This report has been reviewed by the U.S. Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of commercial products constitute endorsement by the U.S. Government.
FOREIGN NOISE RESEARCH

IN

AVIATION

December 1977

Office of Noise Abatement and Control
U.S. Environmental Protection Agency
Washington, D.C. 20460
PREFACE

Method of Data Collection

The information was collected by means of inquiries to foreign noise contacts, both individuals and organizations. The contacts were queried about their research activities and the names of other individuals or organizations that they were aware of who might be involved in pertinent noise research. These referrals were then contacted to ascertain their research efforts. In addition, inquiries were made at the Ninth International Congress on Acoustics, July 1977, in Madrid, Spain. In total, approximately 1300 requests were made. The foreign researchers were asked to respond with information on their noise abatement research projects that have been completed since January 1976, are in progress, or are planned. They were asked to respond with information about research projects that deal with:

- Aviation noise source control technology
- Surface transportation noise source control technology
- Machinery and construction equipment noise source control technology
- Measurement methodology
- Systems research for noise abatement

The latter two categories include projects not specifically classifiable under aviation, surface transportation, or machinery and construction equipment. "Systems research" includes path modification projects such as noise barriers and operational techniques such as modification of traffic flows.
From these contacts, 116 Aircraft Noise Abatement Research Projects were identified.

Handling of Data

To retain reporting accuracy, where possible, the original responses were included in the report. In the case of foreign language reports, or data not in our format, the information was translated and/or transcribed to a unified format and is identified as having been so treated. Some researchers described their projects to us in a very limited fashion. Therefore, these projects, when listed in this report, show very fragmentary data elements. We did not try to augment these responses, but simply transcribed them verbatim in an abbreviated format at the end of each topical section.

Any funding data that was not reported in U. S. dollars has been converted and the reports show both the reported foreign currency figures in parentheses and the converted U. S. dollars figures. Below is the table of exchange rates used:

Exchange Rates as of Tuesday, June 21, 1977
(Source: The Wall Street Journal)

<table>
<thead>
<tr>
<th>Currency Pair</th>
<th>Conversion Rate</th>
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<tbody>
<tr>
<td>Argentina-Peso</td>
<td>0.00281 US Dollar</td>
</tr>
<tr>
<td>Australia-Dollar</td>
<td>1.1100 US Dollar</td>
</tr>
<tr>
<td>Belgium-Franc</td>
<td>0.027715 US Dollar</td>
</tr>
<tr>
<td>Canada-Dollar</td>
<td>0.9428 US Dollar</td>
</tr>
<tr>
<td>Denmark-Krone</td>
<td>0.1649 US Dollar</td>
</tr>
</tbody>
</table>
Finnland-Markka  =  0.2450 US Dollar
France-Franc    =  0.2024 US Dollar
Japan-Yen       =  0.003671 US Dollar
Netherlands-Franc=  0.2024 US Dollar
Northern Ireland-Pound=  1.7196 US Dollar
Norway-Krone    =  0.1884 US Dollar
Poland-Zloty    =  0.0502 US Dollar
Portugal-Escudo =  0.02590 US Dollar
Scotland-Pound  =  1.7196 US Dollar
Sweden-Krona    =  0.2253 US Dollar
Switzerland-Franc=  0.3997 US Dollar
United Kingdom-Pound=  1.7196 US Dollar
West Germany-Mark=  0.4240 US Dollar

Completeness and Accuracy of Information

Countries or International Organizations Where Researchers Were Contacted

<table>
<thead>
<tr>
<th>Argentina</th>
<th>Luxembourg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>North Atlantic Treaty Organization</td>
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<tr>
<td>Austria</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Belgium</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Bulgaria</td>
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</tr>
<tr>
<td>Canada</td>
<td>Organization for Economic Cooperation and Development</td>
</tr>
<tr>
<td>Czechoslovakia</td>
<td>Poland</td>
</tr>
<tr>
<td>Denmark</td>
<td>Portugal</td>
</tr>
<tr>
<td>Finland</td>
<td>Romania</td>
</tr>
<tr>
<td>France</td>
<td>South Africa</td>
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<tr>
<td>East Germany</td>
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</tr>
<tr>
<td>West Germany</td>
<td>Sweden</td>
</tr>
<tr>
<td>Greece</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Hungary</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>International Civil Aviation Organization</td>
<td>United Nations</td>
</tr>
<tr>
<td>Ireland</td>
<td>Yugoslavia</td>
</tr>
<tr>
<td>International Standards Organization</td>
<td>Union of Soviet Socialist Republics</td>
</tr>
<tr>
<td>Israel</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
</tr>
</tbody>
</table>
In some of these countries we did not receive large numbers of responses. This does not prove conclusively that little or no research is being carried out in these countries. In some cases, we probably never identified the proper contacts. However, it is more likely that a low response rate is an indication that in these areas research is not widespread, with one exception—the USSR, where it is certain that research is being conducted but no response was forthcoming to our inquiries.

While it is impossible to be sure of the accuracy of the reported data, it is likely to be accurate because the data was mostly provided by the researchers themselves, not second or third hand. There is a wide variation in the amount of information reported per project. This probably reflects the varying amounts of time that researchers had available to respond to our inquiries.

The dollar figures given for the research efforts should not be taken too literally because they paint an oversimplified picture. The buying power of a fixed amount of dollars can vary from country to country due to fluctuating foreign exchange rates. There are also differences between countries in calculating costs of a project, for example, inclusion of overhead rates. The most important factor when considering the funding data is that it is available for only a fraction of the reported projects. This overshadows any other qualifying factors. It is felt that because of these factors, the total funding figures underestimate the total committed resources, but to an unknown degree.
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<th>Page</th>
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</thead>
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<td>Magnitude of Research Effort</td>
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<td>Analysis of Research</td>
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<td>Basic Research and Technology Funding, 1976-1977</td>
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<td>Interior Noise</td>
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<td>Noise Prediction Technology</td>
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<td>Atmospheric Propagation and Ground Effects</td>
<td>81</td>
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<tr>
<td>Measurement Methodology</td>
<td>85</td>
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<tr>
<td>Architectural Studies</td>
<td>105</td>
</tr>
<tr>
<td>Aircraft Other</td>
<td>113</td>
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</tbody>
</table>
Systems Demonstration, Propulsion Demonstration, and Systems Studies

CTOL (Subsonic)  
CTOL (Supersonic)  
Rotocraft/VTOL  
General Aviation  
Country Index of Research Projects
ACKNOWLEDGEMENTS

The principal compiler of this report, Robert English, of Informatics Inc., wishes to acknowledge the assistance of Pat Dufour, Miriam Neiman and Carl Modig of Informatics; Harvey Nozick, Roger Heymann and Thomas Quindry of the Office of Noise Abatement and Control; and the hundreds of noise abatement researchers abroad who shared information about their projects. We are especially indebted to Harvey Nozick for the contributions his painstaking review made to the final quality of this report.
INTRODUCTION

Purpose of the Report

This is one of three reports which summarize foreign noise abatement research efforts, based on an appraisal carried out by Informatics Inc for the U. S. Environmental Protection Agency, Office of Noise Abatement and Control, as part of their noise research coordination efforts. The United States Environmental Protection Agency has reconstituted interagency noise research panels covering three areas: aviation, surface transportation, and machinery and construction equipment. The purpose of the panels is to assemble a total picture of U. S. Federally-sponsored noise abatement research recently completed, in progress, or planned, and provide recommendations for additional research which should be performed to meet the goals embodied in the national noise abatement strategy. The three panel reports are scheduled for release in early 1978.

The three reports on research abroad are to supplement the information provided in the panel reports by providing a broad overview of the international research effort underway in noise abatement and control.
**Categorization**

For this report, Aircraft Noise Abatement Technology Research, the projects were categorized as follows:

**Basic Research and Technology**
- Propulsion Noise
- Rotor Noise
- Interior Noise
- Airframe Noise
- Noise Prediction Technology
- Atmospheric Propagation and Ground Effects
- Measurement Methodology
- Architectural Studies
- Aircraft Other

**Systems Demonstrations, Propulsion Demonstration, and Systems Studies**
- CTOL*(Subsonic)
- CTOL (Supersonic)
- Rotorcraft/VTOL**
- General Aviation

* Conventional Take-Off and Landing
** Vertical Take-Off and Landing
DISCUSSION OF FOREIGN RESEARCH

MAGNITUDE OF RESEARCH EFFORT

Reported Research by Country

The following number of projects were reported by country:

<table>
<thead>
<tr>
<th>Country</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
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<td>64</td>
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<tr>
<td>Netherlands</td>
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<tr>
<td>West Germany</td>
<td>18</td>
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<tr>
<td>Sweden</td>
<td>2</td>
</tr>
<tr>
<td>Denmark</td>
<td>2</td>
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<tr>
<td>Canada</td>
<td>2</td>
</tr>
<tr>
<td>Norway</td>
<td>1</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>1</td>
</tr>
</tbody>
</table>

Sponsorship of Research

Even though the sponsor was self-identified for only a little more than half of the reported research, it appears that in almost all countries, most of the reported research is government sponsored. West Germany is the only country that shows a level of private sponsorship that is possibly significant.

Type of Research

The type of research was self-identified for less than half of the reported research projects. All of the four types appear to fall at about the same level of effort. The United Kingdom appears to be doing a significant amount of demonstration work and the Netherlands shows a significant level of development work.
<table>
<thead>
<tr>
<th>Type of Research by Country</th>
<th>Fundamental</th>
<th>Development</th>
<th>Demonstration</th>
<th>Measurement &amp; Methodology</th>
<th>Unclassified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>1</td>
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<td></td>
<td>1</td>
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<tr>
<td>Denmark</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1</td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>1</td>
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<td></td>
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<tr>
<td>Norway</td>
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<td></td>
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</tr>
<tr>
<td>Sweden</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7</td>
<td>1</td>
<td>11</td>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>West Germany</td>
<td>1</td>
<td>11</td>
<td>14</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>11</td>
<td>13</td>
<td>16</td>
<td>8</td>
<td>70</td>
</tr>
</tbody>
</table>

*As self-reported by investigators who had the opportunity to classify their projects using one or more of the categories listed in the table.
**The table sums to more than the total number of projects because some projects were classified as more than one type.

**Funding Information**

Funding tables are provided on pages 17-19. They show funding by country for each major category for the period 1976-1977 and funding by country for each sub-category for the same period.
ANALYSIS OF RESEARCH

BASIC RESEARCH AND TECHNOLOGY

Propulsion Noise

A large amount of research in the area of propulsion noise concerns noise from jets. West German researchers are attempting to determine the distribution of sound sources in turbulent gas jets and the basic mechanisms of jet noise generation by the use of a newly developed measuring device. Studies in the United Kingdom are attempting to locate jet noise sources, to determine forward flight effects on jet noise, and to develop criteria for the design of jet engine silencers based on the structure of jets of differing geometry. Another area of research effort is noise from fans, blowers, and turbines. Canadian research efforts have reduced the noise from rotor/stator interaction in an axial blower by staggering the leading edges of the stator vanes. They have achieved a noise reduction of as much as 15 dBA at the blade pass frequency. Projects in United Kingdom and West Germany are addressing basic noise generating mechanisms of ducted fans, turbine blowers, and compressors. A large number of research projects are being conducted by Rolls Royce in the United Kingdom. They are concerned with such topics as the silencing of inverted velocity profile coannular jets, the study of coaxial jet noise, tests of a silencer nozzle ejector system and an assessment of in-flight and static noise levels of in-service engines. The National Gas Turbine Establishment in the United Kingdom is also conducting a large research effort into aircraft powerplant noise. They are concerned with the characteristics of coaxial jet noise, the
effects of flight on exhaust noise, the improvement of methods for the
estimation of broadband noise and interaction tone levels of fans, and
studies of reactive sound absorber properties. Researchers in the
Netherlands are looking to engine disposition and engine aerodynamic
design for noise reduction and are attempting to reduce ground run up
noise of test aircraft by noise damping and protective devices. Also of
note are projects in the United Kingdom that are assessing the cost,
life span, and effectiveness of retrofit hush kits and are attempting to
demonstrate the technology for quieting future engines, including quieter
versions of existing engines.

**Rotor Noise**

Reported research in this area is confined to the United Kingdom
and West Germany. Projects in the United Kingdom are concerned with
the effects of forward speed on the impulsive content of helicopter noise
and with high speed rotor and tail rotor noise. West German research
deals with designing propeller driven aircraft for noise reduction and
with the determination of the essential parameters of disturbed flow
from rotors and its effects on the radiated noise.

**Interior Noise**

All of the reported research projects in this area come from
Westland Helicopters Ltd. in the United Kingdom. They have focussed on
the gearbox as the primary source of interior noise in helicopters. The
research deals with determining the transmission paths of internal
cabin noise in Lynx helicopters from excitation at the gearbox feet.
Also, an evaluation is being made of the noise and vibration transmitted through acoustically and vibrationally treated and untreated helicopter panels. Various treatments such as damping materials, "lump wall" concepts, vibration isolation, conventional soundproofing materials, constrained and unconstrained layers, and sandwich constructions are being considered. The effect of interior noise of coating the gearbox with damping material is also under study.

Airframe Noise

A considerable amount of effort is being applied to airframe noise in the United Kingdom. The British have a major program under way to demonstrate uniform noise shielding with the aim of a noise reduction of up to 6 dBA. The Royal Aircraft Establishment is developing analytical methods for predicting the effects on noise propagation of noise shielding by airborne components. They are also doing wind tunnel model and in-flight research on wing and flap vortices from VC10 and Lockheed Tri-Star aircraft. The Institute of Sound and Vibration Research is looking into jet surface interaction and the sound causing capacity of the dissipation of turbulence. West German efforts are directed toward frequencies in ultrasonic radiation that encounters obstacles, such as wing flaps being hit by the blast of airplane propulsion.

Noise Prediction Technology

Researchers in the United Kingdom and the Netherlands are looking at various aspects of this category. The British are developing rigs to produce mixing jet noise with a "minimum of contamination" and designing scale model engine simulators (ejector-powered nozzles) to act as noise sources for shielding and propagation tests. British efforts
are also directed at developing a model to predict noise from inviscid flows and a computer model of a starting jet. Efforts in the Netherlands are underway to develop a computer model that will aid in the development of zoning around airports.

Atmospheric Propagation and Ground Effects

Only one project was identified in this category. It deals with efforts in the United Kingdom to study noise propagation, including the effects of meteorological conditions, ground reflection and absorption, and non-linear effects.

Measurement Methodology

Researchers in many countries, including Denmark, the Netherlands, Northern Ireland, and the United Kingdom, are setting up measurement systems to monitor noise around airports of all types: international, secondary, small, and military. Other research in Denmark is attempting to replace the current CNR method of calculating air traffic noise with a system utilizing dBA as a measurement unit and considering the duration of noise emissions. Efforts in the United Kingdom are directed toward the development and testing of anechoic wind tunnels for testing jet mixing noise, airframe noise, and vortex refraction effects. British researchers are also attempting to provide a national primary calibration of standard reference microphones and a national reference service on acoustical measurements. Research in the Netherlands hopes to develop standard methods for the measurement of aircraft noise and to set up a measurement system on runways to aid in their design, placement, and operation.
Architectural Studies

Research in the United Kingdom is looking at the airborne sound insulation of panels by active damping. The results show measured velocity dampings of 40 dBA within the first three or four cycles of an impelled plate. They see their work as applicable to aircraft as well as frame buildings. Four projects in the Netherlands sponsored by the Interdevelopmental Commission for Reducing Noise in Air Traffic Routes deal with noise insulation of residences and buildings from aircraft noise. They are attempting to survey the literature, evaluate various insulation materials, and determine which are useful in different conditions. They are especially interested in ventilation, thermal, and condensation effects. Their efforts will also consider a survey into the effectiveness of noise insulation regulations. Both existing buildings and future construction will be considered.

Aircraft Other

This category is a mixture of many different types of research. A common area of research in the Netherlands, Sweden, and West Germany are attempts to develop noise protection zones around both civilian and military airports. West German researchers are in the process of compiling a survey of aviation noise related research in West Germany and will evaluate the general status of German research in this area. Efforts in Norway and the United Kingdom are applied to basic aeroacoustic noise generating mechanisms such as two-stream mixing and boundary effects. Researchers in the United Kingdom
are also trying to study the acoustical fatigue resistance and response of titanium in order to assess its potential as a structural component in airplanes and spacecraft. Swedish research efforts are also directed toward the measurement and computation of sonic boom carpets for single and twin engined propeller aircraft.

**SYSTEMS DEMONSTRATION, PROPULSION DEMONSTRATION, AND SYSTEMS STUDIES**

**CTOL (Subsonic)**

Reported research in this area came from the Netherlands, West Germany, and the United Kingdom. A major area of concern is the modification of flight procedures in order to reduce noise emissions. Procedures under study include: low power-low drag flight operations, reduced flap approaches, two segment approaches, and steeper takeoff and landing flight paths. Also being considered are noise reducing starting procedures, night time jet restrictions, runway alternations, and noise routing of aircraft. These methods are being assessed on the basis of their noise reducing capacity, flight safety considerations, air traffic control consequences, and operational-economic repercussions.

**CTOL(Supersonic)**

Only one project was identified in this area. It deals with West German research into the possibilities of sonic boom adjusted designs for supersonic aircraft.
Rotorcraft/VTOL

Research in this category is concerned with flight procedures for VTOL aircraft that will reduce noise. Various takeoff and landing flight paths and atmospheric conditions are being analyzed in West Germany in order to determine the size and shape of noise screening areas around a VTOL landing field.

General Aviation

Two projects were reported in this category and both are from the Netherlands. They are attempting to inventory the state of general aviation noise abatement technology both at present and in the near future, look at the regulations to be set up in the near future, and assess the possibilities of reducing noise by noise damping equipment. They are studying benefits of special rules of use to cover concerns such as advertising and sport flights, flight instructions, and certain noisy types of aircraft.

SUMMARY

The great majority of reported research falls in the area of Basic Research and Technology. Of the total 116 reported projects, 103 are in this category with only 13 in the Systems Demonstrations, Propulsion Demonstration, and Systems Studies area. Within the Basic Research and Technology area, the largest research effort appears to be in the area of Propulsion Noise (28 projects). Two other categories with significant levels of effort are Measurement Methodology (19 projects) and Aircraft Other (21 projects). All other categories show a much lower level of effort.
Of the types of sources considered, general aviation, with two projects, is receiving the least attention. Rotorcraft and propeller driven aircraft are being studied in 14 projects and the majority of the remainder deal specifically with jet noise.

Several projects stand out as significant efforts, as showing significant results, or as having no U. S. research counterparts; and therefore deserve a second mentioning. A project being carried out by the National Research Council of Canada is looking into the rotor/stator interaction in axial blowers. They have achieved a noise reduction of 15 dBA at the blade pass frequency by staggering the leading edges of the stator vanes. A large effort is underway at Rolls Royce Ltd. in the United Kingdom. They are studying many aspects of jet noise and are utilizing theoretical, experimental, and in-flight techniques. The National Gas Turbine Establishment of the United Kingdom also has a major effort underway to look at aircraft powerplant noise. In the area of helicopter noise control, Westland Helicopters Ltd. of the United Kingdom is carrying out many projects. They are concerned with interior noise due to gearbox vibrations, the effects of forward speed on the impulsive content of helicopter noise, and high speed rotor and tail rotor noise. Another significant British effort is a project by Hawker Siddley Aviation Ltd. that is attempting to demonstrate the realities of airborne noise shielding and is aiming at a 6 dBA reduction.
A significant effort in West Germany is being sponsored by the German Research Society and is considering the frequency spectrum of ultrasonic radiation which encounters obstacles. This is an important consideration when wing flaps are being hit by the blast of airplane propulsion exhaust. The Max-Planck Institute in West Germany is conducting a questionnaire survey of all aviation noise-related research in the Federal Republic of Germany. This survey will include an expert analysis of the general status of German research in this area. The Institute for Flight Technology of Darmstadt Technical Institute in West Germany is conducting a study concerned with optimum takeoff and landing flight paths for VTOL planes. They are also attempting to determine the necessary shape and size of a noise screening area around a VTOL landing field based on the yearly traffic volume and differing atmospheric conditions.

Several projects are being sponsored by the Interdevelopmental Commission for Reducing Noise in Air Traffic Routes of the Netherlands. They are attempting to insulate residences and other buildings from aircraft noise. They are especially interested in ventilation, thermal, and condensation effects as they apply to the various noise insulation materials.
**SUMMARY**

**AIRCRAFT NOISE R & D FUNDING**

**IN THOUSANDS**

1976-1977

*Some funding for other years included because project extended longer than 1976-1977.

Converted to thousands of U.S. Dollars.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Canada</th>
<th>Denmark</th>
<th>Netherlands</th>
<th>Northern Ireland</th>
<th>Sweden</th>
<th>United Kingdom</th>
<th>West Germany</th>
<th>TOTALS</th>
<th>Projects with funding reported</th>
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<tr>
<td>Basic Research and Technology</td>
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<td>56</td>
<td>265</td>
<td>14</td>
<td>30*</td>
<td>726*</td>
<td>1406*</td>
<td>2591*</td>
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<tr>
<td>Systems Demonstrations, Propulsion Demonstration, and Systems Studies</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>127*</td>
<td>195*</td>
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<tr>
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<td>56</td>
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<td>14</td>
<td>30*</td>
<td>726*</td>
<td>1533*</td>
<td>2786*</td>
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</tr>
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</table>
## BASIC RESEARCH AND TECHNOLOGY FUNDING IN THOUSANDS 1976-1977

*Some funding for other years included because projects extended longer than 1976-1977.*

Converted to thousands of U.S. Dollars.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Canada</th>
<th>Denmark</th>
<th>Netherlands</th>
<th>Northern Ireland</th>
<th>Sweden</th>
<th>United Kingdom</th>
<th>West Germany</th>
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<td>66*</td>
<td>112*</td>
<td>272*</td>
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<tr>
<td>Interior Noise</td>
<td></td>
<td></td>
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<td>338*</td>
<td>433*</td>
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Some funding for other years included because project extended longer than 1976-1977. Converted to thousands of U.S. Dollars.

### Systems Demonstrations, Propulsion Demonstration, and Systems Studies Noise R & D Funding

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BASIC RESEARCH AND TECHNOLOGY

PROPULSION NOISE

See Also Pages:

64
67
74
75
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79
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99
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127
**Project Title:**
Noise Reduction in Axial Blowers

**Performing Organization Name & Address:**
National Research Council Canada
Division of Physics
Ottawa, Canada K1A 0R6

**Sponsoring Organization Name & Address:**

**Principal Investigator(s):**
T.F.W. Emberton

**Type of Research Program:**
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Start Date:**

**Completion Date:**

**Estimated**

**Actual**

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

This is a terminating project that has demonstrated, on model scale in the Division of Physics, that the rotor/stator interaction noise of an axial blower can be reduced by staggering the leading edges of the stator vanes. This can be achieved with numerous variations of stagger in either the axial or circumferential directions. In most cases there is a small reduction in mechanical efficiency; in one particular design there is a marginal increase in efficiency. Noise reduction at the blade passage frequency is as much as 25 dB, depending on the number of vanes, their shape and other factors.

One particular design of stator vane having an axial stagger has been selected for testing at higher shaft speeds and blade loading in the Division of Mechanical Engineering. This design was selected primarily for its compatibility with current aero-engine design practice and was not expected to provide the optimum blend of noise reduction and mechanical efficiency. Measurements at several rotor speeds between 6000 and 12000 rpm show that the fundamental and second harmonic of the blade passage frequency are in general reduced in level by 3 to 10 decibels with occasional extreme values of 0 and 15 decibels for particular combinations of rotor speed, mass flow and direction of measurement. These noise reductions confirm the findings, at lower rotor speeds, in the Division of Physics. The measured aerodynamic performance of the staggered stator vanes is similar to that of standard straight-edged vanes for most degrees of choking of the flow. However, the stalling pressures for the staggered vanes are usually a few percent lower than for the standard vanes. When these measurements have been fully analyzed a report will be issued by the Engine Laboratory of Mechanical Engineering Division.

**Propulsion Noise Canada**

<table>
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**Or Total Funding Amount:**

**COMMENTS:**
To develop criteria for the design of jet engine silencers from the comparative analysis of the noise radiation and turbulence structure of jets of differing geometry. The reduction of noise radiated by jet aircraft has been a matter of prime concern for many years. The problem is exemplified by Concorde, where jet noise levels have proven a major operational embarrassment. But even for quiet engines such as the B727 jet noise retains its importance. Advances in technology have allowed jet exhaust speeds to be reduced with consequent U^4 law reduction in the noise radiated by the free jet. Developments in acoustic lining techniques enable internal noise sources to be substantially reduced. But the free jet noise radiation continues to provide a limit below which silencing of internal noise sources becomes valueless. Thus methods of free jet noise control retain a fundamental significance for the overall reduction of engine noise. The academic problems posed by jet noise are also of extreme interest. The mathematical description of the noise contains many subtleties. Combining this with the necessary description of the turbulent structure in the jet poses a theoretical problem which will probably never be solved exactly, except possibly by some hypercomputational technique.

Transcribed from the original.
The effects of the cowl on the noise radiation of an aircraft fan are being studied experimentally. The fan, approximately 6m in diameter, absorbs up to 50kW running at tip speeds up to 150 m/s. It is installed inside a large anechoic chamber with provision to exhaust the flow from the chamber. Hot-wire anemometers are installed in the leading edge of fan blades to measure inlet turbulence. The rig is instrumented for thrust and torque measurements. Noise measurements will be correlated with inlet conditions over a range of fan r.p.m. and thrust.
### Project Title:
Noise Radiation by Rotating Blading

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<tbody>
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<td>Loughborough University of Technology</td>
<td>Ministry of Defence</td>
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<td>Loughborough</td>
<td>(National Gas Turbine Establishment)</td>
</tr>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

This project is a continuation of work funded by N.G.T.E. since 1971 into basic noise generating mechanisms of rotating machinery. The earlier work involved an evaluation of rotor noise theory via direct measurement of an "aero-acoustic transfer function", using rotating hot-wire probes at fan tip speeds up to $M = 0.2$. For an open rotor, good agreement was found between theory and experiment for both random and periodic noise components.

The study has now been extended to a higher speed range by the construction of a new stand to test an aircraft ducted fan unit at tip speeds up to $M = 0.5$. Rotating hot-wires are again being used to investigate basic noise generation mechanisms.
Project Title: Study of the Distribution of Sound Sources in Turbulent Gas Jets

Performing Organization Name & Address:
Institute for Fluid Mechanics of the DFVLR
Goettingen, Bunsenstr. 10
West Germany

Principal Investigator(s):
Dr. Grosche

Start Date: May 1, 1972
Completion Date: Dec. 31, 1976

Sponsoring Organization Name & Address:
Propulsion Noise
West Germany

Type of Research Program:

Funding:

Year
1976 (actual):
1977 (budget):
1978 (forecast):
Total Funding Amount: $111,936

Comments:

Up to now very little is known about the distribution of sound sources in turbulent jets, either experimentally or theoretically; the project aims at determining the distribution of sound sources in infrasound and ultrasound beams by means of a newly developed measuring device, and thereby to gain new insights on the mechanism of jet generation. The measuring device is also suitable in sound-shattering nozzle configuration, nozzle flaps, etc.

Publications

### Project Title:
Noise Formation and Noise Reduction for Turbine Stages with Cool Air Directed onto the Turbine Guide Blades

### Performing Organization Name & Address:
The Technical Institute for Jet Propulsion and Turbomachinery of the Technical University of Aachen
Templergraben 55
Aachen, West Germany

### Principal Investigator(s):
Prof. Dipl. - Ing. Otto David

### Sponsoring Organization Name & Address:
German Research Society
West Germany

### Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

### Start Date: Jan. 1, 1976
### Completion Date: Estimated
### Actual

### Project Summary:
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Within the framework of the research intent, the results of the study of noise origin mechanisms from blowers and compressors are to be applied to the case of use of the turbine with blowing out of cool air. It is the purpose of the plan to determine design criteria for the selection of blowing out of cool air in the case of cooled turbine stages which contribute to a noise reduction of turbines.

### Funding:
- **Year**
  - 1976 (actual):
  - 1977 (budget):
  - 1978 (forecast):

### Total Funding Amount: (300,000 DM) $127,200.

### Comments:
Translated and transcribed from the original German.

28
Project Title:
Study of Axial Flow Fan Aeroacoustics

Performing Organization Name & Address:
National Research Council of Canada
Division of Mechanical Engineering
Ottawa, Canada

Principal Investigator(s):
G. Krishnappa

Start Date: Completion Date:
1973 Estimated 1978
Actual

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Basic research is being carried out to establish the relative importance of the rotor blade row and stator blade row on fan noise generation. Some measurements on the effect of stator blade number and spacing on the in-duct noise signatures were completed and the results are published in Reference 1. Far field noise on different stator blade configuration were also recently measured and the results will be reported in a later publication.

The concept of stepped stator blades was recently tested both for aerodynamic performance and noise reduction. The test results demonstrate that the stepped stator blades has considerable merit with respect to noise reduction with some loss in aerodynamic performance.

REFERENCES
1. G. Krishnappa
   Fan Aeroacoustics, the Effect of Stator Blade Number and Spacing on In-Duct Noise Signatures
   Progress in Aeronautics, Vol. 44, 1976

2. U.W. Schaub, G. Krishnappa
   The Stepped Stator Concept: Aerodynamic and Acoustic Performance Evaluation of a Thrust Fan
   under publication as an AIAA paper
Project Title: Study of the Possibilities of Aviation-Technical Innovations to Reduce the Noise Emission of Aircraft

Performing Organization Name & Address: Department of Economics Amsterdam, Netherlands

Sponsoring Organization Name & Address: Interdepartmental Commission for Reducing Noise over Air Traffic Routes

Principal Investigator(s):

Type of Research Program:

- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Start Date: Completion Date:
1976 est. Estimated Actual

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Fundamentally, we are dealing here with the possibilities with the use of quiet-engine technology by means of configuration optimization (especially with regard to engine disposition) and aerodynamic design to arrive at a minimum noise production with possible future aircraft designs of the national aircraft industry. Adoption of the results should eventually take place in a later stage within the framework of a developmental project in the area of style technology.

Translated and transcribed from the original Dutch.
**Project Title:** Preliminary Study of the Forward Speed Effects of Turbomachinery Tones  

**Performing Organization Name & Address:**  
British Aircraft Corporation Ltd.  
Commercial Aircraft Division  
Brooklands Road  
Weybridge  
Surrey KT13 0SF, United Kingdom  

**Principal Investigator(s):**  
P. R. Kearsey, M. S. Langley  

**Sponsoring Organization Name & Address:**  

**Type of Research Program:**  
- Fundamental  
- Development (Component or System)  
- Demonstration (Experimental, Prototype, or Production)  
- Measurement Methodology  

**Start Date:** Estimated  
**Completion Date:** Actual  

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)  

In a recent study of airframe noise, level flyover at various engine powers were recorded. At 1/3-octave frequencies above 1 kHz the turbomachinery tones dominated the total spectra. When these 1/3-octave levels were compared with the ground running measurements at similar power settings and corrected to the same distance, very poor agreement was obtained. It is proposed to study the narrow band-levels of each tone and its harmonics inflight and statically with a view to the determination of the forward speed effect. It is hoped that this preliminary study will lead to a further more detailed research programme.

**Funding:**  

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**Or Total Funding Amount:**  

**COMMENTS:**  

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<td>Project Summary: (Briefly describe the:</td>
<td>In co-operation with ONEMIA an experimental programme has been conducted on the silencing effects of inverted velocity profile coaxial jets. This programme has given considerable insight into the manner in which such silencing is achieved and so far suggests the likely benefits are small.</td>
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<td>Comments:</td>
<td>AIAA PAPER 77-1253</td>
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"The Noise Characteristics of Inverted Velocity Profile Coaxial Jets" by A. M. Gargill and J. P. Duponchel. To be presented at the 1th AIAA Aero-acoustic Specialists conference Atlanta, Georgia in October, 1977.
Project Title: Aircraft Engine Noise

Performing Organization Name & Address:
ROLLS-ROYCE LTD.,
DERBY,
ENGLAND

Principal Investigator(s):
K. A. CARGILL

Sponsoring Organization Name & Address:
H. M. GOVERNMENT CORD (PE)

Type of Research Program:
— Fundamental
— Development (Component or System)
— Demonstration (Experimental, Prototype, or Production)
— Measurement Methodology

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

In cooperation with the National Gas Turbine Establishment a fundamental programme of tests of coaxial jet noise is being carried out (at NGTE Pyestock, Hants, England) to extend the range of velocities (≈ 1200fps) and scale (3.6" dia, pris.) of available data. This programme, in total is also intended to provide a better understanding of coaxial jet noise.
| **Project Title:** Propulsion Noise  
**Jet Noise Source Location:** United Kingdom |
|---|---|
| **Performing Organization Name & Address:**  
Southampton University  
Institute of Sound & Vibration Research  
Southampton SO9 5NH  
United Kingdom |
| **Sponsoring Organization Name & Address:** |
| **Principal Investigator(s):**  
S. A. Glegg  
M. J. Fisher |
| **Type of Research Program:**  
| Fundamental  
| Development (Component or System)  
| Demonstration (Experimental, Prototype, or Production)  
| Measurement Methodology |
| **Start Date:**  
| Completion Date: |
| Estimated | Actual |
| **Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.) |
| **Year:**  
| **Funding:** |
| 1976 (actual):  
1977 (budget):  
1978 (forecast): |
| **Or Total Funding Amount:** |
| **COMMENTS:** |

**Publications:**  

Transcribed from the original.
Project Title:

Performing Organization Name & Address:
Royal Aircraft Establishment
Farnborough
Hampshire GU14 6TD
United Kingdom

Sponsoring Organization Name & Address:

Principal Investigator(s):
J. McKie

Type of Research Program:

- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Start Date: Completion Date:
Estimated
Actual

Year Funding: Amount
1976 (actual):
1977 (budget):
1978 (forecast):

Or Total Funding Amount:

COMMENTS:

Tests on the influence of angle of incidence between a jet and an external stream on the production of jet noise have shown that a measurable interaction, creating additional noise, exists and could be important in the understanding of jet noise mechanisms and in the correction from static to forward speed conditions.

Reference:
J. B. W. Edwards "Measurements of the noise of a jet at incidence to a freestream."
J. McKie RAE Technical Memorandum Aero 1705 ARO 37/22 (Jan. 77).

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Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

In co-operation with Douglas Aircraft Company Limited, of Long Beach, California, an investigation has been made of the performance, both static and inflight on the "Spinning Disk" model jet facility, of a silencer nozzle ejector system. These tests have shown that such devices are effective inflight.
Project Title:
Aircraft Powerplant Noise Research

Performing Organization Name & Address:
National Gas Turbine Establishment
Farnborough, Hampshire GU14 6LS
United Kingdom

Principal Investigator(s):
K Orr, W D Bryoe, D L Hartler

Start Date: Completion Date:

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Research is centred in the Anochois and Absorber facilities of the Noise test facility. In the Anochois facility, programmes of research involving close collaboration with industry are run on turbines and exhaust jets. The characteristics of coaxial jet noise have been examined extensively, and the results of this research have been contributdd to the S.A.E.-89 Noise sub-committee. Work on the use of co-flowing streams to simulate the effects of flight has shown that the method is valid at relatively low ratios of outer to inner stream diameters. A paper will be delivered to the AIAA Conference October 1977 on this subject.

Studies of the effect of flight on exhaust noise have been a principal activity and the effect of flight on internally-generated noise radiated from the exhaust duct has been measured and good agreement with theory has been demonstrated. The effect of flight on shock-associated noise in jets has also been measured and the results will be published at the AIAA Aero-acoustics conference October 1977.

Tests on various model fans have been run in collaboration with Rolls-Royce to improve methods of estimating broadband noise and interaction tone levels. A method of eliminating unwanted tones arising from inflow distortions on tests on stator engines and rigs using a honeycomb screen has shown good results. Those will be the subject of a paper at the AIAA conference October 1977.

Tests to measure the properties of reactive sound absorbers are run in the Absorber facility; one series of tests was a joint activity with the Boeing Company. A method of measuring directly the local behaviour of liners has been developed, and has been used in research on the effect of high sound level and airflow on the impedance of silencer elements.

Publications (see separate sheet)
Publications


### Project Title:
Aircraft Engine Noise

### Performing Organization Name & Address:
ROLLS-ROYCE
DERBY
ENGLAND

### Principal Investigator(s):
Mr. D. Newby
Dr. B. Stratford

### Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Some investigations have been carried out on fan buzz-saw noise and resulted in better understanding of the underlying source and propagation, leading to a more precise control technique to reduce selected engine orders.

AIAA PAPER 77-1343

"A New Look at the Generation of Buzz-saw Noise" by B. S. Stratford and D. R. Newby
To be presented at the 4th AIAA Aero-acoustic Specialists Conference at Atlanta, Georgia in October, 1977
A test programme extending the range of data from model turbines and investigating the effects of vane numbers and blade/vane spacings on noise has been carried out in the anechoic facility at NGTE Pyestock. The analysis of this data is giving rise to more sophisticated design rules for quiet turbines.
### Project Title:
Reduction of Propulsion Noise

### Performing Organization Name & Address:
German-French Research Institute
St. Louis (ISL)
Rue de L'Industrie 12, Wall am Rhein
West Germany

### Sponsoring Organization Name & Address:

### Principal Investigator(s):
Dr. Rudi Schall

### Start Date: Completion Date:
Jan. 1, 1972  Estimated

### Actual

### Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)
Study to reduce the noise of a jet. Study concerning the mechanism of noise origins with cold and hot free jets with the purpose of reducing jet noise of an airplane or other free jet equipment (e.g., welding torch). Theoretical and experimental works on free jets reduced in size according to model. Studies on the propagation of noise of high intensity. Use of rapid measuring methods not disturbing the jets (laser anemometry, etc.).

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Translated and transcribed from the original German.
Netherlands. Study into the Possibilities and Consequences of Noise-Damping and Protective Devices for Ground Run-up. Air Traffic Service, Amsterdam, Netherlands. Sponsor: Interdepartmental Commission for Reduction of Noise Over Air Traffic Routes. Type: Demonstration. 1976 est. The purpose of this study is to come up with usable solutions in concrete problem situations (for example, Schiphol) in limiting the noise of test aircraft and airplane motors. Primarily, attention should be paid to solutions applied in other situations at home and abroad.


United Kingdom. Aircraft Engine Noise. Rolls-Royce Ltd., Derby, England. H. H. Government MOD (FE). Mr. V. Szewczyk. Mr. R. Healey. Type: Demonstration. Flight and static jet noise assessments are being carried out on several in service engines, (RB211, N45H, Spey and Viper,) covering effects on both straight jet and high by-pass ratio types.


United Kingdom. Research on Quieting Engines and Air Frames. Royal Aircraft Establishment, National Gas Turbine Establishment, Farnborough, Hampshire, United Kingdom. These programs are aimed at demonstrating the technology which could be applied to future engines, including quieter versions of the N45H and R3-211 engines.


BASIC RESEARCH AND TECHNOLOGY

ROTOR NOISE

See Also Pages:

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45
**Project Title:**
Theoretical Studies and High Speed Flight Tests

**Performing Organization Name & Address:**
Westland Helicopters Limited
Yeovil
Somerset BA 20 2YD
United Kingdom

**Principal Investigator(s):**
J. W. LEVETON

**Completion Date:**
MAY 79

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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

To determine the effect of forward speed on the impulsive noise content of a helicopter by both theoretical and experimental studies. The motivation behind the study lies in the fact that very little is known either experimentally or theoretically about forward flight effects. The available experimental data suggest that helicopter noise rises with forward speed, the rise being particularly steep at higher speeds. In a military context this increase in noise implies an increase in detectability, whilst in the civil context it may lead to an undesirable limitation on cruise speed in noise sensitive areas.

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**Sponsoring Organization Name & Address:**
MINISTRY OF DEFENCE (PR)

**Type of Research Program:**

- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Funding:**

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**Or Total Funding Amount:** $62,387

---

47
**Project Title:**

Helicopter Noise Control

**Performing Organization Name & Address:**

WESTLAND HELICOPTERS LIMITED
YEOVIL
SOMERSET, BA 202 YB
UNITED KINGDOM

**Sponsoring Organization Name & Address:**

M.o.D.(PE)

**Principal Investigator(s):**

J. LEVERTON

**Type of Research Program:**

- Fundamentals
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Start Date:**

**Completion Date:**

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<th>Estimated</th>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

A series of projects are in process on aspects of helicopter noise control under both MoD and internal funding. Areas of special interest include:

- High Speed Rotor Noise
- Tail Rotor Noise
- Subjective Response to Helicopter Noise
- Internal Noise Control
- Gear Noise

**Funding:**

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</table>

**Or Total Funding Amount:**

| COMMENTS: | 

48
Project Title:
Noise Reduction in Propulsion of Propeller Driven Airplanes

Performing Organization Name & Address:
Dornier Corp.
Friedrichshafen, Post Fach 317
West Germany

Sponsoring Organization Name & Address:
Federal Highway Ministry (Swiss) Confederate Air Office
Flight Equipment Section

Principal Investigator(s):
Peter Bartels

Type of Research Program:

<table>
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<th>Year</th>
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<tbody>
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Funding:

Project Summary: (briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Side-by-side with the limited noise abatement in existing planes of commercial aviation, it is the aim of this project to develop knowledge which will make it possible to hold down noise emission in propeller planes as much as possible by guiding their construction right from the earliest design stage. In addition to the study of propeller noise, centering on measured output of 100-200 p.e., computational and experimental studies are also carried out on exhaust noise abatement.

Transcribed from the original German.
### Project Title:

**Rotor Noise**
United Kingdom

### Performing Organization Name & Address:
Royal Aircraft Establishment
Farnborough
Hampshire GU1 6XX
United Kingdom

### Principal Investigator(s):
J. Williams

### Start Date: Completion Date: Estimated Actual

### Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

RAE participation in UK discussions on aircraft noise certification now relates primarily to appraisals of the interaction between airfield-performance characteristics and noise-certification procedures for fixed-wing aircraft, of acceptable noise-certification techniques for helicopters, and of economic penalties for technically feasible noise reductions below existing ICAO requirements. Work has started on evaluating the influence of operational procedures on helicopter noise, together with studies of the main and tail noise-generation processes.

Transcribed from the original.
Rotor Noise
West Germany

Project Title:
Relation between the Noise Generated by Rotors and the Defined Disturbance in the Air Flow.

Performing Organization Name & Address:
The Faculty for Aeronautical and Space Studies of the Technical University of Aachen, Templergraben 55
West Germany

Sponsoring Organization Name & Address:

Principal Investigator(s):
Prof. Dr.-Ing. Dieter Geropp

Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Start Date: Completion Date:
Actual

Year Funding: Amount
1976 (actual):
1977 (budget):
1978 (forecast):
Or Total Funding Amount:

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Plan: Dependence of noise generation due to rotary engines on defined disturbances in air flow. The purpose of the planned studies is to determine the essential parameters of disturbed flow and of rotor on the radiated noise. They are to proceed on the basis of the noise source, and this is to be studied in detail. This includes the measurement of pressure fluctuations on the rotor surface to determine the strength of the sound source (dipole).

Transcribed and translated from the original German.

51
<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Noise Reduction for Propeller Driven Aircraft</th>
</tr>
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<tbody>
<tr>
<td>Performing Organization Name &amp; Address:</td>
<td>Friedrichshafen, West Germany</td>
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<tr>
<td>Sponsoring Organization Name &amp; Address:</td>
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Transcribed from the original.
BASIC RESEARCH AND TECHNOLOGY

INTERIOR NOISE

See Also Page:

107
Project Title: Vibration Transmission Paths Study

Performing Organization Name & Address:
Westland Helicopters Limited
Yeovil
Somerset, BA 22 7YS
United Kingdom

Principal Investigator(s):
C. R. WILLS

Sponsoring Organization Name & Address:
MINISTRY OF DEFENCE (PS)

Type of Research Program:

Measurement Methodology

Start Date: Completion Date:
APR. 75 Estimated Actual JUNE 76

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)


Measurements have been made of the structural response of the Lynx helicopter airframe and the resulting internal cabin noise when excited at the gearbox feet and by loudspeakers housed in the cabin.

The airframe was subjected to both single frequency and swept frequency inputs via a vibrator attached to the port forward and starboard aft gearbox feet in turn. Similar acoustic excitation to that for the vibration tests was also provided by two loud speakers mounted in the opposite corners of the cabin on the floor. The resulting airframe response was subsequently measured at the numerous accelerometer positions on the cabin roof, floor, sidewalls and main frame together with the gearbox mounting feet. Microphones were also positioned in the cabin/cockpit area in order to monitor the cabin noise environment.

Funding:

<table>
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<th>Year</th>
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Or Total Funding Amount: (£2,400) $4,127

Comments:

55
Project Title:
Noise and Vibration Survey During Flight

Performing Organization Name & Address:
Westland Helicopters Limited
Yeovil
Somerset, BA 22 2YB
United Kingdom

Principal Investigator(s):
J. S. POLLARD

Sponsoring Organization Name & Address:
NUD (PH)

Type of Research Program:

Funding:

<table>
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<tr>
<td>Or Total Funding Amount:</td>
<td>£13,350</td>
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Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

To determine the relative contributions of structural borne noise and airborne noise by conducting a detailed noise and vibration survey of the gearbox and cabin structures in flight. The flight test results will be correlated with the ground based data from the Motor Rig. The noise and vibration characteristics of a footed gearbox will also be compared with those of a gimbal mounted gearbox.
### Interior Noise
United Kingdom

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Helicopter Cabin Noise Laboratory Evaluation of Vibrating Panel Treatments</th>
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<tr>
<td>Performing Organization Name &amp; Address:</td>
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<tr>
<td>Principal Investigator(s):</td>
<td>J. S. POLJARE</td>
</tr>
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#### Project Summary:
(Briefly describe the goals, approach, expected or actual results, reports generated and the date(s) of publication.)

It is proposed to conduct a laboratory evaluation of the responses of vibrating panel treatments. This investigation will be conducted in the anechoic reverberation facility and will involve the measurement of the noise and vibration transmitted through acoustically and vibrationally treated and untreated panels which are acoustically and/or structurally excited. In addition to testing panels with conventional soundproofing materials, the use of damping treatments, lump wall concepts and new methods of vibration isolation will be studied. Also the stringer/insetting arrangement of the bare panels will be varied and new panels will be made using sandwich construction, composite materials and constrained/unconstrained layers. The experimental work will be backed up with theoretical studies using models developed from classical wave theory, so that comparisons can be made with measured data.
Project Title: Internal Noise Study on Rotor Rig

Performing Organization Name & Address: Westland Helicopters Limited Yeovil Somerset BA 20 7TB United Kingdom

Sponsoring Organization Name & Address: MINISTRY OF DEFENCE (MoD)

Principal Investigator(s): J. S. POLLARD

Start Date: Feb, 76 Completion Date: Estimated Nov, 77 Actual

Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Funding:

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Comments:

To assist in the development of an effective helicopter soundproofing scheme, it is necessary to determine the noise and vibration input paths to the cabin structure, and if possible, the radiation efficiency of the structure. An experimental investigation is therefore taking place on the Lynx Rotor Rig, which is essentially a tied down non-flying Lynx helicopter, to (a) survey noise and vibration levels of the gearbox and cabin structures, (b) study the effect of mounting the gearbox with damping material and (c) conduct a cabin soundproofing study.
### Project Title:
**Internal Noise Study: Noise Vibration Monitoring on Gearbox Rigs**

### Performing Organization Name & Address:
WESTLAND HELICOPTERS LIMITED  
Yeovil, Somerset BA 202YB  
United Kingdom

### Principal Investigator(s):
- M. C. A. Woodward
- J. S. Pollard

### Start Date: Completion Date: Estimation Date: Actual Date:
- FEB. 76

### Project Summary:
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

A number of Lynx and Sea King helicopter gearboxes are being monitored. In order to have comparative records it has been necessary to standardize the procedure by mounting the accelerometers at similar positions on each gearbox and conducting the measurements at similar operating conditions. It is hoped to show how design changes influence the noise aspects of gearboxes and the scatter between identical gearboxes will also be studied. Early measurements have indicated that there could be a large variation in noise levels between identical gearboxes.

### Funding:

<table>
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<tr>
<th>Year</th>
<th>Amount</th>
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<tbody>
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### Remarks:
BASIC RESEARCH AND TECHNOLOGY

AIRFRAME NOISE

See Also Pages:

30
31
76
94
107
128
During 1976 and so far 1977, we have been completing a major programme of flight research which started in 1973. This programme is to demonstrate the realities of airframe noise shielding which are aimed at reducing noise by up to 6 dB.

Transcribed from the original.
### Project Title:
Interference in Ultrasonic Radiation

### Performing Organization Name & Address:
Chair for Air and Space Travel
Aachen Templeigraben 55
West Germany

### Sponsoring Organization Name & Address:
German Research Society

### Principal Investigator(s):
Prof. Dr. -Ing. Ralf Staufenbiel

### Start Date: Completion Date:

### Project Summary:
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

The occurrence of discrete frequencies in the sound spectrum of ultrasonic radiations which encounter obstacles is to be studied. This causes noise that is much louder than the familiar "shock-coll noise". This type of sound generation can occur in rocket and vertical airplane blast-off or when wing flaps are hit by the blast of the airplane propeller. Anechoic chambers are used to measure directional characteristics of the sound field, sound output levels and narrow-band frequency spectrums of the sound field. Sound waves and macroscopic as well as microscopic turbulence are made visible by special schlieren processes.

### Funding:

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Or Total Funding Amount: (310,000 DM) $130,440

### COMMENTS:

Translated and transcribed from the original German.
Work has continued on the further development of analytical methods for the prediction of aircraft noise propagation with the effects of noise shielding by the airframe components and their associated flow fields included. Forward-speed effects on exhaust noise can be important and a good deal of light has been shed on this and related problems by the use of a transformation due to K. Taylor, RAE. The transformation has proven valuable in both scattering problems and in source-type problems, where there is a uniform stream present in the far field. Vertex refraction work has also continued and a simplified prediction method is being developed.
**Project Title:**

**Performing Organization Name & Address:**
Royal Aircraft Establishment
Farnborough
Hampshire GU14 6TD
United Kingdom

**Sponsoring Organization Name & Address:**

**Principal Investigator(s):**
T. A. Holbeche

**Type of Research Program:**
- Fundamental Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Start Date:**

**Completion Date:**

**Estimated**

**Actual**

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Theoretical and experimental work continues on the assessment of the noise generated by airflow over the airframe components and its relation to the total noise field of the aircraft. Flight experiments with a VC 10 and Lockheed Tristar have now been analysed to provide information on the noise directivity and on the variation of noise level with changes of configuration and speed. Consideration is being given to model tests in the RAE 24 ft acoustic wind-tunnel using a directional microphone technique to discriminate against tunnel background noise.

**Reference**

F. Petney  
"An experimental study of airframe self-noise."

**Funding:**

<table>
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Airframe Noise
United Kingdom

<table>
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| Performing Organization Name & Address: 
Royal Aircraft Establishment
Farnborough
Hampshire GU14 6TD
United Kingdom |
| Sponsorng Organization Name & Address: |
| Principal Investigator(s): |
| T. A. Halbeche |
| Start Date: |
| Completion Date: |
| Estimated |
| Actual |
| Type of Research Program: |
| ___ Fundamental |
| ___ Development (Component or System) |
| ___ Demonstration (Experimental, Prototype, or Production) |
| ___ Measurement Methodology |
| Year Funding Amount: |
| 1976 (actual): |
| 1977 (budget): |
| 1978 (forecast): |
| Or Total Funding Amount: |
| COMMENTS: |

The analyses of the flight studies of airframe shielding effects reported last year are largely complete. Further flight investigations of airframe shielding, flow field, and engine installation effects on noise propagation are planned. The properties of the acoustic radiation from a large turbofan engine have also been investigated. Preliminary analysis of flight and tunnel experiments with swept wing aircraft to study flow field effects on engine noise propagation have revealed significant noise redistribution effects associated with the wing and flap vortices and more detailed examination of the results is under way.

References
R. W. Jeffery  "Experimental studies of noise-shielding effects for a delta-winged aircraft,"

Transcribed from the original.
### Project Title:
**Vortex Refraction**

### Performing Organization Name & Address:
British Aircraft Corporation Ltd.
Commercial Aircraft Division
Brooklands Road
Weybridge, Surrey KT13 OSP
United Kingdom

### Sponsoring Organization Name & Address:

### Principal Investigator(s):
- P. R. Kearsley
- M. S. Langley

### Start Date: Completion Date:
- Estimated
- Actual

### Project Summary:
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Work carried out by BAC and COTET has indicated that the velocity field induced by wing shed vortices can significantly reduce the noise radiated from engines. RAF Farnborough have recently supplied us with a copy of a three-dimensional vortex refraction programme capable of assessing the above effects.

In order to evaluate its potential as a prediction method it is proposed to compare results from this programme with test data already accumulated by BAC. Any necessary modifications to the computer program will be made if it is felt that the prediction techniques employed can be improved upon.

It is envisaged that work will also be carried out to assess the relative importance of wing and flap shed vortices.

### Funding:

- **Year**: 1976 (actual);
- 1977 (budget);
- 1978 (forecast):

### Comments:

Transcribed from the original.
Airframe Noise
United Kingdom

Project Title:
Structural Response Under Turbulent Flow Excitations

Performing Organization Name & Address:
Institute of Sound and Vibration Research
The University
Southampton, SO17 1BJ
United Kingdom

Sponsoring Organization Name & Address:

Principal Investigator(s):
Y. K. Lin

Type of Research Program:

Start Date:
Completion Date:
Estimated
Actual

Year
1976 (actual):
1977 (budget):
1978 (forecast):

Funding:

Or Total Funding Amount:

COMMENTS:

In this report three problems of turbulent-induced random vibration are discussed. The first two problems, an airplane flying into atmospheric turbulence and a panel exposed to boundary-layer pressure fluctuations, are treated as linear problems. If Taylor's hypothesis of a frozen turbulence field is valid then the calculation can be greatly simplified using a spectral analysis in the wave-number domain. Furthermore, even if decay in the turbulence is appreciable a superposition scheme can still be used which retains many of the advantages of the above approach.

The third problem, the response of a building to gusty wind, is formulated as a nonlinear problem in which random inputs occur both as parametric and non-parametric excitations. The stochastic averaging method of Stratonovich and Khanshin is used to obtain equivalent lto equations for along-wind and cross-wind motions, and stability conditions are established.

Transcribed from the original.

69
United Kingdom. Untitled project on jet-surface interactions. Royal Aircraft Establishment, Farnborough, Hampshire GU14 6TD, United Kingdom. J. McKia. Experiments in the RAE 24 ft. tunnel to investigate the generation of noise caused by jet-surface interactions under static and forward speed conditions have been continued using a representation of a wing-plus-flap as the interfering surface.


BASIC RESEARCH AND TECHNOLOGY
NOISE PREDICTION TECHNOLOGY

See Also Pages:

24
27
33
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36
37
65
67
68
69
94
102
103
115
130
134
Project Title: Studies Involving the Zoning Legislation and Developing a Computer Model

Performing Organization Name & Address:
National Lucht- en Ruimtevaartlaboratorium
Anthony Fokkerweg 2
Amsterdam 1017
Netherlands

Sponsoring Organization Name & Address:

Principal Investigator(s):

Start Date: Completion Date: Estimated Actual 1976

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

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Explanation: In 1976, the "modification to the aviation law" was supposed to become law. The zoning around airports were regulated with this. Diverse activities were expected in connection with this. Attention was especially to be paid to setting up a regulation in which the calculation method was to be clearly laid down for noise pollution around airfields. A further development of the computation model to determine noise hindrance was also to be expected in 1976.

In later years, emphasis was to be laid on collecting data needed for noise hindrance determination. This was supposed to be dependent on a large degree on the introduction and the use of a MLS-guidance system and making other future changes in the procedure.

Translated and transcribed from the original Dutch.
A rig to produce mixing jet noise with minimum contamination has been developed and tested in the anechoic wind tunnel. Jet velocities up to 300 m/s have been used and forward flight simulated up to 30 m/s. Preliminary results have shown that in the static case the noise generated by the jet corresponds to the results obtained by P. Lush. The effect of forward speed has been to produce a change in field shape and noise level even at very low forward speeds. The effect of yawing the jet has also been examined and significant changes found. These results are now being examined in depth.
<table>
<thead>
<tr>
<th>Project Title: Aircraft Engine Noise</th>
<th>Sponsoring Organization Name &amp; Address: N.I. GOVERNMENT MOD (FE)</th>
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<td>Start Date:</td>
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</table>

The "Spinning Rig" facility has been developed to reduce aerodynamic and acoustic uncertainties. Repeatability is now excellent and although the measurement environment is still suspect (+ 1dB error) and facility still produces some 3dB excess above hot model jet noise.
An investigation has been made of the possibilities of using a model-scale engine simulator (an ejector-powered nacelle) to act as a noise source for acoustic tunnel tests of shielding and propagation. A number of further schemes are being examined to provide representative jet noise sources together with internal noise sources with realistic spectra and tonal content, to simulate the exhaust noise of a full scale high-bypass-ratio engine.
**Project Title:** Aircraft Engine Noise

**Performing Organization Name & Address:** ROLLS-ROYCE LTD., DERBY, ENGLAND.

**Sponsoring Organization Name & Address:** H. M. GOVERNMENT MOD (PE)

**Principal Investigator(s):**
- Dr. R. W. Lowrie
- Mr. D. Newby

**Start Date:** Estimated  
**Completion Date:** Actual

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

---

An intake which should allow inflight noise levels to be observed from a fan on static test has been developed, and calibrated and the work described in AIAA PAPER 77-1323

"The Design and Calibration of a Distortion-Reducing Screen for Fan Noise Testing" by Dr. R. W. Lowrie and Mr. D. Newby

To be presented to the 4th Aero-Acoustics Specialists Conference at Atlanta, Georgia in October, 1977.

---

**Year**  
1976 (actual):  
1977 (budget):  
1978 (forecast):

**Funding Amount**

**Or Total Funding Amount**

**COMMENTS:**

77
## Project Title:

**Aircraft Engine Noise**

### Performing Organization Name & Address:

ROLLS-ROYCE LTD.,
DEERBY,
ENGLAND

### Sponsoring Organization Name & Address:

H, M, GOVERNMENT MOD (PE)

### Principal Investigator(s):

Dr. B. W. Lewis

### Start Date: Completion Date:

<table>
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### Project Summary:

(Briefly describe the goals, approach, expected or actual results, reports generated and the date(s) of publication.)

In conjunction with outside consultants a technique to determine the modal structure of aero engine noise is being developed for field measurements. Progress so far has indicated that it should be feasible and the work is reported in:

**AIAA PAPER 77-1331**

"Farfield Method of Duct Mode Detection for Broadband Noise Sources"

By Dr. B. W. Lewis, B. J. Tester and C. L. Norrey.

To be presented at the 4th AIAA Aero-aoustics Specialists Conference at Atlanta, Georgia in October, 1977.

<table>
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</table>

**Comments:**
Project Title: Coherent Structure in Jet Turbulence

Performing Organization Name & Address:
Southampton University
Institute of Sound & Vibration Research
Southampton S09 5NH
United Kingdom

Principal Investigator(s):
P. O. A. L. Davies
D. I. J. Baxter
P. J. McConachie

Start Date: Completion Date:

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Publication

A discrete vortex model of an axisymmetric starting jet, originally proposed by T. E. Base and P. O. A. L. Davies (T. E. Base 1969 Mathematical Studies of Vortex Models to Represent Unsteady Flow. PHD thesis, Southampton University) is refined, attention being given to small scale aspects of the model flow as well as to grosser features. Some attempt at the simulation of some real flow characteristics is made and comparison with experiment is considered.
**Project Title:**
Jet Noise Prediction from Inviscid Flow Models

**Performing Organization Name & Address:**
Southampton University  
Institute of Sound & Vibration Research  
Southampton SO9 5NH  
United Kingdom

**Principal Investigator(s):**
P.D.A.L. Davies  
C. L. Horrey  
A.V.J. Edwards

**Sponsoring Organization Name & Address:**

**Type of Research Program:**
- Fundamental  
- Development (Component or System)  
- Demonstration (Experimental, Prototype, or Production)  
- Measurement Methodology

**Start Date:**
**Completion Date:**
- Estimated  
- Actual

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

**Year** | **Funding:** | **Amount**
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1976 (actual): |  | 
1977 (budget): |  | 
1978 (forecast): |  | 
Or Total Funding Amount: |  | 

**COMMENTS:**

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Transcribed from the original.
BASIC RESEARCH AND TECHNOLOGY

ATMOSPHERIC PROPAGATION AND GROUND EFFECTS

See Also Pages:

99
117
**Atmospheric Propagation & Ground Effects**

**United Kingdom**

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Propagation of Sound in the Atmosphere</th>
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<tr>
<td>National Physical Laboratory</td>
<td>Dept. of Industry Ministry of Defense</td>
</tr>
<tr>
<td>Teddington</td>
<td>1 Victoria Street (Procurement Executive)</td>
</tr>
<tr>
<td>Middlesex</td>
<td>London SW1 Nat'l Gas Turbine Lab.</td>
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<td>Dr. D. W. Robinson</td>
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<td>Dr. M. E. Delany</td>
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<td>R. C. Payne</td>
<td>Measurement Methodology</td>
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<td>COMMENTS:</td>
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Studies of propagation, including effects of meteorological conditions, ground reflection and absorption, and non-linear effects, with particular reference to the noise from aircraft.

**Publications**


"Sound absorption in air at frequencies up to 100 KHz", E. N. Buzley, NPL Acoustics Report Ac 74, 1976.


Transcribed from the original.
BASIC RESEARCH AND TECHNOLOGY

MEASUREMENT METHODOLOGY

See Also Pages:

25
26
64
66
73
130
### Project Title:
Movable Monitoring System, Verification of Calculation Method.

### Performing Organization Name & Address:
National Agency of Environmental Protection
Kampmannsade 1
1604 København
Denmark

### Sponsoring Organization Name & Address:

### Principal Investigator(s):

### Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

### Start Date: 1977
### Completion Date: 1978

### Project Summary:
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

### Funding:

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<td>1978 (forecast):</td>
<td>50,000 D.kr. 8,245</td>
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### Movable Monitoring System, Verification of Calculation Method:
The reliability of a number of noise calculations performed in major airports have been questioned by the local authorities. The National Agency of Environmental Protection admits that the theoretical calculations rest on a simplified basis, and therefore finds it appropriate to perform a number of noise measurements at selected localities around major airports in order to verify the theoretical calculations.
Guidelines on the Calculation and Evaluation of Air Traffic Noises

As existing working group has agreed that the current method to calculate air traffic noise (CNR-method) shall be replaced by a method in which dB(A) is used as a measurement unit and the duration of the noise emission is considered. The new method will be introduced in connection with renewed noise calculations for Kastrup/Selholm Airport, under the auspices of the "Airport Committee of 1975." The Acoustic Laboratory will assist the Agency of Environmental Protection in the provision of the technical guideline basis.
### Project Title:
Working Up and Analysis of Noise Measuring Recordings

<table>
<thead>
<tr>
<th>Performing Organization Name &amp; Address</th>
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<tr>
<td>National Lucht- en Ruimtevaartlaboratorium Amsterdam 1017 Netherlands</td>
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<td>Measurement Methodology</td>
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<tr>
<td>1976</td>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

**Purpose:** Control of noise hindrance calculations and development of future noise guarding system.

**Explanation:** In 1975, the NLR was involved in working up recordings of RLD noise measurement. On the one hand, this included the setting up of so-called monthly and quarterly reports and calculating programs, that is to say the manual method which up to today has been customary with the RLD, while besides this the purpose was to build up a set of recordings which makes it possible to have a statistical analysis of strong fluctuations in the measured noise level.

In 1975, after the program for the named report had already come, in 1975, the regular production of reports was supposed to be taken care of by the NLR. On the basis of the preliminary test carried out in 1975 as to the possible causes of occurring fluctuations, work was to be done on a wider scale in 1976.

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**Funding:**

<table>
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<td>Total Funding Amount:</td>
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**COMMENTS:**
# Project Title:
Measurements on Runways

# Performing Organization Name & Address:
National Lucht- en Rijnvaaartlaboratorium
Anthony Fokkerweg 2
Amsterdam 1017
Netherlands

# Sponsoring Organization Name & Address:

# Principal Investigator(s):

# Start Date: Completion Date:
1977 Estimated 1981

# Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

# Purpose: Development of methods for runway definition, collecting data, i.e. noise hindrance calculations and control of the performance of flight procedures.

# Explanation:
The development of an improved method of recording the digitalized radar data of TAF 1 advanced to a satisfactory measure in 1976. Because the delivery of the needed magnetic tape recorders shall take place right at the start of 1977, operational use should be made of the new recording apparatus which will take some more time. In expectation of this, use should be made of the recording system with cassettes.

In 1977, the program should be expanded in order to produce the desired runways as efficiently and rapidly as possible.

Just as in the preceding years, in 1977 measurements should be made on aircraft starting from and landing on the Schiphol airport by the NLR. If possible, attention should be paid to the aircraft starting from and landing on the runways of the Rotterdam airport.

In addition, to control the carrying out of the flight procedures, the recorded flight paths should be treated to obtain data with reference to noise prevention calculations such as determining the spread in runways and laying instructional circuits.

In the years after 1977, a limited further optimization will be anticipated of the measuring method and the pertinent working out of programs and continuing the measurements.

# Measurement Methodology:

<table>
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<td>1979 - - - - - -</td>
<td>- - - - - -</td>
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<tr>
<td>1980 - - - - - -</td>
<td>(50,000 F) $10,320</td>
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<tr>
<td>1981 - - - - - -</td>
<td>(750,000 F) $10,120</td>
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# Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

# Comments:

Translated and transcribed from the original Dutch.

90
**Project Title:**
Preventing Noise Caused By Aircraft

**Performing Organization Name & Address:**
National Lucht- en Ruimtevaarlaboratorium
Anthony Fokkerweg 2
Amsterdam 1017
Netherlands

**Principal Investigator(s):**

**Sponsoring Organization Name & Address:**

**Type of Research Program:**

- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Start Date:**
1976

**Completion Date:**
Estimated 1980

**Actual:**

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<th>Year</th>
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<td>(225,000 F) $45,540</td>
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<td>1980</td>
<td>(250,000 F) $50,600</td>
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<tr>
<td>1981</td>
<td>(275,000 F) $55,660</td>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Explanation and time phasing:

In 1976, calculations are to be carried out concerning noise hindrance around:

- Schiphol,
- secondary airports, such as Zestienhaven, Doek, Elde,
- small airports, such as Teuge

The calculations are to be carried out for the present day situation (i.e. 1975) as well as for future situations. If so indicated, calculations should also be carried out on a quarterly basis for the Schiphol airport.

These calculations should also be necessary in the coming years, possibly in adapted form.

Translated and transcribed from the original Dutch.
### Measurement Methodology
Northern Ireland

**Project Title:** Noise Spectra for the Environments of Belfast Airport.

**Performing Organization Name & Address:**
Department of Aeronautical Engineering,
Queen's University,
David Keir Building,
Belfast BT9 5AG, Northern Ireland.

**Principal Investigator(s):**
Professor P.F. Benham
Dr. S. Raghunathan

**Sponsoring Organization Name & Address:**
None

<table>
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<th>Start Date:</th>
<th>Completion Date:</th>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Belfast airport is not very large (not international status) and is situated about 15 miles from the city. It receives however a very wide range of aircraft types, private and commercial and there is an adjacent small military unit. There is an interest from local environmentalists and aeronautical industry to establish the landing, take-off and overhead noise spectra of a range of aircraft at various stations in the environments of the airport.

The department of Aeronautical Engineering, has undertaken this project and a preliminary report will be prepared in October 1977 and a final report in about one year hence.

<table>
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<tr>
<th>Year</th>
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**Comments:**
**Project Title:** Aircraft Noise Measurement Programme

**Performing Organization Name & Address:**
Dept. of Engineering  
University of Reading  
Reading, Berks  
United Kingdom

**Principal Investigator(s):**  
Dr. A. J. Prelove

**Sponsoring Organization Name & Address:**  
Various local authorities to the west of London  
Airport (Heathrow) and close to Gatwick Airport.

**Type of Research Program:**  
- Fundamental  
- Development (Component or System)  
- Demonstration (Experimental, Prototype, or Production)  
- Measurement Methodology

**Start Date:** 1969  
**Completion Date:**

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**Project Summary:** (briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

The aim of the work is to provide a continuing monitor of aircraft noise levels close to Heathrow and Gatwick airports so that trends may be observed and, if necessary, representations made to the U.K. government. All measurements have been made using the Noise and Number Index based on continuous measurements in dBA. Various trends have been observed in the eight years of the running of the programme and these have been tentatively explained in terms of the changing pattern of aircraft types and numbers of movements. No reports have been prepared for public circulation but information is available on request.

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<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Development of Closed Working Section Anechoic Wind Tunnel</th>
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<tbody>
<tr>
<td>Performing Organization Name &amp; Address:</td>
<td>Sponsoring Organization Name &amp; Address:</td>
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<tr>
<td>Department of Aeronautics &amp; Astronautics</td>
<td>Science Research Council</td>
</tr>
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<td>State House</td>
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<td>D. N. C. Cheeseman</td>
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<td>Start Date:</td>
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<td>1973</td>
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Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

An existing 7' x 5' closed section wind tunnel has been converted to have anechoic properties for frequencies above 500 Hz. Specially constructed splitters have been developed to reduce the noise generated by the wind tunnel fan. Due to the need to retain the original aerodynamic capability the splitters have had to be placed in the high speed diffuser where they create a 402 blockage and generate aerodynamic noise which tends to dominate the noise levels in the working section measured with a single microphone at a distance of 36 ft above 500 Hz at a level of 26 dB. The use of correlation techniques has further reduced this level.

Initial experiments carried out during the commissioning of the tunnel demonstrated that jet mixing noise, airframe noise and vortex refraction effects can be satisfactorily measured.

Mr. _J. G. _Pratt_ C. 0. Cheeseman

UNITED KINGDOM

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Measurement Methodology

United Kingdom
**Measurement Methodology**

**West Germany**

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Production of Noise Protection Maps</th>
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<tr>
<td>Performing Organization Name &amp; Address:</td>
<td>Institute for Applied Geodesy Richard-Strauss-Allee 11 Frankfort West Germany</td>
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<tr>
<td>Principal Investigator(s):</td>
<td>Dr.-Ing. Walter Sattlinger</td>
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<tr>
<td>Start Date:</td>
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<td>1,600,000 DM</td>
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<tr>
<td>Comments:</td>
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The production of maps for noise protection zones for civilian and military airports, as a part of the compliance with the regulation issued under the Aviation Noise Control Act of March 30, 1971.

Translated and transcribed from the original German.
A standard measuring procedure needs to be available for aircraft noise on behalf of noise supervision in general as well as for individual aircraft movements. Such a method is being worked on at the present time on the basis of international recommendations. Further developments with possible differentiation of various forms of air traffic are desirable in the future.

As much as possible, use needs to be made of already developed procedures in the framework of studies made earlier.
The purpose of this study is to set up data and guidelines for the design of a noise defense system around air flight territories. A distinction is made between large international aircraft areas, regional civilian aircraft territories, military aircraft territories and small civilian air flight territories. In close deliberation with the responsible authorities, a specification should be drawn up of the noise prevention system for different types of aircraft terrain. On the basis of this, the design of the system should be worked out as to apparatus, use, calibration, and procedures to be worked out for establishing an interpretation of information sources.

In this working out, attention needs to be paid to stationary and mobile noise measuring posts and possible other equipment. Consideration also needs to be given to the location of measuring posts, setting up of equipment to determine atmospheric influences.

Translated and transcribed from the original Dutch.
**Project Title:** Development of a Standard Calculation Method for Noise Pollution Caused by Airplanes

**Performing Organization Name & Address:**

Royal Air Service
Defense, Public Health and Environmental Hygiene Department
Amsterdam, Netherlands

**Sponsoring Organization Name & Address:**

Interdepartmental Commission for Reducing Noise over Air Traffic Routes

**Principal Investigator(s):**


**Start Date:** 1976 commencement

**Completion Date:**

- Estimated
- Actual

**Type of Research Program:**

- Fundamental Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

For the benefit of noise zoning around air flight terrain, such as expected in the legal draft modifying the law of aviation, it is necessary in connection with the involved legal consequences that the calculation of noise curves be done according to a standard method. Guidelines should be taken up for acceptance with regard to flight parameters, aircraft parameters, atmospheric and geomorphological factors, the distribution of flight movements and the compilation of the air corps as well as with regard to acoustical factors which are used for the calculations.

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Translated and transcribed from the original Dutch.
In aircraft flyover noise measurements it is rarely possible to locate the microphone in a position where the effects of the ground plane are insignificant. In order to investigate and minimize these effects it is proposed to study noise data obtained from measurements taken with microphones at various heights and above various ground covers. It is envisaged that noise tests will be made on a modern aircraft with high bypass ratio engine (Lockheed Tristar). Results will then be representative of the aircraft engines which are likely to be in service in the foreseeable future. This work will be particularly relevant to certain revisions of noise certification which are currently being proposed.
**Project Title:**
National Calibration Standards for Sound Pressure and Noise

**Performing Organization Name & Address:**
National Physical Laboratory
Teddington
Middlesex
United Kingdom

**Sponsoring Organization Name & Address:**
Dept. of Industry
1 Victoria Street
London SW1
United Kingdom

1 Victoria Street
The Adelphi
London WC1
London WC1, United Kingdom

**Principal Investigator(s):**
Dr. D. W. Robinson
Dr. N. E. Delany
E. N. Bazley

**Type of Research Program:**
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Start Date:**
Completion Date:
Estimated
Actual

**Funding:**

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<td>1977 (budget):</td>
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<tr>
<td>1978 (forecast):</td>
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**Project Summary:**
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

To provide primary calibration of standard reference microphones and a national reference service on acoustical measurement. International comparisons. Standards for noise emission measurement, especially aircraft.

**Publications:**

"Sound absorption in air at frequencies up to 100 KHz", E. N. Bazley, NPL Acoustics Report Ac 74, 1976.


Transcribed from the original.
### Project Title:

### Performing Organization Name & Address:

**Sponsoring Organization Name & Address:**
Department of Trade  
London W.C. 2  
United Kingdom

### Principal Investigator(s):

### Type of Research Program:

- Fundamental  
- Development (Component or System)  
- Demonstration (Experimental, Prototype, or Production)  
- Measurement Methodology

### Start Date:  
**Completion Date:**

- Estimated  
- Actual

### Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

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<td>1978 (forecast):</td>
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</table>

**Or Total Funding Amount:**

**COMMENTS:**

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Noise studies covering instrumentation and analysis techniques for noise certification purposes, the social effects of aircraft noise, including reverse thrust, noise measurements including the production of RNI contour maps for such purposes as land use planning decisions and the evaluation of noise abatement techniques, night disturbance, etc.

---

Transcribed from the original.
### Project Title:

Measurment Methodology

United Kingdom

### Performing Organization Name & Address:

Royal Aircraft Establishment
Farnborough
Hampshire GU14 6TD
United Kingdom

### Sponsoring Organization Name & Address:

Type of Research Program:

- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

### Principal Investigator(s):

J. Williams

### Start Date: Completion Date:

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Or Total Funding Amount: 

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### Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

RAE has continued to contribute to an international appraisal of the problems of noise measurement in ground-based facilities which provide forward-speed simulation. The RAE 5 ft tunnel has now been converted with a new rated fan and its aerodynamic performance checked; studies of its background noise reduction should start late in 1977, after completion of the anechoic working-chamber and of the circuit acoustic splitter. As regards application of the RAE 24 ft wind tunnel, further investigations relate to its working-chamber acoustics, in-flow microphone characteristics, and acoustic-mirror discrimination. Techniques for noise source location have been reviewed.

### References

- F. W. Armstrong
  - "Some UK Government Establishment research towards quieter aircraft."

- J. Williams
  - "Ground-based facilities with forward-speed representation for aircraft noise research."

- J. Williams
  - "Aerodynamic noise."
  - AGARD Lecture Series 80 (1976).

- Susan M. Danis
  - "The shielding method for noise source location and a review of alternative methods."

Transcribed from the original.
Two series of tests have been made in the RAE 24 ft acoustic wind tunnel on various nozzles to provide information both on the noise characteristics of the nozzles under static and forward speed conditions, and to provide data on which the tunnel as a facility can be assessed for comparison with other facilities in which the nozzles have been tested.

Reference

J. B. W. Edwards "Comparative measurements of the noise of cold air jets from three nozzles under static and forward speed conditions." RAE Technical Memorandum Aero 1692 ARC 37055 (Sept. 76).
BASIC RESEARCH AND TECHNOLOGY
ARCHITECTURAL STUDIES

See Also Pages:

57
69
117
126
128
### Project Title:
Active Damping Methods for Plates and Framed Structures

<table>
<thead>
<tr>
<th>Performing Organization Name &amp; Address:</th>
<th>University of Leeds, West Yorkshire</th>
<th>Civil Engineering Department University of Leeds Leeds, LS2 9JT United Kingdom</th>
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<tr>
<td>Principal Investigator(s):</td>
<td>L. A. Walker</td>
<td></td>
</tr>
<tr>
<td>Start Date:</td>
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<td>(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)</td>
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<td>In the interests of improving airborne sound insulation of panels and of regulating room reverberation, the control of transverse vibration of a thin plate by application of active energy feedback has been evaluated in past work here. A localized point control force is derived from the sensed motion of some point on the plate surface. Control can be effective for particular points and for all resonant modal motions under conditions of light damping. The complete conditions for system stability are established. Bandwidth limitations are not found if the points of sensing and feedback are made identical. Corresponding stability and performance conditions are known for an array of multiple damping units like the single one above. Measured velocity dampings of 40 dB are found within the first three or four cycles of an impulsive plate. The method should be applicable to other structures (aircraft, ships, framed buildings) than the plate, above, and future work (the object of the reference) will concentrate on the application to framed structures.</td>
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| Or Total Funding Amount:               |                                                                 |
|                                       |                                                                 |

| COMMENTS:                              |                                                                 |

References:
Project Title: Study of the Anticipated Measures in which Use is to be Made of Noise-Reducing Equipment in Noise Zones as well as the Optimal Presentation of Equipment Regulation

Performing Organization Name & Address: Public Health & Environmental Hygiene Dept. Amsterdam, Netherlands

Sponsoring Organization Name & Address: Interdepartmental Commission for Reducing Noise over Air Traffic Routes

Principal Investigator(s):

Start Date: 1976 est. Completion Date: Estimated Actual

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

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Dr Total Funding Amount: 

COMMENTS:

Extra noise-resistant equipment is involved in the framework of the protection of homes. From the viewpoint of public health it is important that use be made of as large a possible a number of these insulation regulations (voluntarily). Not only the quality of the equipment and the secondary effects play a role, but also the possible inconvenience of cultivation, but the presentation of the regulations by authorities is also of great importance.

The study includes a social science study for carrying out the preventive program. Also, the study serves to provide guidelines on a social-psychological basis for the presentation of regulations, as well as telling of unfavorable developments of the same type which occur around the English Heathrow airport.

Translated and transcribed from the original Dutch.
Architectural Studies
Netherlands

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Inventory Study into the Possibilities of Protecting Residences and Other Sound-Sensitive Buildings by means of Noise-Averting Equipment</th>
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</table>
| Performing Organization Name & Address: | Royal Air Service
Amsterdam, Netherlands |
| Sponsoring Organization Name & Address: | Interdepartmental Commission for Reducing Noise over Air Traffic Routes |
| Principal Investigator(s): | |
| Type of Research Program: | |
| Start Date: | Completion Date: |
| 1976 est. | Estimated | Actual |
| Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.) | |

The purpose of the study is to come up with a general view of the possibilities for reducing the noise pollution within residences and buildings by means of extra noise insulation on the basis of the effectiveness of the so-called Building Technical Commission for Aircraft Noise as well as on the basis of data from abroad. This study can mean a further addition of a similar study into the study program of traffic noises. On the basis of a wide-spread literature study and data from the Dutch acoustical council, as a function of a stepwise classification into classes of different noise insulation, it can be indicated which insulation measures can be applied where attention should also be paid to secondary effects, as well as ventilation, thermal insulation, condensation effects as well as maintenance and cost aspects.

A distinction shall be made between devices on existing buildings and devices on new buildings to be built near the noise zone around aircraft terrain.

Translated and transcribed from the original Dutch.
**Project Title:** Test Study on the Use of Noise Resisting Equipment on Residences Countering Aircraft Noise

**Performing Organization Name & Address:**
Public Health & Environmental Hygiene Dept.
Amsterdam, Netherlands

**Sponsoring Organization Name & Address:**
Interdepartmental Commission for Reducing Noise over Air Traffic Routes

**Principal Investigator(s):**

**Start Date:** 1976 est.

**Completion Date:**
- Estimated
- Actual

**Type of Research Program:**
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Year Funding:**
- 1976 (actual):
- 1977 (budget):
- 1978 (forecast):

**Or Total Funding Amount:**

**Comments:**

This project envisions the use of noise resisting equipment already developed within the framework of activities of the Building Technical Commission on Aircraft Noise (carried out on a very small scale) on buildings subjected to aircraft noise on such a scale that significant data can be derived therefrom which is needed to determine the noise resisting equipment to be used around airport terrains within noise zones. Consideration is being given to the insulation of about 500 residences, distributed over a number of classes of different noise pollution in terms of Cost Units and peak stressed in other comparable means. In connection with this, a distinction is desirable in the equipment package according to residence type as well as according to total noise insulation. An experimental study is to be made in connection with this.

Translated and transcribed from the original Dutch.
**Architectural Studies**  
Netherlands

**Project Title:** Study into the Possibilities of Saving on Energy Consumption for Heating Purposes and Fuel Costs in Residential Insulated Against Aircraft Noise

<table>
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<tr>
<th>Performing Organization Name &amp; Address:</th>
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<tr>
<td>Public Housing Establishment and Space Dept., Amsterdam, Netherlands</td>
<td>Interdepartmental Commission for Reducing Noise over Air Traffic Routes</td>
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<th>Principal Investigator(s):</th>
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<td>Actual</td>
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**Project Summary:** (briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

In the study they are concerned with gaining insight into possible favorable side effects due to the application of noise-resisting equipment on residences. This study includes a calculation of the savings to be anticipated as well as a testing in the practical situation. In the testing, attention needs to be paid to the influence of the reducing effective use of equipment during certain periods so that probably a distinction must be made between different forms of air travel.

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<th>Year</th>
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**COMMENTS:****

Translated and transcribed from the original Dutch.
**Aircraft Other**

**Netherlands**

<table>
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<th>Project Title:</th>
<th>Studies Concerning Zoning Legislation</th>
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<tr>
<td>Performing Organization Name &amp; Address:</td>
<td>National Lucht- en Ruimtetuinstichting Anthony Yokkerweg 2 Amsterdam 1017 Netherlands</td>
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<tr>
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<td>$30,360</td>
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<td>&quot;-&quot;</td>
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<tr>
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<td>$30,360</td>
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**COMMENTS:**

The activities with the zoning around airport terrain, such as is regulated in the amendment to the aircraft law in preparation, shall be continued in 1977. Namely, these activities concern setting up a regulation. The calculations are set down for determining noise pollution around airports. A further development of the computation model for determining noise prevention is to be expected in 1977.

In later years, emphasis will be laid on collecting data needed for noise hindrance determination; to a considerable degree, these are dependent on the introduction and use of MLS-conducting systems and other future amendments to be made to the procedures.

Translated and transcribed from the original Dutch.
### Aircraft Other
West Germany

<table>
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<tr>
<th>Project Title:</th>
<th>Survey of Current Aviation Noise Research Projects</th>
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<td>Performing Organization Name &amp; Address:</td>
<td>Max-Planck Institute</td>
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<tr>
<td>Principal Investigator(s):</td>
<td>Prof. Dr. Ernst-August Mueller</td>
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<tr>
<td>Start Date:</td>
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<td>Measurement Methodology</td>
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<td>1978 (forecast):</td>
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Or Total Funding Amount: (50,000 DM) $21,200.

**COMMENTS:**

All aviation noise-related research conducted in the FRG from January 1 to December 31 will be surveyed using a questionnaire, and documented in a catalogus. In addition, expert analysis of the collected information will lead to an evaluation of the general status of German research in this area.

Translated and transcribed from the original German.
### Project Title:
Study of the Terrain Noises Emitting from the Civilian Airport, Düsseldorf—Including the Parallel Track—and of the Possibility of Reducing These Noise Levels

### Performing Organization Name & Address:
Technical Monitoring Association
Koeln, Konstantin-Ville-Str. 1
West Germany

### Sponsoring Organization Name & Address:
Minister for Economy, the Middle Classes and Transportation
Düsseldorf

### Principal Investigator(s):
Dr. S. C. Martinez

### Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

### Start Date: Completion Date:

### Project Summary:
(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Determination of present as well as anticipated noise levels under various weather conditions, including all noise sources, such as flight and traffic noises; ascertaining the percentage of noise for each individual source; proposal and evaluation of structural preventive measures.

### Funding:

<table>
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<tr>
<th>Year</th>
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<td>Dr Total Funding Amount:</td>
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### Comments:

Translated and transcribed from the original German.
Aircraft Other
Abbreviated Listings
with Funding


West Germany. Study of the Effect of Noise Abatement Measures on the Operating Capacity of Frankfurt Airport. Federal Air Transportation Office, Brunschweig, Flughafen, West Germany. Ted Huntington. Total Funding Amount: (20,000 DM) $12,720. Study of the improvements effected in Frankfurt Airport. Alteration of the "fa" system in connection with the abandonment of the Wiesbaden-Bruchheim Airport and its effect on the operating capacity of Frankfurt Airport. (Phase 2).
**Project Title:** Study of the Actual Noise Pollution Due to Airplanes at the Level of the Land

**Performing Organization Name & Address:**
Public Health and Environmental Hygiene
Royal Air Service, Defense
Amsterdam, Netherlands

**Sponsoring Organization Name & Address:**
Interdepartmental Commission for Reducing Noise over Air Traffic Routes

**Principal Investigator(s):**

**Start Date:** 1976 est.
**Completion Date:**

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

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The study has the object of creating insight on an annual basis of the actual noise pollution for all relevant air traffic terrain in the Netherlands. The data are to be used for government purposes on various terrains: adoption of standards, phasing and adoption of noise preventive equipment in the framework of the prevention program within the noise zone, planological purposes, etc. A general view can be obtained by an aggregation of various noise pollution calculations for the different air flight terrains on the basis of actual data concerning the performance of flight, the number of aircraft movements, aircraft types and the like.

---

Translated and transcribed from the original Dutch.
On behalf of decisions concerning new air traffic terrain as well as modifications in use and the extension of available terrain, it is desirable to develop better evaluations on the basis of money for noise obstacles, than is presently the case. Different evaluation methods have been studied and applied in the framework of the analysis of a site for a second national airport, but the impression exists that insufficient attention has been paid to the noise aspect. A continuation of the named study is desirable.

Translated and transcribed from the original Dutch.

120
Aircraft Other
Netherlands

Project Title: Study into the Relationship Between Noise Pollution and Obstacles in the Vicinity of Military Aircraft Bases and Small Airports

Performing Organization Name & Address: Public Health and Environmental Hygiene Dept., Amsterdam, Netherlands

Sponsoring Organization Name & Address: Interdepartmental Commission for Reducing Noise over Air Traffic Routes

Principal Investigator(s):

Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Start Date: 1976 est.
Completion Date:
- Estimated
- Actual

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Year Funding Amount
1976 (actual): 
1977 (budget):
1978 (forecast):

Or Total Funding Amount: 

Comments:

On the basis of widespread tests, a relationship has been established by the Kost commission between noise pollution and the obstacles which are present. This relationship is specified by a traffic pattern which is typical for a civilian airport and with the use of a certain group of aircraft.

The purpose of this study is to go into how far the interpretation of the method of Kost is applicable for the judgment of noise pollution with another traffic pattern and another aircraft type, as well as with military flight bases and smaller airports.

Translated and transcribed from the original Dutch.
<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Supplementary Investigation of the Sound Emission of Civil Aircraft Types over Accessible Dutch Aviation Terrain.</th>
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<td>Sponsoring Organization Name &amp; Address:</td>
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<td>Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)</td>
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</table>

This study concentrates on civil aviation (commercial aviation, general aviation and helicopters). The data are used to improve the prognosis of noise pollution, the calculation of actual noise pollution and for the adoption of rules for use to restrict noise.

Use should be made of foreign data wherever possible.

Translated and transcribed from the original Dutch.
In this study we are dealing with obtaining the needed data and insights with regard to the zoning of small, civilian aviation terrain. By means of this information, it can be determined how desired zoning can be achieved by planological and environmental hygiene considerations.

---

**Project Title:** Study of the Possible Results and the Needed Data Concerning the Necessity of Zoning around Aviation Terrain, for which the Use of Aircraft with Turbine Jet Engines is Ruled Out (Smaller Airports)

**Performing Organization Name & Address:**
Royal Air Service
Amsterdam, Netherlands

**Sponsoring Organization Name & Address:**
Interdepartmental Commission for Reducing Noise over Air Traffic Routes

**Principal Investigator(s):**

**Start Date:** 1976 est.
**Completion Date:**

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**Type of Research Program:**

- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)

**Measurement Methodology**

---

**Funding:**

---

In this study we are dealing with obtaining the needed data and insights with regard to the zoning of small, civilian aviation terrain. By means of this information, it can be determined how desired zoning can be achieved by planological and environmental hygiene considerations.

Translated and transcribed from the original Dutch.
Study of the Possibilities of Zoning Aviation Terrain Which Does Not Lie on Dutch Territory, but Which Is Located on Territory Under Dutch Influence

Performing Organization Name & Address: Public Health and Environment Dept.
Amsterdam, Netherlands

Sponsoring Organization Name & Address: Interdepartmental Commission for Reducing Noise over Air Traffic Routes

Principal Investigator(s):

Start Date: 1976 Oct.
Completion Date: Estimated

Type of Research Program:

- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Funding:

1976 (actual):
1977 (budget):
1978 (forecast):

Or Total Funding Amount:

Comments:

The goal of the study is to come up with data in the form of noise-pollution curves concerning a certain military aviation territory lying in the boundary area between Germany and Belgium, where noise is experienced on the Dutch territory. Although an analogous zoning as for Dutch aircraft territory is not possible in the framework of the modified Flight Law, the future noise abatement laws offer small possibilities for this. In the carrying out, use can be made of data to be provided by West German and Belgian authorities.

Translated and transcribed from the original Dutch.
<table>
<thead>
<tr>
<th>Project Title:</th>
<th>(Joint Committee for Establishment of a Noise Disturbance Zone Around Arlanda Airport)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing Organization Name &amp; Address:</td>
<td>Regionplane- och säkerhetsområdens&lt;br&gt;Förvaltningskontor&lt;br&gt;Pack&lt;br&gt;103 40 STOCKHOLM 40 Sweden</td>
</tr>
<tr>
<td>Sponsoring Organization Name &amp; Address:</td>
<td>Aircraft Other&lt;br&gt;Sweden</td>
</tr>
<tr>
<td>Principal Investigator(s):</td>
<td>Board of Civil Aviation, Sweden</td>
</tr>
<tr>
<td>Start Date:</td>
<td>1974</td>
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<td>Completion Date:</td>
<td>Estimated 1977 Actual 1977</td>
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<td>Project Summary:</td>
<td>(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)</td>
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</table>

The joint committee can be regarded as a pilot project with the aim to develop a procedure for establishing noise disturbance zones around the Swedish airports. In the committee are represented regional and local planning authorities and the Board of Civil Aviation.

The committee has attempted to reach an agreement on the delineation of the noise disturbance zone that satisfies both the function of the airport and the development of the surrounding communities.

The basis for the discussion in the committee has been a series of alternative delineations of the zone derived from iterative manipulation of the underlying factors (runway alignment, routing, runway utilization, types of aircraft, day/night-traffic etc).
Project Title:
Assessment of the Effects of Multimodal Response on Fatigue Life

Performing Organization Name & Address:
British Aircraft Corporation Ltd.
Commercial Aircraft Division
Brooklands Road
Weybridge, Surrey, KT13 0SF
United Kingdom

Principal Investigator(s):
D. C. G. Eaton
G. A. Pailey

Start Date: Completion Date:
Estimated Actual

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

The suitability of using fatigue data as derived from single degree of freedom response tests for the prediction of fatigue life of corresponding multimodal response configurations has been questioned. A series of controlled tests on free beams is proposed in which modal characteristics and strain distributions will be determined for certain selected inputs. A comparison will be made of fatigue life against strain levels for the fundamental mode and two mode studies, wherein the random excitation will be centered upon the fundamental frequency and fundamental plus an harmonic frequency, respectively.

Sponsoring Organization Name & Address:

Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Funding:

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<td>1978 (forecast):</td>
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Or Total Funding Amount: 

COMMENTS:

Transcribed from the original.
### Aircraft Engine Noise

**Performing Organization Name & Address:**

ROLES-ROYCE LTD.,

DERBY,

ENGLAND

**Principal Investigator(s):**

Dr. G. E., PEARSON

**Sponsoring Organization Name & Address:**

H. M. GOVERNMENT MOD (PE)

**Type of Research Program:**

- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Project Summary:**

(Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Investigations of sound absorber wall linings in a flow duct facility, (situated at NATO Pyestock, Hants, England). These experimental investigations cover single layer and double layer liners, bulk absorbers and some proprietary panels basically in a rectangular duct. Effect of discontinuities in the lining type, and area changes in the duct are being investigated. More recent projects cover circular and annular lined ducts, and splitters.

**Start Date:**

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**Year**

- 1976 (actual):
- 1977 (budget):
- 1978 (forecast):

**Funding:**

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**Comments:**
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<th>Project Title:</th>
<th>Initial Studies of the Response and Acoustic Fatigue Behaviours of Titanium Development Structure</th>
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<tbody>
<tr>
<td>Performing Organization Name &amp; Address:</td>
<td>British Aircraft Corporation Ltd, Commercial Aircraft Division, Brooklands Road, Weybridge, Surrey KT13 OSP, United Kingdom</td>
</tr>
<tr>
<td>Principal Investigator(s):</td>
<td></td>
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<td>1978 (forecast):</td>
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In future aircraft and space vehicles, certain areas of the structure will be subjected to high noise loadings. Application of structures constructed of titanium have been suggested for use in such areas. It is proposed that first assessments of the fatigue resistance of titanium structures be carried out on specimens manufactured for a current R and D programme. It is envisaged that typical response and fatigue behaviour be observed from siren and coupon tests and the results correlated with a theoretical study.
**Project Title:** Investigation of Noise Protection Zones According to the Aviation Noise Protection Act of March 3, 1971.

<table>
<thead>
<tr>
<th>Performing Organization Name &amp; Address:</th>
<th>Max-Planck Institute for Jet Research Boettingerstr. 6-8 Goettingen West Germany</th>
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<tr>
<td>Principal Investigator(s):</td>
<td>Dr. Klaus Matschat</td>
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<td>Start Date:</td>
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**Type of Research Program:**
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Funding:**
- Year: 1976 (actual);
- 1977 (budget);
- 1978 (forecast);
- Dr Total Funding Amount:

**Plan:** Determination of the noise protection areas according to the Aviation Noise Protection Act of 3-30-71. Development of the method according to which the noise protection zone defined in par. 2 of the aircraft noise law is to be determined. (a) development of a questionnaire for prognosis of the foreseeable flight operations at an airport ("data determination system of the"); (b) development of the method according to which the curves of the constant equivalent noise levels are determined in the vicinity of the airport ("instructions for calculation of"); (c) carrying out the noise protection zone determinations for the airports of the Federal Republic of Germany.

Translated and transcribed from the original German.
Aircraft Other
Abbreviated Listings


United Kingdom. Two-Stream Mixing Noise; Similarity Considerations. Southampton University, Institute of Sound and Vibration Research, Southampton SO9 5NH, United Kingdom. C. L. Morley.


United Kingdom. Investigation of the Trade-Off Effect of Aircraft Noise and Number. University of Southampton, Institute of Sound and Vibration Research, Southampton SO9 5NH, United Kingdom.


SYSTEMS DEMONSTRATION, PROPULSION

DEMONSTRATION, AND SYSTEMS STUDIES

CTOL (Subsonic)

See Also Pages:

36
52
90
122
**Project Title:** Collection of Data Concerning Noise Hindrance Calculations and the Control in the Performance of Flight Procedures

**Performing Organization Name & Address:**
National Lucht- en Ruimtevaartlaboratorium
Antonius Fokkerweg 2
Amsterdam 1017
Netherlands

**Principal Investigator(s):**

**Start Date:** 1976

**Completion Date:**
Estimated 1980
Actual

**Project Summary:** (Briefly describe the goals, approach, expected or actual results, reports generated and the date(s) of publication.)

As in the preceding year, in 1976 the NLR shall make use of a L4/5 radar made available by the Royal Air Force in order to ascertain aircraft starting and landing at Schiphol.

As expected, the measurement of runaways in or after 1976 was carried out with something else than the now conventional L4/5 radar, seeing this is no longer available.

**Sponsoring Organization Name & Address:**

**Type of Research Program:**

- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

**Year**

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**COMMENTS:**

Translated and transcribed from the original Dutch.
Project Title: Setting Up Long Term Proposes Concerning Noise Production of CTOL Aircraft and Study of Low Noise Flight Procedures

Performing Organization Name & Address:
National Lucht- en Ruimtevaartlaboratorium
Anthony Fokkerweg 2
Amsterdam 1017
Netherlands

Principal Investigator(s):

Sponsoring Organization Name & Address:

Type of Research Program:

Funding:

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<td>1981 - n -</td>
<td>(110,000 F) $22,264</td>
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Comments:

The activities begun in 1975 in the framework of this study are to be continued in 1976. These activities can be described as follows:

- study of the influence of aircraft design parameters on the noise production of airplanes,
- indication of the most probable development of new aircraft types,
- following of technical developments which are directed at the modification of existing aircraft types (retrofits),
- the study of noise requirements; present day as well as recent concepts.

The named activities are to be carried out with the accompaniment of a Steering Group in which different Netherlands concerned organizations take part.

It is probable that this study will extend over a number of years, also in connection with the adaptation of results on the basis of new data and insights.

In connection with the study carried out in 1975 concerning the reduction of the noise level of aircraft heard on the ground by "low-power low drag" procedures, the noise aspects of other flight procedures were studied, such as "reduced flap setting" during approach.
**Project Title:** A Further Study of the Effects of Approach Procedures on Noise (Lockheed L-1011 and Boeing 747 Aircraft)

<table>
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<tr>
<th>Performing Organization Name &amp; Address:</th>
<th>Sponsoring Organization Name &amp; Address:</th>
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<tr>
<td>British Airways European Division</td>
<td>Procurement Executive, Ministry of Defence</td>
</tr>
<tr>
<td>London (Heathrow) Airport</td>
<td>John Adam Street, London W2 6BN</td>
</tr>
<tr>
<td>Honours, Hillesley, N.G. EJR</td>
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<tr>
<td>R H Chowns</td>
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<td>Principal Noise Engineer</td>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

In this second study of the effect of approach procedures on community noise, the original examination of the Trident 3 has been extended to include the L-1011 and the Boeing 747 aircraft.

Recommendations are made for further work in regard to performance margins and to the method of assessment used and for a study of the implications, in terms of flight control system response and aircraft handling, of steeper than 3° approach paths.

**Funding:**

<table>
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**Or Total Funding Amount:** (£11500) £19,775

**COMMENTS:**

I.P./8/650
Technical Note Nr P/690

June 1976
### Project Title:
Study of the Adoption Possibilities of Flight Procedures Favorable from a Noise Prevention Viewpoint for Certain Aviation Terrain

### Performing Organization Name & Address:
Royal Aviation Service
Amsterdam, Netherlands

### Sponsoring Organization Name & Address:
Interdepartmental Commission for Reducing Noise over Air Traffic Routes

<table>
<thead>
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<th>Principal Investigator(s):</th>
<th>Type of Research Program:</th>
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- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

<table>
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### Project Summary:
(Briefly describe the goals, approach, expected or actual results, reports generated and the date(s) of publication.)

In the study, we are dealing with obtaining more insight into the possibilities of 2-segment approach, noise-abatement start procedures, noise-routing and the like. Attention must be paid to the practical possibilities from the standpoint of flight safety, air traffic control, operational-economic results and the working out of local noise pollution problems. The study also serves to gain insight into the instrumentation problems belonging thereto, including costs.

Translated and transcribed from the original Dutch.

136
### Project Title:
Study into the Possibilities and Results of Combating Certain Types of Noise from the Dutch Air Fleet

<table>
<thead>
<tr>
<th>Performing Organization Name &amp; Address:</th>
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<tbody>
<tr>
<td>Royal Aircraft Service</td>
<td>Interdepartmental Commission for Reducing Noise over Air Traffic Routes</td>
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This study aims at coming up with operationally usable data concerning the possible application of noise abatement modifications on the DC-8 and DC-9 aircraft in connection with measures to be taken abroad.

In particular, insight is to be gained into the technical aspects, the influence of exploitation, cost and financing possibilities of the re-fitting, time it takes to carry this out and the results of the noise pollution of Schiphol.

Transcribed and translated from the original Dutch.

137
Project Title: Operational Noise Abatement

Performing Organization Name & Address: Dept. of Trade London, United Kingdom

Sponsoring Organization Name & Address:

Principal Investigator(s):

Type of Research Program:
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

Start Date: Completion Date:
1977 Estimated Actual

Funding: Year Amount
1976 (actual): 
1977 (budget): 
1978 (forecast): 

Or Total Funding Amount: 

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Noise abatement procedures (such as managed drag, two-segment approach, etc.) Night operations: night jet restrictions, runway alternations, night disturbance levels, etc.

Comments:

Transcribed from the original.
The aim is to demonstrate in a comprehensive manner the possibility of noise abatement by steeper takeoff and landing flight paths. For this purpose, the noise level is examined for the various technically feasible flight paths within the spectrum of future airplane propulsion categories. Individual flight patterns are thoroughly tested for feasibility in a flight simulator with visual simulation to ascertain the limits of possibility, taking into account the stresses exerted on the pilot.
SYSTEMS DEMONSTRATION, PROPULSION DEMONSTRATION, AND SYSTEMS STUDIES

corl (Supersonic)

See Also Page:

118
Theoretical study of the pressure distribution (boom distribution) caused by a supersonic plane and investigation of the possibility for a boom-adjusted design for supersonic airplanes.

Translated and transcribed from the original German.
SYSTEMS DEMONSTRATION, PROPULSION DEMONSTRATION, AND SYSTEMS STUDIES

ROTORCRAFT/VTOL

See Also Pages:

47
48
49
50
122
153
<table>
<thead>
<tr>
<th>Project Title: Flight Mechanical Studies Concerning the Problem of Stoop Flight Paths for VTOL Airplanes with Best Noise Characteristics</th>
</tr>
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<tbody>
<tr>
<td>Performing Organization Name &amp; Address: Institute for Flight Technology of Darmstadt Technical Institute Darmstadt, Petersenstr. 18 West Germany</td>
</tr>
<tr>
<td>Sponsoring Organization Name &amp; Address: German Research Society</td>
</tr>
<tr>
<td>Principal Investigator(s): Dipl. -Ing Volker Nitsche</td>
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<td>Start Date: Completion Date: May 1, 1970 Estimated Actual</td>
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</table>

Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

In this project, optimum takeoff and landing flight paths are computed for typical VTOL planes by varying the maximum takeoff thrust. The required flight time and fuel consumption are determined. The effect of the various takeoff and landing flight paths and of the thrust as well as of atmospheric conditions on the shape and size of the noise screening area around a VTOL landing field with a given yearly traffic volume. The boundary of the area is determined within which the flight noise exceeds the limits set by the German laws for the protection against flight noise. In contrast, calculation is made for an expanded definition of the noise protection area by using larger values for the noise coefficient.

Translated and transcribed from the original German.
<table>
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<td>Helicopter Noise Studies</td>
<td>Department of Trade</td>
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<tr>
<td></td>
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Or Total Funding Amount: ..........................................

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**Project Title:** Flight Path of VTOL Airplanes for Optimum Noise Pattern

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<td>Institute for Aviation Mechanics of the DFVLR</td>
<td>Federal Minister for Research and Technology</td>
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<tr>
<td>Braunschweig, Flughafen, West Germany</td>
<td>Federal Defense Minister</td>
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<tr>
<td>Dr. -Ing. Wilhelm</td>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

Noise abatement for short and vertical takeoff planes. Research on steep landing approach in the interest of noise abatement for traditional airplanes; effect of parameters; new piloting techniques, such as upthrust piloting. Flight tests with variable-configuration plane hfb-320 s-1; simulated flights; problems of flight characteristics.

**Type of Research Program:**
- Fundamental
- Development (Component or System)
- Demonstration (Experimental, Prototype, or Production)
- Measurement Methodology

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**Total Funding Amount:**

**COMMENTS:**

Translated and transcribed from the original German.
SYSTEMS DEMONSTRATION, PROPULSION
DEMONSTRATION, AND SYSTEMS STUDIES
GENERAL AVIATION
See Also Pages:
49
52
92
97
118
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123
General Aviation  
Netherlands

<table>
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<tr>
<th>Project Title:</th>
<th>Supplementary Study into Requirements, Viewpoints on Noise Prevention and Noise Production, the Equipping and Use of Civil Aircraft at Present Not Falling under International Noise Certification</th>
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| Performing Organization Name & Address: | Royal Aircraft Service  
Amsterdam, Netherlands |
| Sponsoring Organization Name & Address: | Interdepartmental Commission for Reducing Noise over Air Traffic Routes |
| Principal Investigator(s): | |
| Type of Research Program: | |
| Start Date:  
1976 est. | Completion Date:  
Estimated  
Actual |
| Project Summary: (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.) | |

In this special general aviation study, which also concerns helicopters, we are dealing with an inventory of the state of aviation technology to be expected in the near future and today in the area of noise combating, the regulations to be set up in the near future, the possibilities of achieving a lower noise production by means of noise-damping equipement and the consequences of this for Dutch general aviation.

It also deserves to be studied in this connection how noise pollution from this form of flight can be reduced by setting special rules of use, especially with regard to advertising flights and sport flights.

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Transcribed and translated from the original Dutch.
**General Aviation**
Netherlands

**Project Title:** Study of the Adoption Possibilities of Noise Limiting Regulations for Civilian Aircraft and the Influence of Noise Pollution

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<td>Fundamental</td>
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<td>Demonstration (Experimental, Prototype, or Production)</td>
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<td>Measurement Methodology</td>
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**Project Summary:** (Briefly describe the goals, approach, expected or actual results, report(s) generated and the date(s) of publication.)

This investigation includes a closer study of the adaption of regulations including time restrictions for certain noisy types of aircraft, rules for flight instruction and practical flights, sport aviation and the like. Attention must be paid to the practical possibilities from the viewpoint of flight safety, air traffic control, the operational-economic consequences and working out local noise pollution problems.

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