound attenuation is assessed. The fuselage furnishes an acoustic attenuation of about 20 dB; windows and metallic areas appear to transmit approximately equal amounts of sound energy.

78A46339

**UTTL:** Legal issues inherent in Space Shuttle operations  
Journal of Space Law, vol. 6, Spring 1978, p. 47-76.

**AUTH:** A/MOSSINGHOFF, G. J.; B/SLOUP, G. P.

**MAJS:** /\*INTERNATIONAL COOPERATION/\*LEGAL LIABILITY/\*NASA  
PROGRAMS/\*SPACE SHUTTLES/\*SPACE TRANSPORTATION SYSTEM

**MINS:** / CIVIL AVIATION/ GOVERNMENT/INDUSTRY RELATIONS/  
INTERNATIONAL RELATIONS/ OUTER SPACE TREATY

**ABS:** The National Aeronautics and Space Act of 1958  
(NASAct) is discussed with reference to its relevance  
to the operation of the Space Shuttle. The law is  
interpreted as giving NASA authority to regulate  
specific Shuttle missions, as well as authority to  
decide how much space aboard the Shuttle gets rented  
to whom. The Shuttle will not, however, be considered  
a 'common carrier' either in terms of NASAct or FAA  
regulations, because it will not be held available to  
the public-at-large, as are the flag carriers of  
various national airlines, e.g., Lufthansa, Air  
France, Aeroflot, etc. It is noted that the Launch  
Policy of 1972, which ensures satellite launch  
assistance to other countries or international  
organizations, shall not be interpreted as conferring  
common carrier status on the Space Shuttle.

79A14136  
**UTTL:** Technology for aircraft energy efficiency  
 In: International Air Transportation Conference,  
 Washington, D.C., April 4-6, 1977, Proceedings,  
 (A79-14126 03-03) New York, American Society of Civil  
 Engineers, 1977, p. 127-171.

**AUTH:** A/KLINEBERG, J. M.  
**MAJS:** /\*AIRCRAFT DESIGN/\*CIVIL AVIATION/\*COMMERCIAL AIRCRAFT  
 /\*ENERGY CONSERVATION/\*FUEL CONSUMPTION/\*NASA PROGRAMS  
 /\*TECHNOLOGY ASSESSMENT  
**MINS:** / AERODYNAMIC CHARACTERISTICS/ AIRCRAFT CONSTRUCTION  
 MATERIALS/ AIRCRAFT ENGINES/ AIRCRAFT STRUCTURES/  
 LAMINAR FLOW/ TURBOPROP ENGINES  
**ABS:** Six technology programs for reducing fuel use in U.S.  
 commercial aviation are discussed. The six NASA  
 programs are divided into three groups: Propulsion -  
 engine component improvement, energy efficient engine,  
 advanced turboprops; Aerodynamics - energy efficient  
 transport, laminar flow control; and Structures -  
 composite primary structures. Schedules, phases, and  
 applications of these programs are considered, and it  
 is suggested that program results will be applied to  
 current transport derivatives in the early 1980s and  
 to all-new aircraft of the late 1980s and early 1990s.

79A14138  
**UTTL:** Alternate aircraft fuels prospects and operational  
 implications  
 In: International Air Transportation Conference,  
 Washington, D.C., April 4-6, 1977, Proceedings,  
 (A79-14126 03-03) New York, American Society of Civil  
 Engineers, 1977, p. 197-241.

**AUTH:** A/WITCOFSKI, R. D.  
**MAJS:** /\*AIR TRANSPORTATION/\*AIRCRAFT FUELS/\*CIVIL AVIATION/\*  
 COMMERCIAL AIRCRAFT/\*LIQUID HYDROGEN/\*SYNTHETIC FUELS  
**MINS:** / COAL GASIFICATION/ ENERGY CONSUMPTION/ ENERGY  
 REQUIREMENTS/ FUEL CONSUMPTION/ HYDROCARBON FUEL  
 PRODUCTION/ HYDROGEN FUELS/ HYDROGEN PRODUCTION/  
 KEROSENE/ LIQUEFIED NATURAL GAS/ METHANE  
**ABS:** The paper discusses NASA studies of the potentials of  
 coal-derived aviation fuels, specifically synthetic  
 aviation kerosene, liquid methane, and liquid  
 hydrogen. Topics include areas of fuel production, air  
 terminal requirements for aircraft fueling (for liquid  
 hydrogen only), and the performance characteristics of  
 aircraft designed to utilize alternate fuels. Energy  
 requirements associated with the production of each of  
 the three selected fuels are determined, and fuel  
 prices are estimated. Subsonic commercial air  
 transports using liquid hydrogen fuel have been  
 analyzed, and their performance and the performance of

aircraft which use commercial aviation kerosene are  
 compared. Environmental and safety issues are  
 considered.

79A16123  
**UTTL:** Free as a bird - A point of view  
 (Canadian Aeronautics and Space Institute, Annual  
 General Meeting, Winnipeg, Canada, May 15-17, 1978.)  
 Canadian Aeronautics and Space Journal, vol. 24,  
 Nov.-Dec. 1978, p. 339-346.

**AUTH:** A/BURKE, J. D.  
**MAJS:** /\*BALLOON FLIGHT/\*GLIDING/\*LIGHT AIRCRAFT/\*MAN  
 OPERATED PROPULSION SYSTEMS/\*SOARING  
**MINS:** / CIVIL AVIATION/ GENERAL AVIATION AIRCRAFT  
**ABS:** A number of ways are discussed in which ingenious  
 people can further increase their enjoyment of  
 experimenting in air (balloons, man-powered flight,  
 etc.). For the lowest cost forms of flight, private  
 sponsorship has been modestly successful. Much more  
 could be done if people would not take themselves so  
 seriously and always demand that advanced technology  
 should serve some nationalistic or economic goals. For  
 the society, the next step forward will perhaps  
 originate if it is demonstrated to the government,  
 manufacturers, and customers that private flying has  
 become too costly due to those factors which limit the  
 acquisition and introduction of new knowledge.

79A30560  
**UTTL:** The GATE studies - Assessing the potential of future  
 small general aviation turbine engines  
 American Society of Mechanical Engineers, Gas Turbine  
 Conference and Exhibit and Solar Energy Conference,  
 San Diego, Calif., Mar. 12-15, 1979, Paper, 22 p.

**AUTH:** A/STRACK, W. C.  
**MAJS:** /\*AIRCRAFT ENGINES/\*GENERAL AVIATION AIRCRAFT/\*  
 PROPULSION SYSTEM CONFIGURATIONS/\*TURBINE ENGINES  
**MINS:** / JET ENGINES/ PROPULSION SYSTEM PERFORMANCE/ RESEARCH  
 AND DEVELOPMENT/ TECHNOLOGICAL FORECASTING  
**ABS:** Four studies have been completed that explore the  
 opportunities for future General Aviation Turbine  
 Engines (GATE) in the 150-1000 SHP class. These  
 studies forecasted the potential impact of advanced  
 technology turbine engines in the post-1988 market,  
 identified important aircraft and missions, desirable  
 engine sizes, engine performance and cost goals,  
 Parametric evaluations of various engine cycles,  
 configurations, design features, and advanced  
 technology elements defined baseline conceptual  
 engines for each of the important missions identified  
 by the market analysis. Both fixed-wing and helicopter  
 aircraft, and turboshaft, turboprop, and turbofan

engines were considered. Key technology areas were recommended for NASA support in order to realize proposed improvements.

79A36091

**UTTL:** The search and rescue satellite mission - A basis for international cooperation  
In: PLANS 1978; Position Location and Navigation Symposium, San Diego, Calif., November 6-9, 1978, Record. (A79-36063 15-04) New York. Institute of Electrical and Electronics Engineers, Inc., 1978, p. 345-348.

**AUTH:** A/REDISCH, W. N.; B/TRUDELL, B. J.

**MAJS:** /\*COMMUNICATION SATELLITES/\*GROUND-AIR-GROUND COMMUNICATIONS/\*RESCUE OPERATIONS/\*SATELLITE NETWORKS

**MINS:** / AIRCRAFT ACCIDENTS/ SEARCHING/ SPACECRAFT COMMUNICATION/ SYSTEMS ANALYSIS

**ABS:** The use of geostationary and polar-orbiting satellites to monitor and locate signals of the Emergency Locator Transmitter (ELT) and Emergency Position Indicating Radio Beacon (EPIB) of general aviation aircraft and inspected marine vessels respectively is described. The joint U.S. Canada/France SARSAT demonstration program will require a minimum of four minutes of mutual visibility of distress transmitter, local user terminal and satellite to obtain a location by Doppler tracking. The program consisting of placing instrumentation on-board three of the Tiros-N series of NOAA operational satellites is attracting interest also from other countries including the USSR, Norway, Australia, and Japan.

79A38882

**UTTL:** Exploring team avionics systems by simulation  
In: Annual Simulation Symposium, 11th, Tampa, Fla., March 15-17, 1978, Record of Proceedings. (A79-38876 16-59) Tampa, Fla., Annual Simulation Symposium; Long Beach, Calif., IEEE Computer Society, 1978, p. 155-170.

**AUTH:** A/BRENT, G. A.; B/MCCALLA, T. M., JR.

**MAJS:** /\*AIRBORNE/SPACEBORNE COMPUTERS/\*AVIONICS/\*COMPUTERIZED DESIGN/\*COMPUTERIZED SIMULATION/\*MICROPROCESSORS/\*PROGRAMMING LANGUAGES

**MINS:** / AIRCRAFT DESIGN/ ARCHITECTURE (COMPUTERS)/ COMPUTER PROGRAMS/ FLIGHT INSTRUMENTS/ HARDWARE/ IN-FLIGHT MONITORING

**ABS:** Configurations of software and hardware in a no-critical-element team architecture are under study for future general aviation aircraft avionics. The team integrated avionics system, based on microprocessors, can monitor and partially interpret all flight instrument data, engine parameters, and

navigation information faster than a human pilot. Simulation programs based on an event-oriented simulation language are being used to design team architectures.

79A42800

**UTTL:** Simulation study of the operational effects of fuel-conservative approaches  
Journal of Aircraft, vol. 16, July 1979, p. 498-505.

**AUTH:** A/TOBIAS, L.; B/PALMER, E. A.; C/OBRIEN, P. J.

**MAJS:** /\*AIR TRAFFIC CONTROL/\*AIRLINE OPERATIONS/\*ENERGY CONSERVATION/\*FUEL CONSUMPTION

**MINS:** / AIRCRAFT LANDING/ APPROACH/ CIVIL AVIATION/ COMPUTERIZED SIMULATION/ FLIGHT PATHS/ WORKLOADS (PSYCHOPHYSIOLOGY)

**ABS:** Fuel-conservative procedures have been investigated using real-time air traffic control simulations linked to two piloted simulators. The fuel-conservative procedures studied were profile descents and two types of landing approaches, delayed flap and IATA. The investigation determined the effect of these procedures on the ATC system operation. It examined the mixing of aircraft executing fuel-conservative approaches with those executing conventional approaches. The most difficult approach type mix of traffic was found to be 50% conventional and 50% delayed flap. However, for the test scenario chosen, arrival rates of at least 30 aircraft per hour were feasible and resulted in a net average fuel saving, even for the most difficult mix. Also, there is a fuel savings and reduced controller workload for the profile descent procedures.

79A49344

**UTTL:** NASA/Princeton digital avionics flight test facility  
Institute of Electrical and Electronics Engineers and American Institute of Aeronautics and Astronautics, Digital Avionics Systems Conference, 3rd, Fort Worth, Tex., Nov. 6-8, 1979, Paper, 7 p.

**AUTH:** A/DOWNING, D. R.; B/BRYANT, W. H.; C/STENGEL, R. F.

**MAJS:** /\*AVIONICS/\*DIGITAL SYSTEMS/\*FLIGHT TESTS/\*FLY BY WIRE CONTROL/\*GENERAL AVIATION AIRCRAFT/\*TEST FACILITIES

**MINS:** / AIRBORNE/SPACEBORNE COMPUTERS/ COMPUTER GRAPHICS/ DATA LINKS/ ELECTRONIC EQUIPMENT TESTS/ IN-FLIGHT MONITORING/ PRODUCT DEVELOPMENT/ RESEARCH AIRCRAFT/ TECHNOLOGY ASSESSMENT

**ABS:** This paper describes a general-aviation digital avionics flight-test facility being jointly developed by the Flight Dynamics Laboratory of Princeton University and NASA/Langley Research Center. This facility consists of the Princeton avionics research aircraft (ARA) and NASA/Langley's digital avionics

research (DARE) system. The ARA is a fully instrumented five-degree-of-freedom fly-by-wire aircraft. The DARE system contains a state-of-the-art flight computer system and receiving equipment that permits use of the NASA/Wallops Flight Center's position-tracking ground-based display-generation and ground-to-air digital-data-link equipment. The DARE/ARA system will be used for flight evaluation of advanced control, guidance, and display concepts developed as part of NASA/Langley Research Center's general aviation terminal area operations program.

79A51091

**UTTL:** Advanced crew station concepts, displays, and input/output technology for civil aircraft of the future

Institute of Electrical and Electronics Engineers and American Institute of Aeronautics and Astronautics, Digital Avionics Systems Conference, 3rd, Fort Worth, Tex., Nov. 6-8, 1979, Paper, 11 p.

**AUTH:** A/HATFIELD, J. J.; B/ROBERTSON, J. B.; C/BATSON, V. M.

**MAJS:** /\*AIR TRANSPORTATION/\*AIRCRAFT DESIGN/\*AVIONICS/\*CIVIL AVIATION/\*CREW STATIONS

**MINS:** / AIR TRAFFIC CONTROL/ COCKPITS/ DISPLAY DEVICES/ ELECTRONIC EQUIPMENT/ INPUT/OUTPUT ROUTINES/ TECHNOLOGICAL FORECASTING

**ABS:** Current efforts on a new Cockpit Avionics Research program are described. The major thrusts of the program presented include: a comparative analysis of advanced display media and development of promising selected media, development of flight display generation techniques, and identification and development of promising I/O technology. In addition, the advanced integrated display concepts described include a 'tunnel in the sky' display and a traffic situation display with associated keyboard. Finally, the Cockpit Avionics Research program is summarized, future research plans are presented, and the need for an expanded program is discussed.

79A52694

**UTTL:** NASA/FAA general aviation crash dynamics program - An update

International Society of Air Safety Investigators, Annual Seminar, Montreal, Canada, Sept. 24-27, 1979, Paper, 12 p.

**AUTH:** A/HAYDUK, R. J.; B/THOMSON, R. G.; C/CARDEN, H. D.

**MAJS:** /\*AIRCRAFT SAFETY/\*CRASH LANDING/\*GENERAL AVIATION AIRCRAFT/\*IMPACT DAMAGE/\*SEATS/\*TEST FACILITIES

**MINS:** / AIRCRAFT COMPARTMENTS/ AIRCRAFT STRUCTURES/ COMPOSITE STRUCTURES/ COMPUTERIZED SIMULATION/ GRAPHS

(CHARTS)/ NASA PROGRAMS/ STRUCTURAL DESIGN CRITERIA  
**ABS:** Work in progress in the NASA/FAA General Aviation Crash Dynamics Program for the development of technology for increased crash-worthiness and occupant survivability of general aviation aircraft is presented. Full-scale crash testing facilities and procedures are outlined, and a chronological summary of full-scale tests conducted and planned is presented. The Plastic and Large Deflection Analysis of Nonlinear Structures and Modified Seat Occupant Model for Light Aircraft computer programs which form part of the effort to predict nonlinear geometric and material behavior of sheet-stringer aircraft structures subjected to large deformations are described, and excellent agreement between simulations and experiments is noted. The development of structural concepts to attenuate the load transmitted to the passenger through the seats and subfloor structure is discussed, and an apparatus built to test emergency locator transmitters in a realistic environment is presented.

80A21122  
**UTTL:** A spin-recovery parachute system for light general aviation airplanes  
 NASA Langley Research Center, Aerospace Mechanisms Symposium, 14th, Hampton, Va., May 1, 2, 1980, Paper, 16 p.  
**AUTH:** A/BRADSHAW, C. F.  
**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT CONFIGURATIONS/\*GENERAL AVIATION AIRCRAFT/\*LIGHT AIRCRAFT/\*PARACHUTES/\*SPIN TESTS  
**MINS:** / AERODYNAMIC STABILITY/ AIRCRAFT RELIABILITY/ FLIGHT TESTS/ NASA PROGRAMS  
**ABS:** A tail-mounted spin-recovery parachute system has been designed and developed by the NASA Langley Research Center for use on light general aviation airplanes. The system was designed for use on typical airplane configurations, including low-wing, high-wing, single- and twin-engine designs. A mechanically triggered pyrotechnic slug gun is used to forcibly deploy a pilot parachute which extracts a bag that deploys a ring-slot spin-recovery parachute. The total system weighs 8.2 kg (18 lb). System design factors included airplane wake effects on parachute deployment, prevention of premature parachute deployment, positive parachute jettison, compact size, low weight, system reliability, and pilot and ground crew safety. Extensive ground tests were conducted to qualify the system. The recovery parachute has been used successfully in flight 17 times.

80A21224  
**UTTL:** Toward new small transports for commuter airlines  
 Astronautics and Aeronautics, vol. 18, Feb. 1980, p. 16-25.  
**AUTH:** A/GIULIANETTI, D. J.; B/WILLIAMS, L. J.  
**MAJS:** /\*AIR TRANSPORTATION/\*AIRLINE OPERATIONS/\*ECONOMIC ANALYSIS/\*LIGHT TRANSPORT AIRCRAFT/\*PASSENGER AIRCRAFT  
**MINS:** / AIR TRAFFIC CONTROL/ AIRCRAFT DESIGN/ AIRCRAFT SAFETY/ CARGO AIRCRAFT/ COST REDUCTION/ ECONOMIC FACTORS/ GENERAL AVIATION AIRCRAFT/ GROUND HANDLING/ PASSENGERS/ TECHNOLOGY ASSESSMENT  
**ABS:** The article discusses the results of a survey of commuter airline operators and large and small airframe manufacturers conducted by the Small Transport Aircraft Technology Office of the NASA Ames Research Center. Attention is given to economic concerns of the operator and manufacturer, as well as social concerns of the passenger, community, and system. Discussion also covers research and technology opportunities for improving commuter aircraft, and provides a background of information on the commuter and short-haul local-service air carriers, regulations

pertaining to their aircraft, and operations, overall airline interfaces, and facility requirements.

80A32064  
**UTTL:** Hybrid composites that retain graphite fibers on burning  
 In: Rising to the challenge of the '80s: Annual Conference and Exhibit, 35th, New Orleans, La., February 4-8, 1980, Preprints, (ABO-32058 12-24) New York, Society of the Plastics Industry, Inc., 1980, p. 11-D 1 to 11-D 8.  
**AUTH:** A/HOUSE, E. E.  
**MAJS:** /\*AIRCRAFT CONSTRUCTION MATERIALS/\*CARBON FIBER REINFORCED PLASTICS/\*FIRE PREVENTION/\*GRAPHITE-EPOXY COMPOSITE MATERIALS  
**MINS:** / AIRCRAFT HAZARDS/ CIVIL AVIATION/ ELECTRIC EQUIPMENT / REINFORCING FIBERS/ THERMAL DECOMPOSITION  
**ABS:** A laboratory scale program was conducted to determine fiber release tendencies of graphite reinforced/resinous matrix composites currently used or projected for use in civil aircraft. In the event of an aircraft crash and burn situation, there is concern that graphite fibers will be released from the composites once the resin matrix is thermally decomposed. Hybridizing concepts aimed at preventing fiber release on burning were postulated and their effectiveness evaluated under fire, impact, and air flow during an aircraft crash.

80A34840  
**UTTL:** Current and projected use of carbon composites in United States aircraft  
 NATO, AGARD, Specialists Meeting on Electromagnetic Effects of Carbon Composite Materials upon Avionics Systems, Lisbon, Portugal, June 16-19, 1980, Paper, 31 p.  
**AUTH:** A/LEONARD, R. W.; B/MULVILLE, D. R.  
**MAJS:** /\*AIRCRAFT CONSTRUCTION MATERIALS/\*AIRCRAFT STRUCTURES /\*CARBON FIBERS/\*COMMERCIAL AIRCRAFT/\*FIBER COMPOSITES /\*WINGS  
**MINS:** / AIRFRAME MATERIALS/ AVIONICS/ FIGHTER AIRCRAFT/ GENERAL AVIATION AIRCRAFT/ HELICOPTERS/ STRUCTURAL WEIGHT/ SYSTEMS ENGINEERING/ UNITED STATES OF AMERICA  
**ABS:** It is noted that carbon composite materials are beginning to be used in commercial transports, general aviation aircraft, military fighter aircraft and helicopters due to demonstrated weight savings and potential manufacturing cost savings. Attention is given to current production applications of carbon composites which range from the secondary structures of new commercial transports to wing primary structures of fighters. Current development efforts

are discussed that will lead to their future application to fuselages, as well as whole airframes. Finally, laminate constructions which vary widely, and may be relevant to avionics system design, are examined.

80A40340

**UTTL:** Analysis of eighty-four commercial aviation incidents - Implications for a resource management approach to crew training

In: Annual Reliability and Maintainability Symposium, San Francisco, Calif., January 22-24, 1980. Proceedings. (A80-40301 16-38) New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 298-306.

**AUTH:** A/MURPHY, M. R.

**MAJS:** /\*AIRCRAFT ACCIDENT INVESTIGATION/\*CIVIL AVIATION/\* FLIGHT CREWS/\*FLIGHT SAFETY/\*PILOT PERFORMANCE/\* RESOURCES MANAGEMENT

**MINS:** / AIR TRAFFIC CONTROL/ AIRCRAFT MANEUVERS/ AIRCRAFT SAFETY/ COMMERCIAL AIRCRAFT/ DECISION MAKING/ PILOT TRAINING/ VERBAL COMMUNICATION/ WORKLOADS (PSYCHOPHYSIOLOGY)

**ABS:** A resource management approach to aircrew performance is defined and utilized in structuring an analysis of 84 exemplary incidents from the NASA Aviation Safety Reporting System. The distribution of enabling and associated (evolutionary) and recovery factors between and within five analytic categories suggests that resource management training be concentrated on: (1) interpersonal communications, with air traffic control information of major concern; (2) task management, mainly setting priorities and appropriately allocating tasks under varying workload levels; and (3) planning, coordination, and decisionmaking concerned with preventing and recovering from potentially unsafe situations in certain aircraft maneuvers.

80A47656

**UTTL:** A review of propeller discrete frequency noise prediction technology with emphasis on two current methods for time domain calculations  
Journal of Sound and Vibration, vol. 71, Aug. 8, 1980, p. 399-419.

**AUTH:** A/FARASSAT, F.; B/SUCCI, G. P.

**MAJS:** /\*ACOUSTIC EMISSION/\*LANGLEY COMPLEX COORDINATOR/\* NOISE POLLUTION/\*NOISE PREDICTION (AIRCRAFT)/\*NOISE REDUCTION/\*PROPELLER BLADES

**MINS:** / COMPUTER PROGRAMS/ FOURIER ANALYSIS/ GENERAL AVIATION AIRCRAFT/ NASA PROGRAMS/ SOUND PRESSURE/ SUPERSONIC FLIGHT

**ABS:** A review of propeller noise prediction technology is

presented which highlights the developments in the field from the successful attempt of Gutin to the current sophisticated techniques. Two methods for the predictions of the discrete frequency noise from conventional and advanced propellers in forward flight are described. These methods developed at MIT and NASA Langley Research Center are based on different time domain formulations. Brief description of the computer algorithms based on these formulations are given. The output of these two programs, which is the acoustic pressure signature, is Fourier analyzed to get the acoustic pressure spectrum. The main difference between the programs as they are coded now is that the Langley program can handle propellers with supersonic tip speed while the MIT program is for subsonic tip speed propellers. Comparisons of the calculated and measured acoustic data for a conventional and an advanced propeller show good agreement in general.

80A50225

**UTTL:** Spinning for safety's sake

SAFE Journal, vol. 10, Fall 1980, p. 28-33.

**AUTH:** A/STOUGH, H. P., III; B/DICARLO, D. J.; C/PATTON, J. M., JR.

**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT SPIN/\*GENERAL AVIATION AIRCRAFT/\*SPIN DYNAMICS

**MINS:** / AIRCRAFT CONFIGURATIONS/ CENTER OF GRAVITY/ FLIGHT HAZARDS/ INERTIA/ NASA PROGRAMS/ RECOVERY PARACHUTES/ RESEARCH AND DEVELOPMENT

**ABS:** NASA Langley is currently engaged in a comprehensive research program to improve the stall/spin characteristics of general aviation airplanes. Part of this program has included systematic flight tests of a fully instrumented airplane to determine the effects of various tail, wing, and fuselage modifications, and variation of inertia, center-of-gravity, and control positions on the spin and recovery characteristics. Airplane equipment, onboard instrumentation ground equipment, test area, and test procedures have been combined to provide a safe, practical means for conducting research in preplanned hazardous conditions. Configuration changes produced spins varying from easily recoverable to unrecoverable, and wind section design significantly influenced airplane stall, spin, and recovery characteristics.

81A13413  
UTTL: Midair collisions - The accidents, the systems, and the Realpolitik  
Human Factors, vol. 22, Oct. 1980, p. 521-533.  
NASA-supported research.  
AUTH: A/WIENER, E. L.  
MAJS: /\*AIRCRAFT ACCIDENT INVESTIGATION/\*HUMAN FACTORS  
ENGINEERING/\*MAN MACHINE SYSTEMS/\*MIDAIR COLLISIONS  
MINS: / AIRLINE OPERATIONS/ COLLISION AVOIDANCE/ GENERAL  
AVIATION AIRCRAFT/ GOVERNMENT/INDUSTRY RELATIONS/  
GROUND TRACKS  
ABS: Two midair collisions occurring in 1978 are described, and the air traffic control system and procedures in use at the time, human factors implications and political consequences of the accidents are examined. The first collision occurred in Memphis and involved a Falcon jet and a Cessna 150 in a situation in which the controllers handling each aircraft were not aware of the presence of the other aircraft until it was too late. The second occurred in San Diego four months later, when a Boeing 727 on a visual approach struck a Cessna 172 from the rear. Following the San Diego collision there arose a great deal of investigative activity, resulting in suggestions for tighter control on visual flight rules aircraft and the expansion of positive control airspace. These issues then led to a political battle involving general aviation, the FAA and the Congress. It is argued, however, that the collisions were in fact system-induced errors resulting from an air traffic control system which emphasizes airspace allocation and politics rather than the various human factors problems facing pilots and controllers.

81A15881  
UTTL: Numerical lifting line theory applied to drooped leading-edge wings below and above stall  
Journal of Aircraft, vol. 17, Dec. 1980, p. 898-904.  
Research supported by the Minta Martin Fund for Aeronautical Research;  
AUTH: A/ANDERSON, J. D., JR.; B/CORDA, S.; C/VAN WIE, D. M.  
MAJS: /\*AERODYNAMIC CHARACTERISTICS/\*DROOPED AIRFOILS/\*LEADING EDGES/\*LIFT/\*RECTANGULAR WINGS  
MINS: / AERODYNAMIC STALLING/ AIRFOIL PROFILES/ ANGLE OF ATTACK/ ITERATIVE SOLUTION  
ABS: A numerical iterative solution to the classical Prandtl lifting-line theory, suitably modified for poststall behavior, is used to study the aerodynamic characteristics of straight rectangular finite wings with and without leading-edge droop. This study is prompted by the use of such leading-edge modifications

to inhibit stall/spins in light general aviation aircraft. The results indicate that lifting-line solutions at high angle of attack can be obtained that agree with experimental data to within 20%, and much closer for many cases. Therefore, such solutions give reasonable preliminary engineering results for both drooped and undrooped wings in the poststall region. However, as predicted by von Karman, the lifting-line solutions are not unique when sectional negative lift slopes are encountered. In addition, the present numerical results always yield symmetrical lift distributions along the span, in contrast to the asymmetrical solutions observed by Schairer in the late 1930's. Finally, a series of parametric tests at low angle of attack indicate that the effect of drooped leading edges on aircraft cruise performance is minimal.

81A19471  
UTTL: A status report on NASA general aviation stall/spin flight testing  
Society of Experimental Test Pilots. Technical Review, vol. 15, no. 1, 1980, p. 36-49.  
AUTH: A/PATTON, J. M., JR.  
MAJS: /\*AERODYNAMIC STALLING/\*FLIGHT TESTS/\*GENERAL AVIATION AIRCRAFT/\*LIGHT AIRCRAFT/\*NASA PROGRAMS/\*SPIN TESTS  
MINS: / AIRCRAFT STABILITY/ AIRFRAMES/ LEADING EDGES/ TEST PILOTS/ WINGS  
ABS: The NASA Langley Research Center has undertaken a comprehensive program involving spin tunnel, static and rotary balance wind tunnel, full-scale wind tunnel, free flight radio control model, flight simulation, and full-scale testing. Work underway includes aerodynamic definition of various configurations at high angles of attack, testing of stall and spin prevention concepts, definition of spin and spin recovery characteristics, and development of test techniques and emergency spin recovery systems. This paper presents some interesting results to date for the first aircraft (low-wing, single-engine) in the program, in the areas of tail design, wing leading edge design, mass distribution, center of gravity location, and small airframe changes, with associated pilot observations. The design philosophy of the spin recovery parachute system is discussed in addition to test techniques.

MISCELLANEOUS ARTICLES PUBLISHED BY NASA IN STAR

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75N19205  
**UTTL:** Design considerations for stall/spin avoidance  
 In Princeton Univ. Gen. Aviation Aircraft Safety p  
 59-76 (SEE N75-19199 11-03)  
**AUTH:** A/ANDERSON, S. B.  
**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT DESIGN/\*FLIGHT SAFETY  
 /\*GENERAL AVIATION AIRCRAFT  
**MINS:** / ACCIDENT PREVENTION/ AERODYNAMIC CHARACTERISTICS/  
 AIRCRAFT PERFORMANCE/ CONTROLLABILITY  
**ABS:** The paper discusses three aspects of the stall/spin  
 problem: (1) aerodynamic effects, (2) stall warning,  
 and (3) stall limiting. The results show that the  
 stall/spin problem could be alleviated by good  
 handling qualities up to and beyond the stall, careful  
 selection of aerodynamic parameters which promote  
 spin-resistance, adequate stall warning methods and  
 stall margins, and an acceptable form of limiting  
 elevator effectiveness near the maximum coefficient of  
 lift.

75N29004  
**UTTL:** Current and future opportunities in aeronautical  
 engineering  
 In NASA. Langley Res. Center NASA/Univ. Conf. on  
 Aeron. p 25-60 (SEE N75-29001 20-01)  
**AUTH:** A/BRIZENDINE, J. C.  
**MAJS:** /\*AERONAUTICAL ENGINEERING/\*AIRCRAFT INDUSTRY/\*  
 ECONOMIC FACTORS/\*EDUCATION/\*PERSONNEL DEVELOPMENT/\*  
 SOCIAL FACTORS  
**MINS:** / GENERAL AVIATION AIRCRAFT/ GOVERNMENT PROCUREMENT/  
 INDUSTRIAL MANAGEMENT  
**ABS:** Current demand for aeronautical engineers is  
 approximately balanced with supply, with some  
 shortfall in certain specialties. In the near term (5  
 years), demand will exceed supply of new graduates. A  
 number of factors have brought on the state of  
 imbalance: (1) the cyclic nature of the demand of our  
 defense requirements; (2) drastic changes in DOD  
 aircraft procurement; (3) the emergence of the space  
 age; (4) evolution of social attitudes toward  
 technology with resultant decline in enrollments; and  
 (5) the universities themselves through their  
 influences in the direction of careers selected by  
 engineers. These factors have been counteracted  
 somewhat by increased DOD emphasis on aircraft  
 development programs but more importantly by the  
 favorable growth in civil aircraft requirements.

75N29007  
**UTTL:** The next forty years in aviation  
 In NASA. Langley Res. Center NASA/Univ. Conf. on  
 Aeron. p 71-102 (SEE N75-29001 20-01)  
**AUTH:** A/HAWKINS, W. M.  
**MAJS:** /\*AIR TRANSPORTATION/\*AIRLINE OPERATIONS/\*GENERAL  
 AVIATION AIRCRAFT/\*MILITARY AIRCRAFT  
**MINS:** / ECONOMIC FACTORS/ OPERATIONS/ PREDICTIONS/ RESEARCH/  
 TECHNOLOGY ASSESSMENT  
**ABS:** A prediction of the status of various types of  
 aviation activities which may be expected in twenty  
 years is presented. The basic assumptions are that the  
 population of the nation will continue to grow at more  
 than 7 percent and that the need for air  
 transportation of passengers and cargo will increase  
 accordingly. Various predictions are also made for the  
 developments in vertical takeoff aircraft, short haul  
 airline operations, general aviation, and military  
 aircraft. Areas of improvement are indicated for air  
 navigation, air traffic control, night vision, quiet  
 aircraft, and the use of hydrogen as a fuel.

75N29021  
**UTTL:** General aviation's future need for research  
 In NASA. Langley Res. Center NASA/Univ. Conf. on  
 Aeron. p 379-380 (SEE N75-29001 20-01)  
**AUTH:** A/HARNED, M.  
**MAJS:** /\*AERONAUTICAL ENGINEERING/\*AIRCRAFT EQUIPMENT/\*  
 GENERAL AVIATION AIRCRAFT/\*PROJECT MANAGEMENT/\*  
 RESEARCH PROJECTS/\*UNIVERSITIES  
**MINS:** / AIRCRAFT DESIGN/ DATA ACQUISITION/ EDUCATION/  
 RESEARCH FACILITIES/ TECHNOLOGY ASSESSMENT  
**ABS:** The research requirements for general aviation  
 aircraft are presented. Emphasis is placed on  
 improving the performance of airfoils, propellers, and  
 engines. Additional requirements are expressed with  
 respect to external noise reduction, internal noise  
 reduction, and exhaust emission control. The  
 requirement for anti-icing developments to create  
 improved flight safety is discussed.

76N10998

**UTTL:** General overview of drag  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen.  
Aviation Drag Reduction Workshop p 11-37 (SEE  
N76-10997 02-01)

**AUTH:** A/ANDERSON, S. A.

**MAJS:** /\*AIRCRAFT CONFIGURATIONS/\*BODY-WING AND TAIL  
CONFIGURATIONS/\*DRAG REDUCTION

**MINS:** / AERODYNAMIC DRAG/ GENERAL AVIATION AIRCRAFT/  
STRUCTURAL DESIGN CRITERIA

**ABS:** The state-of-the-art on aerodynamic drag reduction is  
briefly reviewed. The various elements making up the  
total drag of an aircraft include fuselage, wing,  
nacelles, trim, interference, tail, and cooling drag.

76N10999

**UTTL:** Prospects and time tables for analytical estimation of  
the drag of complete aircraft configuration  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen.  
Aviation Drag Reduction Workshop p 39-41 (SEE  
N76-10997 02-01)

**AUTH:** A/SMETANA, F. O.

**MAJS:** /\*AERODYNAMIC DRAG/\*AIRCRAFT CONFIGURATIONS/\*  
ESTIMATING

**MINS:** / AIRCRAFT DESIGN/ GENERAL AVIATION AIRCRAFT/  
PREDICTION ANALYSIS TECHNIQUES/ WIND TUNNEL TESTS

**ABS:** Analytical drag methods and wind tunnel evaluation of  
aircraft design features are used to identify  
excessive drag of general aviation aircraft with  
reciprocating engines.

76N11000

**UTTL:** Summary of drag clean-up tests in NASA Langley  
full-scale tunnel  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen.  
Aviation Drag Reduction Workshop p 43-60 (SEE  
N76-10997 02-01)

**AUTH:** A/MCKINNEY, M. O.

**MAJS:** /\*DRAG REDUCTION/\*FIGHTER AIRCRAFT/\*LIGHT AIRCRAFT/\*  
WIND TUNNEL TESTS

**MINS:** / AERODYNAMIC DRAG/ AIRCRAFT CONFIGURATIONS/ AIRCRAFT  
DESIGN/ FULL SCALE TESTS/ GENERAL AVIATION AIRCRAFT

**ABS:** This summary of drag results presents tabulations on  
fighter aircraft and light twin general aviation  
aircraft wind tunnel tests. The figures show that the  
friction drag for light twins is larger than that for  
the fighters because of the greater wetted area and  
the smaller wing area used for reference. Full scale  
tunnel tests developed the following design features  
contributing to excessive drag: cooling flow system,  
engine exhaust stacks, landing gears, control surface

gaps, and wing irregularities and leakages.

76N11001

**UTTL:** Simplified theoretical methods for aerodynamic design  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen.  
Aviation Drag Reduction Workshop p 61-76 (SEE  
N76-10997 02-01)

**AUTH:** A/TULINIUS, J. R.

**MAJS:** /\*AERODYNAMIC DRAG/\*NUMERICAL ANALYSIS/\*STRUCTURAL  
DESIGN CRITERIA/\*WING PROFILES

**MINS:** / FLUID DYNAMICS/ GENERAL AVIATION AIRCRAFT/  
INTERFERENCE DRAG/ LIFT DRAG RATIO

**ABS:** The objective of this paper is to describe theoretical  
procedures which can be utilized by the general  
aviation industry for aerodynamic design. Discussed  
are the design process and theoretical methods used to  
design a wing. Then theoretical methods for estimating  
the interference velocities due to fuselage, or other  
bodies, and nacelles are elaborated. It is assumed  
that flow fields due to different components can be  
superimposed, and then the pressure coefficients  
computed from the Bernoulli equation. Methods to  
estimate the induced, viscous form, and compressible  
drags are also discussed. In addition, a procedure for  
modifying the surface contours to reduce adverse  
pressure distributions induced by component  
interference is detailed.

76N11002

**UTTL:** Drag reduction: Back to basics  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen.  
Aviation Drag Reduction Workshop p 77-85 (SEE  
N76-10997 02-01)

**AUTH:** A/NICKS, O. W.

**MAJS:** /\*AIRCRAFT CONFIGURATIONS/\*DRAG REDUCTION/\*WIND TUNNEL  
TESTS

**MINS:** / AERODYNAMIC DRAG/ AIRCRAFT DESIGN/ GENERAL AVIATION  
AIRCRAFT

**ABS:** Aeronautical design engineering for general aviation  
aircraft considers the iteration of wind tunnel test  
data are lift, weight, drag, and thrust as the basic  
balancing factor in drag reduction efforts.

76N11003

**UTTL:** Some comments on fuselage drag  
In its Proc. of the NASA, Ind., Univ., Gen. Aviation  
Drag Reduction Workshop p 87-102 (SEE N76-10997 02-01)

**AUTH:** A/ROSKAM, J.

**MAJS:** /\*DRAG REDUCTION/\*FUSELAGES/\*INTERFERENCE DRAG/\*  
STRUCTURAL DESIGN CRITERIA

**MINS:** / GENERAL AVIATION AIRCRAFT/ SKIN FRICTION/ SURFACE

ROUGHNESS EFFECTS/ WINDSHIELDS

**ABS:** The following areas relating to fuselage drag are considered: (1) fuselage fineness - ratio and why and how this can be selected during preliminary design; (2) windshield drag; (3) skin roughness; and (4) research needs in the area of fuselage drag.

76N11004

**UTTL:** Propeller blockage research needs  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 103-105 (SEE N76-10997 02-01)

**AUTH:** A/TUMLINSON, R. R.

**MAJS:** /\*AERODYNAMIC DRAG/\*AIRCRAFT CONFIGURATIONS/\* ESTIMATING/\*PROPELLER SLIPSTREAMS

**MINS:** / AERODYNAMIC INTERFERENCE/ GENERAL AVIATION AIRCRAFT/ PROPULSIVE EFFICIENCY/ WING-FUSELAGE STORES

**ABS:** The effect of mutual propeller/nacelle of fuselage interference on aircraft propulsive efficiency is studied in order to determine accurate drag levels from flight test data by accurately estimating installed thrust and drag and the resulting aircraft performance.

76N11007

**UTTL:** The economic impact of drag in general aviation  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 125-135 (SEE N76-10997 02-01)

**AUTH:** A/NEAL, R. D.

**MAJS:** /\*AERODYNAMIC DRAG/\*ECONOMIC FACTORS/\*GENERAL AVIATION AIRCRAFT

**MINS:** / COST EFFECTIVENESS/ DRAG REDUCTION/ FUEL CONSUMPTION / TURBOFAN ENGINES

**ABS:** General aviation aircraft fuel consumption and operating costs are closely linked to drag reduction methods. Improvements in airplane drag are envisioned for new models; their effects will be in the 5 to 10% range. Major improvements in fuel consumption over existing turboprop airplanes will be the combined results of improved aerodynamics plus additional effects from advanced turboprop engine designs.

76N11008

**UTTL:** Some methods for reducing wing drag and wing-Nacelle interference  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 137-156 (SEE N76-10997 02-01)

**AUTH:** A/KELLY, T. C.

**MAJS:** /\*AIRFOILS/\*DIFFUSERS/\*DRAG REDUCTION/\*STRUCTURAL

DESIGN CRITERIA/\*WINGS

**MINS:** / AERODYNAMIC DRAG/ AIRCRAFT CONFIGURATIONS/ GENERAL AVIATION AIRCRAFT/ NACELLES

**ABS:** Primary efforts directed toward drag reduction centered on the design of both supercritical and subcritical families of airfoils, the reduction of induced drag through the use of vortex diffusers, and the reduction of interference drag for executive-type aircraft.

76N11009

**UTTL:** Drag reduction through higher wing loading  
In its Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 157-169 (SEE N76-10997 02-01)

**AUTH:** A/KOHLMAN, D. L.

**MAJS:** /\*DRAG REDUCTION/\*LIGHT AIRCRAFT/\*WING LOADING

**MINS:** / AERODYNAMIC DRAG/ AIRCRAFT CONFIGURATIONS/ AIRFOIL PROFILES/ GENERAL AVIATION AIRCRAFT

**ABS:** A reduction in wing area, thickness, and span increases wing loading and lowers parasitic drag for a typical light airplane by 10.5%.

76N11012

**UTTL:** Wing-tip vanes as vortex attenuation and induced drag reduction devices  
In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 203-214 (SEE N76-10997 02-01)

**AUTH:** A/WENTZ, W. H., JR.; B/NAGATI, M. G.

**MAJS:** /\*DRAG REDUCTION/\*VANES/\*VORTEX BREAKDOWN/\*WING TIPS

**MINS:** / COMPUTERIZED DESIGN/ GENERAL AVIATION AIRCRAFT/ RECTANGULAR WINGS/ TURBINE BLADES

**ABS:** Analytical studies have been conducted to examine the feasibility of utilizing wing tip turbines to remove swirl from the wing trailing vortex, and hence reduce the potential for upset of following aircraft. Energy recovery from the turbines is also analyzed. A computer routine has been developed to permit rapid parametric studies of various tip turbine designs. It is shown that the optimum turbine is a non-rotating set of vanes which reduce swirl and recover energy in the form of reduced overall configuration induced drag. A specific case study indicates a 23% reduction in induced drag for a rectangular wing of aspect ratio 5.33, operated at a lift coefficient at 1.0.

76N11015  
**UTTL:** Installation drag considerations as related to turboprop and turboprop engines  
 In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 245-256 (SEE N76-10997 02-01)  
**AUTH:** A/BURNETT, G. A.  
**MAJS:** /\*AIRCRAFT CONFIGURATIONS/\*DRAG REDUCTION/\*INSTALLING /\*JET ENGINES  
**MINS:** / GENERAL AVIATION AIRCRAFT/ INTERFERENCE DRAG/ PROPELLERS/ TURBOPROP ENGINES  
**ABS:** Some of the specific areas associated with straight jet and turboprop engine installations are outlined where drag reduction and, thus, improved aircraft system performance is obtained. Specific areas constitute air intake sizing for general aviation aircraft, exhaust duct geometries and cooling system arrangements for propeller powered aircraft.

76N11017  
**UTTL:** An exploratory investigation of the cooling drag associated with general aviation propulsive systems  
 In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 263-272 (SEE N76-10997 02-01)  
**AUTH:** A/CROSS, E. J.  
**MAJS:** /\*AIR COOLING/\*AIRCRAFT ENGINES/\*INTERFERENCE DRAG  
**MINS:** / AIR FLOW/ AIRCRAFT CONFIGURATIONS/ FLIGHT TESTS/ GENERAL AVIATION AIRCRAFT  
**ABS:** A systematic investigation of the drag associated with cooling air flow in contemporary general aviation engine installations is proposed. Theoretical and experimental methods include a state-of-the-art survey, determination of cooling drag by flight tests, and establishment of relative magnitude and components of cooling drag.

76N11019  
**UTTL:** Some comments on trim drag  
 In its Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 295-305 (SEE N76-10997 02-01)  
**AUTH:** A/ROSKAM, J.  
**MAJS:** /\*AERODYNAMIC BALANCE/\*DRAG REDUCTION/\*HORIZONTAL TAIL SURFACES/\*PROPELLER DRIVE  
**MINS:** / BODY-WING AND TAIL CONFIGURATIONS/ ECONOMIC FACTORS/ GENERAL AVIATION AIRCRAFT/ NACELLES/ PREDICTION ANALYSIS TECHNIQUES  
**ABS:** A discussion of data of and methods for predicting trim drag is presented. Specifically the following subjects are discussed: (1) economic impact of trim drag; (2) the trim drag problem in propeller driven

airplanes and the effect of propeller and nacelle location; (3) theoretical procedures for predicting trim drag; and (4) research needs in the area of trim drag.

76N11028  
**UTTL:** Possible applications of soaring technology to drag reduction in powered general aviation aircraft  
 In Kansas Univ. Proc. of the NASA, Ind., Univ., Gen. Aviation Drag Reduction Workshop p 409-430 (SEE N76-10997 02-01)  
**AUTH:** A/MCMASTERS, J. H.; B/PALMER, G. M.  
**MAJS:** /\*AIRCRAFT DESIGN/\*DRAG REDUCTION/\*GENERAL AVIATION AIRCRAFT/\*GLIDERS/\*TECHNOLOGY TRANSFER  
**MINS:** / AERODYNAMIC COEFFICIENTS/ AERODYNAMIC STABILITY/ LIFT DRAG RATIO  
**ABS:** A brief examination of the performance figures achieved by modern soaring machines and a little reflection on the often huge disparity in L/D values between sailplanes and GA aircraft indicates that careful attention to lessons learned in sailplane design and manufacture hold realistic promise for substantial gains in the aerodynamic efficiency of several GA types.

76N11995  
**UTTL:** General aviation components  
 In its Gen. Aviation and Community Develop. p 3-16 (SEE N76-11994 03-01)  
**MAJS:** /\*AIRCRAFT PARTS/\*AIRCRAFT PERFORMANCE/\*GENERAL AVIATION AIRCRAFT  
**MINS:** / AIRCRAFT CONFIGURATIONS/ AIRCRAFT DESIGN/ SHORT TAKEOFF AIRCRAFT  
**ABS:** An overview is presented of selected aviation vehicles. The capabilities and performance of these vehicles are first presented, followed by a discussion of the aerodynamics, structures and materials, propulsion systems, noise, and configurations of fixed-wing aircraft. Finally the discussion focuses on the history, status, and future of attempts to provide vehicles capable of short-field operations.

76N11998  
**UTTL:** Airways and avionics  
 In its Gen. Aviation and Community Develop. p 36-47 (SEE N76-11994 03-01)  
**MAJS:** /\*AIR TRAFFIC CONTROL/\*NAVIGATION AIDS  
**MINS:** / FLIGHT PATHS/ GENERAL AVIATION AIRCRAFT/ NATIONAL AVIATION SYSTEM/ RADIO NAVIGATION/ TERMINAL GUIDANCE  
**ABS:** Terminal and enroute traffic control are summarized along with visual and radio navigation aids.

76N11999  
**UTTL:** Human factors in general aviation  
 In its Gen. Aviation and Community Develop. p 48-55  
 (SEE N76-11994 03-01)  
**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*HUMAN FACTORS ENGINEERING  
 /\*MAN MACHINE SYSTEMS  
**MINS:** / AIRCRAFT ACCIDENTS/ AIRCRAFT DESIGN/ DISPLAY DEVICES  
 / PILOT SELECTION  
**ABS:** The relation of the pilot to the aircraft in general aviation is considered. The human component is analyzed, along with general aviation facilities. The man-machine interface, and the man-environment interface are discussed.

76N12000  
**UTTL:** General aviation environment  
 In its Gen. Aviation and Community Develop. p 59-80  
 (SEE N76-11994 03-01)  
**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*REGULATIONS  
**MINS:** / AIRCRAFT RELIABILITY/ EARTH RESOURCES/ ECONOMIC FACTORS/ ENVIRONMENT PROTECTION  
**ABS:** The background, development, and relationship, among economic factors, airworthiness, costs, and environment protection are examined. Government regulations for airports, air agencies, aircraft, and airmen are reviewed.

76N12001  
**UTTL:** Physical environment  
 In its Gen. Aviation and Community Develop. p 81-87  
 (SEE N76-11994 03-01)  
**MAJS:** /\*AIRPORT PLANNING/\*ENVIRONMENT PROTECTION/\*GENERAL AVIATION AIRCRAFT  
**MINS:** / AIR POLLUTION/ EARTH RESOURCES/ NOISE POLLUTION/ REGULATIONS/ WASTE DISPOSAL/ WATER QUALITY  
**ABS:** Environmental legislation affecting airports and the more common environmental effects resulting from airport construction are discussed with special emphasis on general aviation airports. The discussion is focused on the regulation of noise, pollution, and water quality.

76N12002  
**UTTL:** Alternative modes and travel substitutes  
 In its Gen. Aviation and Community Develop. p 88-104  
 (SEE N76-11994 03-01)  
**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*URBAN TRANSPORTATION  
**MINS:** / AIR TRANSPORTATION/ COSTS/ HIGHWAYS/ RAIL TRANSPORTATION/ TECHNOLOGY ASSESSMENT/ TELECOMMUNICATION  
**ABS:** Modes alternative to general aviation and the

substitutability of telecommunications technology in lieu of intercity travel are reviewed.

76N12003  
**UTTL:** Community perspectives  
 In its Gen. Aviation and Community Develop. p 109-138  
 (SEE N76-11994 03-01)  
**MAJS:** /\*DECISION MAKING/\*GENERAL AVIATION AIRCRAFT/\*URBAN PLANNING  
**MINS:** / AIR TRANSPORTATION/ ECONOMIC FACTORS/ URBAN TRANSPORTATION  
**ABS:** General aviation is considered from the perspective of the local community's decision-making process in determining its needs for access to general aviation services. The decision-making model, preliminary decision, community characteristics, and planning processes are discussed.

76N12004  
**UTTL:** Developing the plan  
 In its Gen. Aviation and Community Develop. p 139-149  
 (SEE N76-11994 03-01)  
**MAJS:** /\*AIR TRANSPORTATION/\*GENERAL AVIATION AIRCRAFT/\*URBAN PLANNING  
**MINS:** / AIRPORT PLANNING/ COSTS/ ECONOMIC FACTORS/ MANAGEMENT PLANNING/ SOCIOLOGY/ URBAN TRANSPORTATION  
**ABS:** The basic sequence in the planning development process is discussed. Alternative ways of satisfying estimated needs, and the selection of an alternative are described along with the development of a plan to implement the selected alternative.

76N12005  
**UTTL:** Transportation and general aviation in Virginia  
 In its Gen. Aviation and Community Develop. p 153-196  
 (SEE N76-11994 03-01)  
**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*TRANSPORTATION/\*VIRGINIA  
**MINS:** / AIR TRANSPORTATION/ HIGHWAYS/ RAIL TRANSPORTATION/ URBAN TRANSPORTATION  
**ABS:** The diversity of Virginia is examined with respect to its transportation facilities and services, the Virginia Air Transportation System Plan, regionalism, and selected case studies of individual facilities.

76N15052  
**UTTL:** A semibuoyant vehicle for general transportation missions  
 In MIT Proc. of the Interagency Workshop on Lighter than Air Vehicles p 431-439 (SEE N76-15015 06-01)  
**AUTH:** A/HAVILL, C. D.; B/HARPER, M.

MAJS: /\*AIRSHIPS/\*CIVIL AVIATION/\*TECHNOLOGY ASSESSMENT  
MINS: / COST ESTIMATES/ FUEL CONSUMPTION/ PAYLOADS/ WEIGHT  
ANALYSIS

ABS: The concept of a small, semibuoyant, lifting-body airship with either a disposable or nondisposable buoyant fluid is discussed. Estimations of fuel consumption, payload capability, power requirements and productivity are made and compared to other flight systems. Comparisons are made on the basis of equal cost vehicles. The assumption is made that, to a first-order approximation, the costs of developing, procuring, and operating a commercial air transport vehicle are proportional to vehicle empty weight. It must be noted that no historical cost data exist for the lifting-body airship and therefore these comparisons must be considered preliminary.

76N31157

UTTL: Some system considerations in configuring a digital flight control - navigation system  
In NASA. Dryden Flight Res. Center Advanced Control Technol. and its Potential for Future Transport Aircraft p 3-35 (SEE N76-31135 22-01)

AUTH: A/BOONE, J. H.; B/FLYNN, G. R.

MAJS: /\*AUTOMATIC FLIGHT CONTROL/\*COMPUTER TECHNIQUES/\*  
DIGITAL TECHNIQUES

MINS: / ANALOG COMPUTERS/ AUTOMATIC PILOTS/ CIVIL AVIATION/  
NAVIGATION/ RISK

ABS: A trade study was conducted with the objective of providing a technical guideline for selection of the most appropriate computer technology for the automatic flight control system of a civil subsonic jet transport. The trade study considers aspects of using either an analog, incremental type special purpose computer or a general purpose computer to perform critical autopilot computation functions. It also considers aspects of integration of noncritical autopilot and autothrottle modes into the computer performing the critical auto and functions, as compared to the federation of the noncritical modes into either a separate computer or with a R-Nav computer. The study is accomplished by establishing the relative advantages and/or risks associated with each of the computer configurations.

77N17083

UTTL: Application of automobile emission control technology to light piston aircraft engines  
In NASA. Lewis Res. Center Aircraft Piston Eng. Exhaust Emissions Symp. p 23-44 (SEE N77-17081 08-07)

AUTH: A/TRIPP, D.; B/KITTREDGE, G.

MAJS: /\*AUTOMOBILE ENGINES/\*HYDROCARBON COMBUSTION/\*LIGHT AIRCRAFT/\*PISTON ENGINES

MINS: / AIRCRAFT ENGINES/ FUEL CONTROL/ FUEL-AIR RATIO/ TECHNOLOGY UTILIZATION

ABS: The possibility was evaluated for achieving the EPA Standards for HC and CO emissions through the use of air-fuel ratio enleanment at selected power modes combined with improved air-fuel mixture preparation, and in some cases improved cooling. Air injection was also an effective approach for the reduction of HC and CO, particularly when combined with exhaust heat conservation techniques such as exhaust port liners.

77N17086

UTTL: Summary report on effects at temperature, humidity, and fuel-air ratio on two air-cooled light aircraft engines  
In its Aircraft Piston Eng. Exhaust Emissions Symp. p 85-120 (SEE N77-17081 08-07)

AUTH: A/KEMPKE, E. E., JR.

MAJS: /\*AIRCRAFT ENGINES/\*FUEL-AIR RATIO/\*LIGHT AIRCRAFT/\* TEMPERATURE EFFECTS

MINS: / AIR COOLING/ GRAPHS (CHARTS)/ HUMIDITY MEASUREMENT/ PISTON ENGINES

ABS: Five different engine models were tested to experimentally characterize emissions and to determine the effects of variation in fuel-air ratio and spark timing on emissions levels and other operating characteristics such as cooling, misfiring, roughness, power acceleration, etc. The results are given of two NASA reports covering the Avco Lycoming O-320-D engine testing and the recently obtained results on the Teledyne Continental TS10-360-C engine.

77N17098

UTTL: Summary of the general aviation manufacturers' position on aircraft piston engine emissions  
In NASA. Lewis Res. Center Aircraft Piston Eng. Exhaust Emissions Symp. p 329-336 (SEE N77-17081 08-07)

AUTH: A/HELMS, J. L.

MAJS: /\*AIRCRAFT ENGINES/\*CONFERENCES/\*EXHAUST GASES/\* MANUFACTURING/\*PISTON ENGINES

MINS: / AERONAUTICS/ FUEL CONSUMPTION/ GOVERNMENT/INDUSTRY RELATIONS/ NOISE REDUCTION

ABS: The General Aviation Manufacturers recommended that the EPA rescind the aircraft piston engine emissions regulations currently on the books. The reason was the very small emission reduction potential and the very poor benefit-cost ratio involved in this form of emission reduction. The limited resources of this industry can far better be devoted to items of much greater benefit to the citizens of this country - reducing noise, improving fuel efficiency (which will incidently reduce exhaust emissions), and improving the safety, operational, and economic aspects of aircraft, all far greater contributions to our total national transportation system.

77N18087

UTTL: General aviation approach and landing practices  
In its Aircraft Safety and Operating Problems p 91-120 (SEE N77-18081 09-03)

AUTH: A/PARKER, L. C.; B/GOODE, M. W.

MAJS: /\*AIR TRAFFIC/\*AIRCRAFT LANDING/\*AIRPORTS/\*GENERAL AVIATION AIRCRAFT/\*LIGHT AIRCRAFT/\*PILOT PERFORMANCE

MINS: / AIRCRAFT SAFETY/ FLIGHT CHARACTERISTICS/ FLIGHT SAFETY/ MIDAIR COLLISIONS

ABS: The characteristics of air traffic patterns at uncontrolled airports and techniques used by a group of general aviation pilots in landing light airplanes are documented. The results of some 1,600 radar tracks taken at four uncontrolled airports and some 600 landings made by 22 pilots in two, four place, single engine light airplanes show that the uncontrolled traffic pattern is highly variable. The altitudes, distances, and piloting procedures utilized may affect the ability for pilots to see-and-avoid in this environment. Most landing approaches were conducted at an airspeed above recommended, resulting in significant floating during flare and touchdowns that were relatively flat and often nose-low.

77N18101

UTTL: General aviation crash safety program at Langley Research Center  
In its Aircraft Safety and Operating Problems p 369-390 (SEE N77-18081 09-03)

AUTH: A/THOMSON, R. G.

MAJS: /\*AIRCRAFT SAFETY/\*CRASH LANDING/\*NASA PROGRAMS/\* SAFETY MANAGEMENT

MINS: / COMPUTER PROGRAMS/ ENERGY ABSORPTION/ FAILURE MODES/ RESEARCH AND DEVELOPMENT/ STRUCTURAL ANALYSIS

ABS: The purpose of the crash safety program is to support development of the technology to define and demonstrate new structural concepts for improved crash safety and occupant survivability in general aviation

aircraft. The program involves three basic areas of research: full-scale crash simulation testing, nonlinear structural analyses necessary to predict failure modes and collapse mechanisms of the vehicle, and evaluation of energy absorption concepts for specific component design. Both analytical and experimental methods are being used to develop expertise in these areas. Analyses include both simplified procedures for estimating energy absorption capabilities and more complex computer programs for analysis of general airframe response. Full-scale tests of typical structures as well as tests on structural components are being used to verify the analyses and to demonstrate improved design concepts.

77N18109

**UTTL:** Effects of aircraft noise on flight and ground structures

In Its Aircraft Safety and Operating Problems p 513-526 (SEE N77-18081 09-03)

**AUTH:** A/MIXSON, J. S.; B/MAYES, W. H.; C/WILLIS, C. M.

**MAJS:** /\*AIRCRAFT NOISE/\*NASA PROGRAMS/\*SHOCK WAVES/\*SOUND PRESSURE

**MINS:** / AIRCRAFT CONFIGURATIONS/ DYNAMIC RESPONSE/ EXTERNALLY BLOWN FLAPS/ LIGHT AIRCRAFT/ NOISE POLLUTION/ STRUCTURAL VIBRATION

**ABS:** Acoustic loads measured on jet-powered STOL configurations are presented for externally blown and upper surface blown flap models ranging in size from a small laboratory model up to a full-scale aircraft model. The implications of the measured loads for potential acoustic fatigue and cabin noise are discussed. Noise transmission characteristics of light aircraft structures are presented. The relative importance of noise transmission paths, such as fuselage sidewall and primary structure, is estimated. Acceleration responses of a historic building and a residential home are presented for flyover noise from subsonic and supersonic aircraft. Possible effects on occupant comfort are assessed. The results from these three examples show that aircraft noise can induce structural responses that are large enough to require consideration in the design or operation of the aircraft.

77N29772

**UTTL:** Remotely piloted aircraft in the civil environment  
In JPL The 2nd Conf. on Remotely Manned Systems (RMS)  
p 47-48 (SEE N77-29750 20-54)

**AUTH:** A/GREGORY, T. J.; B/NELMS, W. P., JR.; C/KARMAKAR, J.

**MAJS:** /\*AERIAL RECONNAISSANCE/\*CIVIL AVIATION/\*PILOTLESS

AIRCRAFT/\*REMOTELY PILOTED VEHICLES/\*TECHNOLOGY UTILIZATION

**MINS:** / AIR TRANSPORTATION/ MAPPING/ MONITORS/ REMOTE SENSORS/ RESCUE OPERATIONS/ TELECOMMUNICATION

**ABS:** Existing remotely piloted vehicle application programs are described along with the technology of several important subsystems and the potential vehicle uses and operational concepts. Regulatory constraints and present and future study activities that may lead to demonstration and then operational programs, are discussed.

78N11073  
**UTTL:** General aviation piston-engine exhaust emission reduction  
 In its Aircraft Eng. Emissions p 243-275 (SEE N78-11063 02-07)  
**AUTH:** A/KEMPKE, E. E., JR.; B/HOUTMAN, W. H.; C/WESTFIELD, W. T.; D/DUKE, L. C.; E/REZY, B. J.  
**MAJS:** /\*AIR POLLUTION/\*AIRCRAFT ENGINES/\*EXHAUST GASES/\*GENERAL AVIATION AIRCRAFT/\*PISTON ENGINES/\*POLLUTION CONTROL  
**MINS:** / AIR POLLUTION/ AIR QUALITY/ STANDARDS/ SYSTEMS ENGINEERING  
**ABS:** To support the promulgation of aircraft regulations, two airports were examined, Van Nuys and Tamiami. It was determined that the carbon monoxide (CO) emissions from piston-engine aircraft have a significant influence on the CO levels in the ambient air in and around airports, where workers and travelers would be exposed. Emissions standards were set up for control of emissions from aircraft piston engines manufactured after December 31, 1979. The standards selected were based on a technologically feasible and economically reasonable control of carbon monoxide. It was concluded that substantial CO reductions could be realized if the range of typical fuel-air ratios could be narrowed. Thus, improvements in fuel management were determined as reasonable controls.

78N12137  
**UTTL:** Legal Issues inherent in space shuttle operations  
 In Comm. on Sci. and Technol. (U. S. Senate) Space Transportation System p 611-637 (SEE N78-12127 03-16)  
**MAJS:** /\*LAW (JURISPRUDENCE)/\*NASA PROGRAMS/\*SPACE SHUTTLES/\*SPACE TRANSPORTATION  
**MINS:** / CIVIL AVIATION/ COMMERCIAL AIRCRAFT/ GOVERNMENT/INDUSTRY RELATIONS/ PROJECT MANAGEMENT/ PUBLIC LAW  
**ABS:** The legal issues inherent in NASA's proceeding into the day-to-day operations of the space shuttle and other elements of the Space Transportation System are considered in light of the National Aeronautics and Space Act of 1958. Based on this review, it was concluded that there is no immediate need for substantive amendments to that legislation.

78N19727  
**UTTL:** Summary report of the General Aviation Committee  
 In Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshops p 304-308 (SEE N78-19711 10-47)  
**AUTH:** A/GOODRICH, W. C.

**MAJS:** /\*CIVIL AVIATION/\*GENERAL AVIATION AIRCRAFT/\*SUMMARIES  
**MINS:** / AIRCRAFT ACCIDENTS/ AIRPORTS/ METEOROLOGICAL SERVICES/ METEOROLOGY/ PILOT TRAINING/ WEATHER FORECASTING/ WIND SHEAR  
**ABS:** Fatal weather involved general aviation accidents and the criteria for weather observations at general aviation airports were discussed. It was generally agreed that: (1) meteorologists do not seem to have sufficient understanding of general aviation requirements, (2) pilots are not aware of the meteorological services and publications which are available to them; (3) Uniform capability is not being utilized to the degree possible; and (4) there is a wealth of weather data available within the Department of Defense which is not available in the system for civil use. The committee recommends that student pilot training programs include actual inflight weather experience accomplished through instructor training, and efforts be made to make real time weather data available to the pilot from all sources to include military installations, Unicom operators, tower and approach controllers, and air traffic controllers.

78N19728  
**UTTL:** Summary report of Committee A  
 In Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop p 309-313 (SEE N78-19711 10-47)  
**AUTH:** A/SPRINKLE, C. H.  
**MAJS:** /\*AIRCRAFT DESIGN/\*ATMOSPHERIC MODELS/\*CIVIL AVIATION /\*METEOROLOGICAL SERVICES  
**MINS:** / ATMOSPHERIC TURBULENCE/ HUMIDITY/ METEOROLOGY/ SUMMARIES/ WEATHER FORECASTING/ WIND SHEAR  
**ABS:** Sessions were held with the standing committees on aircraft design, simulation, general services, and general aviation. It was stated that current procedures for designing structural components with respect to turbulence forcing functions were adequate. It was agreed that the ultimate goal of aviation weather services was the delivery of accurate and timely information to the cockpit flight crew.

78N19729  
**UTTL:** Summary report of Committee B  
 In Tennessee Univ. Space Inst. Proc. of the 1st Ann. Meteorol. and Environ. Inputs to Aviation Systems Workshop p 314-320 (SEE N78-19711 10-47)  
**AUTH:** A/LENSCHOW, D. H.  
**MAJS:** /\*AIRCRAFT DESIGN/\*ATMOSPHERIC MODELS/\*CIVIL AVIATION /\*METEOROLOGICAL SERVICES  
**MINS:** / LANDING/ LIGHTNING/ PILOT TRAINING/ STRUCTURAL DESIGN/ WEATHER FORECASTING/ WIND SHEAR

**ABS:** Topics discussed in this summary include: (1) general aviation and services; (2) aircraft design; and (3) simulation. It was concluded that private pilots need to be more knowledgeable about weather. Improvement is needed in providing general aviation pilots with changes in the weather reporting and forecasting systems. There should also be some simulation of various severe shear profiles in training simulators, although there is still a problem in simulating shear conditions using mathematical models and data.

79N15064

**UTTL:** New NASA-Ames wind-tunnel techniques for studying airplane spin and two-dimensional unsteady aerodynamics  
In AGARD Dyn. Stability Parameters 12 p (SEE N79-15061 06-08)

**AUTH:** A/MALCOLM, G. N.; B/DAVIS, S. S.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*COMMERCIAL AIRCRAFT/\*FIGHTER AIRCRAFT/\*WIND TUNNEL TESTS

**MINS:** / AERODYNAMICS/ ANGLE OF ATTACK/ DATA ACQUISITION/ MEASURING INSTRUMENTS/ REYNOLDS NUMBER/ SPIN TESTS/ UNSTEADY FLOW/ WIND TUNNEL MODELS

**ABS:** Two new wind tunnel test apparatuses were developed at NASA-Ames Research Center. The first is a rotary-balance apparatus to be used in the Ames 12-Foot Pressure Tunnel for investigating the effects of Reynolds number, spin rate, and angle of attack on the aerodynamics of fighter and general aviation aircraft in a steady spin motion. The second apparatus provides capability for oscillating a large two dimensional wing (0.5 m chord, 1.35 m span) instrumented with steady and unsteady pressure transducers in the Ames 11 x 11 ft. Transonic Wind Tunnel. A complete description of both apparatuses, their capabilities, and some typical wind tunnel results are presented.

79N15962

**UTTL:** Overview of NASA general aviation program  
In NASA. Lewis Res. Center The Rotary Combust. Engine p 1-11 (SEE N79-15961 07-07)

**AUTH:** A/WINBLADE, R. L.

**MAJS:** /\*AIRCRAFT ENGINES/\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS/\*PROJECT PLANNING/\*RESEARCH MANAGEMENT

**MINS:** / AIRCRAFT PERFORMANCE/ AIRCRAFT RELIABILITY/ ENVIRONMENT EFFECTS/ FLIGHT SAFETY

**ABS:** The NASA efforts devoted to new technology for general aviation are summarized. Areas covered include: (1) improved safety through improved crashworthy structural design, spin resistance, and improved operations around uncontrolled airports; (2) reduced environmental impact for both reciprocating and turbine engines; and (3) research for improvement in the performance of both aerodynamic and system components.

79N15963

**UTTL:** General aviation energy-conservation research programs  
In its The Rotary Combust. Engine p 13-35 (SEE N79-15961 07-07)

**AUTH:** A/WILLIS, E. A.

**MAJS:** /\*AIRCRAFT ENGINES/\*ENERGY CONSERVATION/\*GENERAL AVIATION AIRCRAFT/\*NASA PROGRAMS/\*RESEARCH MANAGEMENT

**MINS:** / AIRCRAFT FUELS/ COMBUSTION EFFICIENCY/ DIESEL ENGINES/ ENGINE DESIGN/ EXHAUST GASES/ FUEL CONSUMPTION/ MECHANICAL DRIVES/ POLLUTION CONTROL

**ABS:** A review is presented of nonturbine general aviation engine programs underway at the NASA-Lewis Research Center. The program encompasses conventional, lightweight diesel, and rotary engines. Its three major thrusts are: (1) reduced SFC's; (2) improved fuels tolerance; and (3) reducing emissions. Current and planned future programs in such areas as lean operation, improved fuel management, advanced cooling techniques, and advanced engine concepts, are described. These are expected to lay the technology base, by the mid to latter 1980's, for engines whose total fuel costs are as much as 30% lower than today's conventional engines.

79N15964

**UTTL:** Development status of rotary engine at Toyo Kogyo  
In NASA. Lewis Res. Center The Rotary Combust. Engine p 37-84 (SEE N79-15961 07-07)

**AUTH:** A/YAMAMOTO, K.

**MAJS:** /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT/\*MECHANICAL DRIVES

**MINS:** / COMBUSTION EFFICIENCY/ EXHAUST GASES/ FUEL CONSUMPTION/ JAPAN/ POLLUTION CONTROL

**ABS:** Progress in the development of rotary engines which use a thermal reactor as the primary part of the exhaust emission control system is reviewed. Possibilities of further improvements in fuel economy of future rotary engines are indicated.

79N15965

**UTTL:** Update of development on the new Audi NSU rotary engine generation  
In NASA. Lewis Res. Center The Rotary Combust. Engine 85-107 (SEE N79-15961 07-07)

**AUTH:** A/VANBASSHUYSEN, R.

**MAJS:** /\*AIRCRAFT ENGINES/\*AUTOMOBILE ENGINES/\*ENGINE DESIGN /\*GENERAL AVIATION AIRCRAFT/\*MECHANICAL DRIVES

**MINS:** / COMBUSTION EFFICIENCY/ EXHAUST GASES/ FUEL CONSUMPTION/ POLLUTION CONTROL/ TECHNOLOGY TRANSFER

**ABS:** Rotary engines with a chamber volume of 750 cc as a two rotor automotive powerplant, called KKM 871 are described. This engine is compared to a 3 liter or 183

cubic inch, six-cylinder reciprocating engine. Emphasis is placed on exhaust emission control and fuel economy.

79N15966

**UTTL:** Review of the Rhein-Flugzeugbau Wankel powered aircraft program  
In NASA. Lewis Res. Center The Rotary Combust. Engine p 109-122 (SEE N79-15961 07-07)

**AUTH:** A/RIETHMUELLER, M.

**MAJS:** /\*AIRCRAFT ENGINES/\*DUCTED FAN ENGINES/\*ENGINE DESIGN  
/\*GENERAL AVIATION AIRCRAFT/\*MECHANICAL DRIVES

**MINS:** / AUTOMOBILE ENGINES/ EXHAUST GASES/ FUEL CONSUMPTION/  
LIGHT AIRCRAFT/ POLLUTION CONTROL/ TECHNOLOGY TRANSFER

**ABS:** The development of light aircraft with special emphasis on modern propulsion systems and production is discussed in terms of the application of rotary engines to aircraft. Emphasis is placed on the integrated ducted-fan propulsion system using rotary engines.

79N15967

**UTTL:** Rotary engine developments at Curtiss-Wright over the past 20 years and review of general aviation engine potential

In NASA. Lewis Res. Center The Rotary Combust. Engine p 123-174 (SEE N79-15961 07-07)

**AUTH:** A/JONES, C.

**MAJS:** /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*FUEL INJECTION/\*  
GENERAL AVIATION AIRCRAFT/\*MECHANICAL DRIVES

**MINS:** / AUTOMOBILE ENGINES/ ENERGY CONSERVATION/ EXHAUST  
GASES/ FUEL CONSUMPTION/ NOISE REDUCTION/ POLLUTION  
CONTROL/ TECHNOLOGY TRANSFER

**ABS:** The development of the rotary engine as a viable power plant capable of wide application is reviewed. Research results on the stratified charge engine with direct chamber injection are included. Emission control, reduced fuel consumption, and low noise level are among the factors discussed in terms of using the rotary engine in general aviation aircraft.

79N15968

**UTTL:** Engine requirements for future general aviation aircraft

In NASA. Lewis Res. Center The Rotary Combust. Engine p 175-186 (SEE N79-15961 07-07)

**AUTH:** A/STICKLE, J. W.

**MAJS:** /\*AIRCRAFT ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION  
AIRCRAFT/\*MARKET RESEARCH/\*MECHANICAL DRIVES

**MINS:** / AUTOMOBILE ENGINES/ ENERGY CONSERVATION/ POLLUTION  
CONTROL/ TECHNOLOGICAL FORECASTING/ TECHNOLOGY

TRANSFER

**ABS:** The market place is examined for general aviation aircraft into the 1980's. The visible constraints that engine manufacturers must face regardless of the type of cycle are indicated.

79N17427

**UTTL:** Summary report of the Lightning and Static Electricity Committee

In Tenn. Univ. Space Inst. Proc. of the 2nd Ann. Workshop on Meteorol. and Environ. Inputs to Aviation Systems p 203-214 (SEE N79-17413 08-47)

**AUTH:** A/PLUMER, J. A.

**MAJS:** /\*AERONAUTICS/\*ATMOSPHERIC ELECTRICITY/\*LIGHTNING/\*  
STATIC ELECTRICITY

**MINS:** / AIRCRAFT DETECTION/ DATA SYSTEMS/ ENVIRONMENT  
PROTECTION/ GENERAL AVIATION AIRCRAFT/ IMPACT DAMAGE/  
INDEPENDENT VARIABLES/ PILOT TRAINING/ PREDICTIONS/  
TECHNOLOGY ASSESSMENT

**ABS:** Lightning protection technology as applied to aviation and identifying these technology needs are presented. The flight areas of technical needs include: (1) the need for In-Flight data on lightning electrical parameters; (2) technology base and guidelines for protection of advanced systems and structures; (3) improved laboratory test techniques; (4) analysis techniques for predicting induced effects; (5) lightning strike incident data from General Aviation; (6) lightning detection systems; (7) obtain pilot reports of lightning strikes; and (8) better training in lightning awareness. The nature of each problem, timeliness, impact of solutions, degree of effort required, and the roles of government and industry in achieving solutions are discussed.

79N18075

**UTTL:** An assessment of the risks presented by the use of carbon fiber composites in commercial aviation:

Executive summary

In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com. Aviation p 1-24 (SEE N79-18074 09-31)

**MAJS:** /\*AIRCRAFT STRUCTURES/\*CARBON FIBERS/\*COMMERCIAL  
AIRCRAFT/\*COMPOSITE MATERIALS/\*RISK

**MINS:** / AIRCRAFT ACCIDENTS/ CIVIL AVIATION/ DISPERSING/  
PROBABILITY THEORY/ PROJECT PLANNING/ RELIABILITY  
ANALYSIS/ TABLES (DATA)

**ABS:** To support the investigation, experimental data from a number of different sources were used, including tests of carbon fibers (CF) release from burning composites and vulnerability tests for selected equipment. Field survey were conducted in the vicinity of several

major airports in order to characterize the types of facilities that might be exposed to CF releases. Census data were employed to enumerate the number of residential and commercial establishments in the vicinity of the 26 large hub airports. These data formed part of the input to a risk simulation model which produced a conditional risk profile, showing the probability of different amounts of loss given that an accidental release of CF has occurred. A national risk profile was developed, which estimates the annual losses due to CF usage in commercial aircraft based upon the anticipated usage in 1993.

79N20001

**UTTL:** Flight test techniques for low speed airfoil evaluation

In NASA. Langley Res. Center Advanced Technol. Airfoil Res., Vol. 1, Pt. 2 p 623-642 (SEE N79-19989 11-01)

**AUTH:** A/HOFFMANN, M. J.; B/GREGOREK, G. M.; C/WEISLOGEL, G. S.

**MAJS:** /\*AIRFOILS/\*FLIGHT TESTS/\*LOW SPEED

**MINS:** / AIRCRAFT WAKES/ ANGLE OF ATTACK/ DATA REDUCTION/ IN-FLIGHT MONITORING/ INSTRUMENTS/ PRESSURE MEASUREMENTS

**ABS:** Techniques for in-flight evaluation of new airfoils by modifying a single engine general aviation aircraft and measuring and recording airfoil surface pressures, airfoil wake pressures, and aircraft angle of attack and airspeed are presented. Included are descriptions of the aircraft modifications, instrumentation, data reduction techniques, illustrations of typical results and comments on new equipment for flight test applications.

79N22199

**UTTL:** Carbon fibers and composites  
In Its Carbon Fiber Risk Anal. p 29-40 (SEE N79-22196 13-24)

**AUTH:** A/PRIDE, R. A.

**MAJS:** /\*CARBON FIBERS/\*GRAPHITE-EPOXY COMPOSITE MATERIALS/\* RISK

**MINS:** / AIRCRAFT CONSTRUCTION MATERIALS/ AIRCRAFT STRUCTURES / CIVIL AVIATION/ HAZARDS/ WEIGHT (MASS)

**ABS:** The basic nature of composite materials is considered. Carbon fiber composites and their area of current and planned application in civil aircraft are discussed, specifically within the framework of the various aspects of risk analysis.

79N22200

**UTTL:** Source of released carbon fibers  
In its Carbon Fiber Risk Anal. p 41-71 (SEE N79-22196 13-24)

**AUTH:** A/BELL, V. L.

**MAJS:** /\*AIRCRAFT ACCIDENTS/\*CARBON FIBERS/\*GRAPHITE-EPOXY COMPOSITE MATERIALS/\*RISK

**MINS:** / AIRCRAFT ACCIDENTS/ CIVIL AVIATION/ CRASHES/ FIRES/ HAZARDS

**ABS:** The potential for the release of carbon fibers from aircraft crashes/fires is addressed. Simulation of the conditions of aircraft crash fires in order to predict the quantities and forms of fibrous materials which might be released from civilian aircraft crashes/fires is considered. Figures are presented which describe some typical fiber release test activities together with some very preliminary results of those activities. The state of the art of carbon fiber release is summarized as well as some of the uncertainties concerning accidental fiber release.

79N22208

**UTTL:** An assessment of national risk: General concepts and overall approach  
In NASA. Langley Res. Center Carbon Fiber Risk Anal. p 199-234 (SEE N79-22196 13-24)

**AUTH:** A/KALELKAR, A. S.

**MAJS:** /\*CARBON FIBERS/\*CIVIL AVIATION/\*RISK/\*UTILIZATION

**MINS:** / AIRCRAFT STRUCTURES/ COMMERCIAL AIRCRAFT/ EVALUATION / HAZARDS

**ABS:** The analysis of risk presented by carbon fiber utilization in commercial aviation is reported. The discussion is presented in three parts: (1) general concepts; (2) overall approach; and (3) risk evaluation and perspective.

79N23896

**UTTL:** Some new airfoils  
In NASA. Langley Res. Center The Sci. and Technol. of Low Speed and Motorless Flight, Pt. 1 p 131-154 (SEE N79-23889 15-01)

**AUTH:** A/EPPLER, R.

**MAJS:** /\*AERODYNAMIC CHARACTERISTICS/\*AIRFOILS/\*COMPUTERS/\* STRUCTURAL ANALYSIS/\*STRUCTURAL DESIGN

**MINS:** / AERODYNAMIC COEFFICIENTS/ CANARD CONFIGURATIONS/ COMPUTER PROGRAMS/ COORDINATES/ GLIDERS/ GRAPHS (CHARTS)/ LIFT/ LIGHT AIRCRAFT/ PROBLEM SOLVING/ TABLES (DATA)/ VELOCITY DISTRIBUTION

**ABS:** A computer approach to the design and analysis of airfoils and some common problems concerning laminar separation bubbles at different lift coefficients are briefly discussed. Examples of application to

ultralight airplanes, canards, and sailplanes with flaps are given.

79N23918

**UTTL:** A review of the icing situation from the standpoint of general aviation  
In NASA. Lewis Res. Center Aircraft Icing p 31-38  
(SEE N79-23912 15-02)

**AUTH:** A/NEWTON, D. W.

**MAJS:** /\*AIRCRAFT HAZARDS/\*GENERAL AVIATION AIRCRAFT/\*ICE FORMATION/\*PROGRAM TREND LINE ANALYSIS

**MINS:** / AIRCRAFT SAFETY/ CERTIFICATION/ INDICATING INSTRUMENTS/ WEATHER FORECASTING

**ABS:** An overview of the present situation in the field of aircraft icing with respect to certification and operation of nontransport category airplanes is given. Problems of definition and inconsistencies are pointed out. Problems in the forecasting and measurement of icing intensities are discussed. The present regulatory environment is examined with respect to its applicability and appropriateness to nontransport airplanes.

79N27078

**UTTL:** Treatment of the control mechanisms of light airplanes in the flutter clearance process  
In Its Sci. and Technol. of Low Speed and Motorless Flight p 437-466 (SEE N79-27070 18-01)

**AUTH:** A/BREITBACH, E. J.

**MAJS:** /\*FLUTTER/\*LIGHT AIRCRAFT

**MINS:** / FLIGHT CONTROL/ MATHEMATICAL MODELS/ NONLINEARITY

**ABS:** It has become more and more evident that many difficulties encountered in the course of aircraft flutter analyses can be traced to strong localized nonlinearities in the control mechanisms. To cope with these problems, more reliable mathematical models paying special attention to control system nonlinearities were established by means of modified ground vibration test procedures in combination with suitably adapted modal synthesis approaches. Three different concepts are presented.

80N14634  
**UTTL:** Meteorological input to general aviation pilot training  
 In Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems p 30-36 (SEE N80-14633 05-47)  
**AUTH:** A/COLOMY, J. R.  
**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*METEOROLOGY/\*PILOT TRAINING  
**MINS:** / AIRCRAFT ACCIDENTS/ EDUCATION/ FLIGHT SAFETY/ INSTRUMENT FLIGHT RULES/ LEARNING  
**ABS:** The meteorological education of general aviation pilots is discussed in terms of the definitions and concepts of learning and good educational procedures. The effectiveness of the meteorological program in the training of general aviation pilots is questioned. It is suggested that flight instructors provide real experience during low ceilings and visibilities, and that every pilot receiving an instrument rating should experience real instrument flight.

80N14636  
**UTTL:** Accident investigation  
 In Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems p 46-57 (SEE N80-14633 05-47)  
**AUTH:** A/BRUNSTEIN, A. I.  
**MAJS:** /\*AIRCRAFT ACCIDENT INVESTIGATION/\*GENERAL AVIATION AIRCRAFT/\*TRANSPORT AIRCRAFT/\*WEATHER  
**MINS:** / AIRCRAFT ACCIDENTS/ METEOROLOGICAL PARAMETERS/ STATISTICAL ANALYSIS/ TABLES (DATA)  
**ABS:** Aircraft accident investigations are discussed with emphasis on those accidents that involved weather as a contributing factor. The organization of the accident investigation board for air carrier accidents is described along with the hearings, and formal report preparation. Statistical summaries of the investigations of general aviation accidents are provided.

80N19194  
**UTTL:** Approach to the assessment of the hazard  
 In its Assessment of Carbon Fiber Elec. Effects p 11-27 (SEE N80-19193 10-24)  
**AUTH:** A/HUSTON, R. J.  
**MAJS:** /\*AIRCRAFT ACCIDENTS/\*CARBON FIBERS/\*COMPOSITE MATERIALS/\*ELECTRIC EQUIPMENT/\*FIRES  
**MINS:** / AIRCRAFT CONSTRUCTION MATERIALS/ ATMOSPHERIC DIFFUSION/ CIVIL AVIATION/ ELECTRICAL FAULTS/ ELECTRICAL INSULATION/ VULNERABILITY

**ABS:** An overview of the carbon fiber hazard assessment is presented. The potential risk to the civil sector associated with the accidental release of carbon fibers from aircraft having composite structures was assessed along with the need for protection of civil aircraft from carbon fibers.

80N19201  
**UTTL:** Assessment of risk due to the use of carbon fiber composites in commercial and general aviation  
 In NASA. Langley Res. Center Assessment of Carbon Fiber Elec. Effects p 183-211 (SEE N80-19193 10-24)  
**AUTH:** A/FIKSEL, J.; B/ROSENFELD, D.; C/KALELKAR, A.  
**MAJS:** /\*AIRCRAFT SAFETY/\*CARBON FIBERS/\*COMMERCIAL AIRCRAFT /\*FIBER COMPOSITES/\*GENERAL AVIATION AIRCRAFT/\*RISK  
**MINS:** / ACCIDENT INVESTIGATION/ AIRCRAFT ACCIDENTS/ FIRE DAMAGE/ FLAME PROPAGATION/ MONTE CARLO METHOD  
**ABS:** The development of a national risk profile for the total annual aircraft losses due to carbon fiber composite (CFC) usage through 1993 is discussed. The profile was developed using separate simulation methods for commercial and general aviation aircraft. A Monte Carlo method which was used to assess the risk in commercial aircraft is described. The method projects the potential usage of CFC through 1993, investigates the incidence of commercial aircraft fires, models the potential release and dispersion of carbon fibers from a fire, and estimates potential economic losses due to CFC damaging electronic equipment. The simulation model for the general aviation aircraft is described. The model emphasizes variations in facility locations and release conditions, estimates distribution of CFC released in general aviation aircraft accidents, and tabulates the failure probabilities and aggregate economic losses in the accidents.

80N19541  
**UTTL:** Emulation applied to reliability analysis of reconfigurable, highly reliable, fault-tolerant computing systems  
 In AGARD Avionics Reliability, Its Tech. and Related Disciplines 11 p (SEE N80-19519 10-38)  
**AUTH:** A/MIGNEAULT, G. E.  
**MAJS:** /\*AIRBORNE/SPACEBORNE COMPUTERS/\*MICROPROGRAMMING/\* RELIABILITY ANALYSIS  
**MINS:** / CIVIL AVIATION/ COMPUTER PROGRAMS/ COMPUTERIZED SIMULATION/ ERROR ANALYSIS  
**ABS:** Emulation techniques applied to the analysis of the reliability of highly reliable computer systems for future commercial aircraft are described. The lack of credible precision in reliability estimates obtained

by analytical modeling techniques is first established. The difficulty is shown to be an unavoidable consequence of: (1) a high reliability requirement so demanding as to make system evaluation by use testing infeasible; (2) a complex system design technique, fault tolerance; (3) system reliability dominated by errors due to flaws in the system definition; and (4) elaborate analytical modeling techniques whose precision outputs are quite sensitive to errors of approximation in their input data. Next, the technique of emulation is described, indicating how its input is a simple description of the logical structure of a system and its output is the consequent behavior. Use of emulation techniques is discussed for pseudo-testing systems to evaluate bounds on the parameter values needed for the analytical techniques. Finally an illustrative example is presented to demonstrate from actual use the promise of the proposed application of emulation.

80N21305

**UTTL:** Civil applications of global positioning systems  
In NASA, Washington Global Positioning System for  
Gen. Aviation: Joint FAA-NASA Seminar p 75-81 (SEE  
N80-21299 12-04)

**AUTH:** A/CALIBI, V.

**MAJS:** /\*AIR NAVIGATION/\*CIVIL AVIATION/\*GLOBAL POSITIONING  
SYSTEM

**MINS:** / GENERAL AVIATION AIRCRAFT/ RADIO RECEIVERS/ USER  
REQUIREMENTS

**ABS:** User requirements germane to civil applications in the  
GPS are discussed. The Z-set is discussed as a  
possible low cost set which might meet the civil  
requirement as a GPS receiver.

80N21306

**UTTL:** A program for predicting antenna radiation patterns  
In NASA, Washington Global Positioning System for  
Gen. Aviation: Joint FAA-NASA Seminar p 83-105 (SEE  
N80-21299 12-04)

**AUTH:** A/GILREATH, M.

**MAJS:** /\*AIRCRAFT ANTENNAS/\*ANTENNA DESIGN/\*ANTENNA RADIATION  
PATTERNS/\*COMPUTER PROGRAMS/\*MICROWAVE LANDING SYSTEMS

**MINS:** / BOEING 737 AIRCRAFT/ C-135 AIRCRAFT/ COMPUTERIZED  
SIMULATION/ GENERAL AVIATION AIRCRAFT/ LEAR JET  
AIRCRAFT

**ABS:** The status of the aircraft antenna prediction program  
at Langley is reviewed with emphasis on the analytical  
techniques and computer programs developed for antenna  
siting and performance prediction. Scale-model  
aircraft are used to obtain experimental data for  
verification of analytical results. Computer generated

models of the Boeing 737, the KC-135, the Cessna 402B,  
and the Gates Lear jet are discussed.

80N21307

**UTTL:** Designing low cost receivers for general aviation  
users  
In NASA, Washington Global Positioning System for  
Gen. Aviation: Joint FAA-NASA Seminar p 107-117 (SEE  
N80-21299 12-04)

**AUTH:** A/NATALI, F. D.

**MAJS:** /\*AREA NAVIGATION/\*GENERAL AVIATION AIRCRAFT/\*GLOBAL  
POSITIONING SYSTEM/\*RECEIVERS/\*SYSTEMS ENGINEERING

**MINS:** / ANALOG CIRCUITS/ ANTENNA DESIGN/ LOW COST/  
MICROPROCESSORS/ MULTIPATH TRANSMISSION/ OSCILLATORS

**ABS:** Approaches to the design of a low cost receiver which  
meets all IFR requirements for 2D area navigation are  
discussed. These include: (1) using current technology  
with a minimum of specialized LSI, a minimum of  
circuit complexity, and minimal use of critical  
components; (2) emphasized microprocessor technology;  
and (3) a special analog/digital chip fabrication. A  
low cost GPS receiver configuration with a single  
sequencing tracking channel is examined. Problem areas  
are indicated.

80N21308

**UTTL:** Design approaches for GPS receivers/processors  
In NASA, Washington Global Positioning System for  
Gen. Aviation: Joint FAA-NASA Seminar p 119-128 (SEE  
N80-21299 12-04)

**AUTH:** A/NINO, R. V.

**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*GLOBAL POSITIONING SYSTEM  
/\*RECEIVERS

**MINS:** / AVIONICS/ COSTS/ SYSTEMS ENGINEERING/ TECHNOLOGY  
UTILIZATION

**ABS:** The design philosophy for a low-cost GPS  
receiver-processor is discussed.

80N22286

**UTTL:** Flight selection at United Airlines  
In NASA, Ames Res. Center Resource Management on the  
Flight Deck p 61-75 (SEE N80-22283 13-03)

**AUTH:** A/TRAUB, W.

**MAJS:** /\*FLIGHT CREWS/\*PERSONNEL MANAGEMENT/\*PILOT SELECTION

**MINS:** / CIVIL AVIATION/ COMPUTER ASSISTED INSTRUCTION/  
COMPUTER PROGRAMS/ FLIGHT TIME/ PERSONALITY TESTS/  
PILOT TRAINING/ PSYCHOLOGICAL TESTS/ PSYCHOMOTOR  
PERFORMANCE

**ABS:** Airline pilot selection procedures are discussed  
including psychological and personality tests,  
psychomotor performance requirements, and flight

skills evaluation. Necessary attitude and personality traits are described and an outline of computer selection, testing, and training techniques is given.

BON22287

**UTTL:** British Airways' pre-command training program  
In NASA. Ames Res. Center Resource Management on the  
Flight Deck p 76-86 (SEE N80-22283 13-03)  
**AUTH:** A/HOLDSTOCK, L. F. J.  
**MAJS:** /\*FLIGHT CREWS/\*FLIGHT TRAINING/\*PERSONNEL MANAGEMENT  
/\*PILOT TRAINING  
**MINS:** / AIRLINE OPERATIONS/ CIVIL AVIATION/ FLIGHT  
SIMULATORS/ PILOT SELECTION  
**ABS:** Classroom, flight simulator, and in-flight sessions of  
an airline pilot training program are briefly  
described. Factors discussed include initial command  
potential assessment, precommand airline management  
studies course, precommand course, and command course.

BON22328

**UTTL:** AiResearch QCGAT engine, airplane, and nacelle design  
features  
In NASA. Lewis Res. Center Gen. Aviation Propulsion  
p 11-43 (SEE N80-22327 13-07)  
**AUTH:** A/HELDENBRAND, R. W.  
**MAJS:** /\*AIRCRAFT DESIGN/\*ENGINE DESIGN/\*GENERAL AVIATION  
AIRCRAFT/\*NACELLES/\*QUIET ENGINE PROGRAM/\*TURBOFAN  
ENGINES  
**MINS:** / ENGINE CONTROL/ EXHAUST GASES/ NOISE REDUCTION/  
NOZZLE DESIGN/ PROPULSION SYSTEM CONFIGURATIONS  
**ABS:** The quiet, clean, general aviation turbofan engine and  
nacelle system was designed and tested. The engine  
utilized the core of the AiResearch model TFE731-3  
engine and incorporated several unique noise- and  
emissions-reduction features. Components that were  
successfully adapted to this core include the fan,  
gearbox, combustor, low-pressure turbine, and  
associated structure. A highly versatile workhorse  
nacelle incorporating interchangeable acoustic and  
hardwall duct liners, showed that large-engine  
attenuation technology could be applied to small  
propulsion engines. The application of the mixer  
compound nozzle demonstrated both performance and  
noise advantages on the engine. Major performance,  
emissions, and noise goals were demonstrated.

BON22329

**UTTL:** AiResearch QCGAT engine performance and emissions  
tests  
In NASA. Lewis Res. Center Gen. Aviation Propulsion  
p 45-64 (SEE N80-22327 13-07)  
**AUTH:** A/NORGREN, W. M.  
**MAJS:** /\*ENGINE NOISE/\*EXHAUST GASES/\*GENERAL AVIATION  
AIRCRAFT/\*JET AIRCRAFT NOISE/\*QUIET ENGINE PROGRAM/\*  
TURBOFAN ENGINES  
**MINS:** / ENGINE TESTS/ FUEL CONSUMPTION/ NOISE REDUCTION/  
NOZZLE FLOW/ PERFORMANCE TESTS  
**ABS:** Results of aerodynamic performance and emission tests.  
conducted on a specially designed QCGAT engine in the  
17,793-N (4,000 lb) thrust class, are presented.  
Performance of the AiResearch QCGAT engine was  
excellent throughout all testing. No serious  
mechanical malfunctions were encountered, and no  
significant test time was lost due to engine-related  
problems. Emissions were drastically reduced over  
similar engines, and the engine exhibited good smoke  
performance.

BON22330

**UTTL:** AiResearch QCGAT engine: Acoustic test results  
In NASA. Lewis Res. Center Gen. Aviation Propulsion  
p 65-100 (SEE N80-22327 13-07)  
**AUTH:** A/KISNER, L. S.  
**MAJS:** /\*ENGINE NOISE/\*GENERAL AVIATION AIRCRAFT/\*JET  
AIRCRAFT NOISE/\*NOISE PREDICTION (AIRCRAFT)/\*QUIET  
ENGINE PROGRAM/\*TURBOFAN ENGINES  
**MINS:** / ACOUSTIC DUCTS/ ACOUSTIC MEASUREMENTS/ LININGS/  
NACELLES/ NOISE REDUCTION/ NOZZLE GEOMETRY  
**ABS:** The noise levels of the quiet, general aviation  
turbofan (QCGAT) engine were measured in ground static  
noise tests. The static noise levels were found to be  
markedly lower than the demonstrably quiet AiResearch  
model TFE731 engine. The measured QCGAT noise levels  
were correlated with analytical noise source  
predictions to derive free-field component noise  
predictions. These component noise sources were used  
to predict the QCGAT flyover noise levels at FAR Part  
36 conditions. The predicted flyover noise levels are  
about 10 decibels lower than the current quietest  
business jets.

BON22331

**UTTL:** QCGAT aircraft/engine design for reduced noise and  
emissions  
In NASA. Lewis Res. Center Gen. Aviation Propulsion  
p 101-133 (SEE N80-22327 13-07)  
**AUTH:** A/LANSON, L.; B/TERRILL, K. M.  
**MAJS:** /\*AIRCRAFT DESIGN/\*ENGINE DESIGN/\*GENERAL AVIATION

**MINS:** AIRCRAFT/\*NOISE REDUCTION/\*TURBOFAN ENGINES / AIRCRAFT CONSTRUCTION MATERIALS/ COMPOSITE STRUCTURES/ EXHAUST GASES/ FUEL CONSUMPTION/ NACELLES  
**ABS:** The high bypass ratio QCGAT engine played an important role in shaping the aircraft design. The aircraft which evolved is a sleek, advanced design, six-place aircraft with 3538 kg (7,800 lb) maximum gross weight. It offers a 2778 kilometer (1500 nautical mile) range with cruise speed of 0.5 Mach number and will take-off and land on the vast majority of general aviation airfields. Advanced features include broad application of composite materials and a supercritical wing design with winglets. Full-span fowler flaps were introduced to improve landing capability. Engines are fuselage-mounted with inlets over the wing to provide shielding of fan noise by the wing surfaces. The design objectives, noise, and emission considerations, engine cycle and engine description are discussed as well as specific design features.

80N22332

**UTTL:** Avco Lycoming QCGAT program design cycle, demonstrated performance and emissions  
In NASA, Lewis Res. Center Gen. Aviation Propulsion p 135-154 (SEE N80-22327 13-07)

**AUTH:** A/FOGEL, P.; B/KOSCHIER, A.

**MAJS:** /\*ENGINE DESIGN/\*EXHAUST GASES/\*GENERAL AVIATION AIRCRAFT/\*QUIET ENGINE PROGRAM/\*THERMODYNAMIC CYCLES/\*TURBOFAN ENGINES

**MINS:** / COMBUSTION CHAMBERS/ COMBUSTION EFFICIENCY/ ENGINE TESTS/ FUEL CONSUMPTION/ NACELLES/ TURBOSHAFTS

**ABS:** A high bypass ratio, twin spool turbofan engine of modular design which incorporates a front fan module driven by a modified LT5101 core engine was tested. The engine is housed in a nacelle incorporating full length fan ducting with sound treatment in both the inlet and fan discharge flow paths. Design goals of components and results of component tests are presented together with full engine test results. The rationale behind the combustor design selected for the engine is presented as well as the emissions test results. Total system (engine and nacelle) test results are included.

80N22333

**UTTL:** Avco Lycoming quiet clean general aviation turbofan engine  
In NASA, Lewis Res. Center Gen. Aviation Propulsion p 155-187 (SEE N80-22327 13-07)

**AUTH:** A/WILSON, C. A.

**MAJS:** /\*ENGINE NOISE/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*QUIET ENGINE PROGRAM/\*TURBOFAN ENGINES

**MINS:** / ACOUSTIC MEASUREMENTS/ ENGINE DESIGN/ MIXERS/ NACELLES/ NOISE PREDICTION (AIRCRAFT)

**ABS:** A fan module was developed using an existing turboshaft engine. The fan was designed using the latest in large engine noise control technology. A mixer was added to reduce the already low exhaust gas velocity. A nacelle incorporating sound treatment was provided for the test engine. A noise prediction model was used through the design process to evaluate the various design alternatives. Acoustic tests were then made to verify the prediction and identify the noise characteristics of the fan, core, jet, and sound treatment. Analysis of the recorded data yielded close agreement with the expected results. Core noise, as was expected, was the predominant source of noise for the quiet clean general aviation turbofan (QCGAT) engine. Flyover noise predictions were made which indicated that the Avco Lycoming QCGAT engine would meet the goals set for the QCGAT program.

80N22334

**UTTL:** Summary of NASA QCGAT program  
In its Gen. Aviation Propulsion p 189-193 (SEE N80-22327 13-07)

**AUTH:** A/SIEVERS, G. K.

**MAJS:** /\*ENGINE NOISE/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION/\*QUIET ENGINE PROGRAM/\*TURBOFAN ENGINES

**MINS:** / ENGINE DESIGN/ ENGINE TESTS/ EXHAUST EMISSION/ FUEL CONSUMPTION/ NOISE MEASUREMENT

**ABS:** The application of large turbofan engine technology to small general aviation turbofan engines to achieve low noise, low emissions, and acceptable fuel consumption is described.

80N22335

**UTTL:** New opportunities for future, small, General-Aviation Turbine Engines (GATE)  
In its Gen. Aviation Propulsion p 195-219 (SEE N80-22327 13-07)

**AUTH:** A/STRACK, W. C.

**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*TECHNOLOGICAL FORECASTING /\*TURBINE ENGINES

**MINS:** / ECONOMICS/ ENGINE DESIGN/ FUEL CONSUMPTION/ MARKET RESEARCH/ TECHNOLOGY ASSESSMENT

**ABS:** The results of four independent contracted studies to explore the opportunities for future small turbine engines are summarized in a composite overview. Candidate advanced technologies are screened, various cycles and staging arrangements are parametrically evaluated, and optimum conceptual engines are identified for a range of 300 to 600 horsepower applications. Engine improvements of 20 percent in

specific fuel consumption and 40 percent in engine cost were forecast using high risk technologies that could be technically demonstrated by 1988. The ensuing economic benefits are in the neighborhood of 20 to 30 percent for twin-engine aircraft currently powered by piston engines.

80N22336

**UTTL:** An overview of NASA research on positive displacement general-aviation engines  
In its Gen. Aviation Propulsion p 227-229 (SEE N80-22327 13-07)

**AUTH:** A/KEMPKE, E. E., JR.

**MAJS:** /\*AIRCRAFT ENGINES/\*GENERAL AVIATION AIRCRAFT/\*RESEARCH AND DEVELOPMENT/\*TECHNOLOGY ASSESSMENT  
**MINS:** / DIESEL ENGINES/ ENGINE DESIGN/ EXHAUST EMISSION/  
FUEL CONSUMPTION/ FUEL INJECTION/ PISTON ENGINES/  
SPARK IGNITION

**ABS:** The research and technology program related to improved and advanced general aviation engines is described. Current research is directed at the near-term improvement of conventional air-cooled spark-ignition piston engines and at future alternative engine systems based on all-new spark-ignition piston engines, lightweight diesels, and rotary combustion engines that show potential for meeting program goals in the midterm and long-term future. The conventional piston engine activities involve efforts on applying existing technology to improve fuel economy, investigation of key processes to permit leaner operation and reduce drag, and the development of cost effective technology to permit flight at high-altitudes where fuel economy and safety are improved. The advanced engine concepts activities include engine conceptual design studies and enabling technology efforts on the critical or key technology items.

80N22338

**UTTL:** Lightweight diesel aircraft engines for general aviation  
In NASA, Lewis Res. Center Gen. Aviation Propulsion p 247-285 (SEE N80-22327 13-07)

**AUTH:** A/BERENYI, S. G.; B/BROUWERS, A. P.

**MAJS:** /\*AIRCRAFT ENGINES/\*DIESEL ENGINES/\*ENGINE DESIGN/\*GENERAL AVIATION AIRCRAFT  
**MINS:** / AIRCRAFT PERFORMANCE/ CONFIGURATIONS/ COST ANALYSIS/  
DESIGN ANALYSIS/ FUEL CONSUMPTION/ WEIGHT REDUCTION

**ABS:** A methodical design study was conducted to arrive at new diesel engine configurations and applicable advanced technologies. Two engines are discussed and the description of each engine includes concept

drawings. A performance analysis, stress and weight prediction, and a cost study were also conducted. This information was then applied to two airplane concepts, a six-place twin and a four-place single engine aircraft. The aircraft study consisted of installation drawings, computer generated performance data, aircraft operating costs and drawings of the resulting airplanes. The performance data shows a vast improvement over current gasoline-powered aircraft. At the completion of this basic study, the program was expanded to evaluate a third engine configuration. This third engine incorporates the best features of the original two, and its design is currently in progress. Preliminary information on this engine is presented.

80N22341

**UTTL:** NASA propeller technology program  
In its Gen. Aviation Propulsion p 315-325 (SEE N80-22327 13-07)

**AUTH:** A/MIKKELSON, D. C.

**MAJS:** /\*NASA PROGRAMS/\*PROPELLER EFFICIENCY/\*PROPELLERS  
**MINS:** / AIRCRAFT NOISE/ AIRSPEED/ DESIGN ANALYSIS/ PROPELLER  
BLADES/ TURBOFANS

**ABS:** A program on propeller technology applicable to both low and high speed general aviation aircraft is summarized, and the overall program objectives and approach are outlined.

80N22342

**UTTL:** Low speed propellers: Impact of advanced technologies  
In NASA, Lewis Res. Center Gen. Aviation Propulsion p 327-343 (SEE N80-22327 13-07)

**AUTH:** A/KEITER, I. D.

**MAJS:** /\*GENERAL AVIATION AIRCRAFT/\*PROPELLER EFFICIENCY/\*PROPELLERS

**MINS:** / AIRCRAFT NOISE/ AIRCRAFT PERFORMANCE/ COMPOSITE  
MATERIALS/ COST REDUCTION/ FUEL CONSUMPTION/ PROPELLER  
BLADES/ WEIGHT REDUCTION

**ABS:** Sensitivity studies performed to evaluate the potential of several advanced technological elements on propeller performance, noise, weight, and cost for general aviation aircraft are discussed. Studies indicate that the application of advanced technologies to general aviation propellers can reduce fuel consumption in future aircraft an average of ten percent, meeting current regulatory noise limits. Through the use of composite blade construction, up to 25 percent propeller weight reduction can be achieved. This weight reduction in addition to seven percent propeller efficiency improvements through application of advanced technologies result in four percent

reduction in direct operating costs, ten percent reduction in aircraft acquisition cost, and seven percent lower gross weight for general aviation aircraft.

80N22343

UTTL: Advanced turboprop potential for high speed  
In NASA, Lewis Res. Center Gen. Aviation Propulsion  
p 345-359 (SEE N80-22327 13-07)

AUTH: A/GATZEN, B. S.

MAJS: /\*AIRCRAFT PERFORMANCE/\*TURBOFAN AIRCRAFT/\*TURBOPROP  
AIRCRAFT

MINS: / AIRCRAFT NOISE/ COMPOSITE MATERIALS/ COST REDUCTION/  
FUEL CONSUMPTION/ GENERAL AVIATION AIRCRAFT/ HIGH  
SPEED/ PROPELLER BLADES/ PROPELLER EFFICIENCY

ABS: A turboprop propulsion system for general aviation  
aircraft, allowing high speed flight (to 0.8 Mach) is  
discussed. Design methodologies for aerodynamic and  
acoustic considerations and the performance and cost  
advantages of a prop-fan aircraft are presented.

80N22347

UTTL: NASA propeller noise research  
In NASA, Lewis Res. Center Gen. Aviation Propulsion  
p 405-420 (SEE N80-22327 13-07)

AUTH: A/GREENE, G. C.

MAJS: /\*AIRFOILS/\*GENERAL AVIATION AIRCRAFT/\*NOISE REDUCTION  
/\*PROPELLERS

MINS: / COST EFFECTIVENESS/ FLIGHT TESTS/ NOISE PREDICTION  
(AIRCRAFT)/ OPTIMIZATION/ TECHNOLOGY ASSESSMENT/ WIND  
TUNNEL TESTS

ABS: The research in propeller noise prediction,  
noise/performance optimization, and interior reduction  
is described. Selected results are presented to  
illustrate the status of the technology and the  
direction of future research.

80N23511

UTTL: Emergency in-flight egress opening for general  
aviation aircraft  
In Its Proc. of the 14th Aerospace Mech. Symp. p  
173-194 (SEE N80-23495 14-31)

AUTH: A/BEMENT, L. J.

MAJS: /\*BAILOUT/\*EGRESS/\*GENERAL AVIATION AIRCRAFT

MINS: / ACCIDENT PREVENTION/ AIRCRAFT ACCIDENTS/ STRUCTURAL  
DESIGN

ABS: An emergency in-flight egress system was installed in  
a light general aviation airplane. The airplane had no  
provision for egress on the left side. To avoid a  
major structural redesign for a mechanical door, an  
add on 11.2 kg (24.6 lb) pyrotechnic-actuated system

was developed to create an opening in the existing  
structure. The skin of the airplane was explosively  
severed around the side window, across a central  
stringer, and down to the floor, creating an opening  
of approximately 76 by 76 cm. The severed panel was  
jettisoned at an initial velocity of approximately  
13.7 m/sec. System development included a total of 68  
explosive severance tests on aluminum material using  
small samples, small and full scale flat panel  
aircraft structural mockups, and an actual aircraft  
fuselage. These tests proved explosive  
sizing/severance margins, explosive initiation,  
explosive product containment, and system dynamics.  
This technology is applicable to any aircraft of  
similar construction.

80N23512

UTTL: A spin-recovery parachute system for light  
general-aviation airplanes  
In its Proc. of the 14th Aerospace Mech. Symp. p  
195-209 (SEE N80-23495 14-31)

AUTH: A/BRADSHAW, C.

MAJS: /\*AIRCRAFT SPIN/\*GENERAL AVIATION AIRCRAFT/\*  
JETTISONING/\*PARACHUTES

MINS: / MECHANICAL DEVICES/ RELIABILITY ANALYSIS/ SPIN TESTS  
/ STATIC LOADS/ SYSTEMS ENGINEERING

ABS: A tail mounted spin recovery parachute system was  
designed and developed for use on light general  
aviation airplanes. The system was designed for use on  
typical airplane configurations, including low wing,  
high wing, single engine and twin engine designs. A  
mechanically triggered pyrotechnic slug gun is used to  
forcibly deploy a pilot parachute which extracts a bag  
that deploys a ring slot spin recovery parachute. The  
total system weighs 8.2 kg. System design factors  
included airplane wake effects on parachute  
deployment, prevention of premature parachute  
deployment, positive parachute jettison, compact size,  
low weight, system reliability, and pilot and ground  
crew safety. Extensive ground tests were conducted to  
qualify the system. The recovery parachute was used  
successfully in flight 17 times.

80N29305

UTTL: A methodology for long-range prediction of air  
transportation  
In NASA, Lewis Res. Center Aircraft Res. and  
Technol. for Future Fuels p 25-30 (SEE N80-29300  
20-07)

AUTH: A/AYATI, M. B.; B/ENGLISH, J. M.

MAJS: /\*AIR TRANSPORTATION/\*AIRCRAFT FUELS/\*PREDICTION  
ANALYSIS TECHNIQUES

**MINS:** / AIRCRAFT PERFORMANCE/ CIVIL AVIATION/ DEMAND (ECONOMICS)/ ECONOMIC ANALYSIS/ SOCIAL FACTORS  
**ABS:** A framework and methodology for long term projection of demand for aviation fuels is presented. The approach taken includes two basic components. The first was a new technique for establishing the socio-economic environment within which the future aviation industry is embedded. The concept utilized was a definition of an overall societal objective for the very long run future. Within a framework so defined, a set of scenarios by which the future will unfold are then written. These scenarios provide the determinants of the air transport industry operations and accordingly provide an assessment of future fuel requirements. The second part was the modeling of the industry in terms of an abstracted set of variables to represent the overall industry performance on a macro scale. The model was validated by testing the desired output variables from the model with historical data over the past decades.

BON33340

**UTTL:** NASA general aviation stall/spin flight testing  
In Society of Experimental Test Pilots Tech. Rev.,  
Vol. 15, No. 1 p 36-49 (SEE N80-33337 24-01)

**AUTH:** A/PATTON, J. M., JR.

**MAJS:** /\*AERODYNAMIC STALLING/\*AIRCRAFT SPIN/\*FLIGHT TESTS/\*  
GENERAL AVIATION AIRCRAFT

**MINS:** / FULL SCALE TESTS/ WIND TUNNEL TESTS

**ABS:** A comprehensive program incorporating spin tunnel, static and rotary balance wind tunnel, full scale wind tunnel, free flight radio control model, flight simulation, and full scale flight testing was undertaken. Work includes aerodynamic definition of various configurations at high angles of attack, testing of stall and spin prevention concepts, definition of spin and spin recovery characteristics, and development of test techniques and emergency spin recovery systems. Some of the more interesting results to date are presented for the first airplane in the program in the areas of tail design, wind leading edge design, mass distribution, center of gravity location, and small airframe changes, with associated pilot observations. Design philosophy of the spin recovery parachute system is discussed, in addition to test techniques.

81N12980

**UTTL:** NASA Research in aeropropulsion  
In Its Impact for the 80's: Proc. of a Conf. on  
Selected Technol. for Business and Ind. p 11-26 (SEE  
N81-12978 03-99)

**AUTH:** A/STEWART, W. L.

**MAJS:** /\*CIVIL AVIATION/\*COMMERCIAL AIRCRAFT/\*PROPULSION  
SYSTEM CONFIGURATIONS/\*TECHNOLOGY ASSESSMENT

**MINS:** / AIRCRAFT INDUSTRY/ EXHAUST EMISSION/ GENERAL  
AVIATION AIRCRAFT/ PROPULSION SYSTEM PERFORMANCE/  
VARIABLE CYCLE ENGINES

**ABS:** The role of the Lewis Research Center in aeronautical  
propulsion is described. The state of the art in  
engine systems and components are discussed and some  
of the problems that confront the civil and military  
aeronautic sectors are addressed. Some of the programs  
that are under way are summarized with emphasis on the  
future needs and opportunities in aeronautics.

81N14560

**UTTL:** Aircraft icing instrumentation: Unfilled needs  
In NASA. Marshall Space Flight Center Proc: Fourth  
Ann. Workshop on Meteorol. and Environ. Inputs to  
Aviation Systems p 61-65 (SEE N81-14555 05-47)

**AUTH:** A/KITCHENS, P. F.

**MAJS:** /\*ATMOSPHERIC TEMPERATURE/\*ICE FORMATION/\*  
METEOROLOGICAL PARAMETERS/\*ROTARY WING AIRCRAFT

**MINS:** / AIRCRAFT SPECIFICATIONS/ ATMOSPHERIC MOISTURE/ DROP  
SIZE/ DROPS (LIQUIDS)/ SOLAR RADIATION

**ABS:** A list of icing instrumentation requirements are  
presented. Because of the Army's helicopter  
orientation, many of the suggestions are specific to  
rotary wing aircraft; however, some of the  
instrumentation are also suitable for general aviation  
aircraft.

SECTION 3  
SUBJECT INDEX LISTING



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