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TRANSPORT JET AIRCRAFT NOISE ABATEMENT
IN FOREIGN COUNTRIES:
GROWTH, STRUCTURE, IMPACT

Final Report
VOLUME I: EUROPE
July, 1980

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Subsequent to the July printing of this volume, I attended the First Netherlands Colloquium on International Air Transport at The Hague, August 25-29, 1980. Interviews with Mr. Hans Raben, Director-General, Netherlands Civil Aviation Authority, and with Professor Dr. Werner Guildimann, Director Federal Air Office, Switzerland, indicated that definitive action has finally been taken in those two countries to implement the specific noise-related landing charges which were referred to in Volume I as being under consideration. Briefly, the actions are the following:

Switzerland: On November 1, 1980, a Noise Surcharge is being added to the existing landing charge at the Zurich and Geneva-Cointrin Airports. In Volume I, p. 114, it was noted that the Swiss were considering two plans. One contained four noise brackets with surcharges ranging from Sfr 400 where the noise values exceeded 100 dB(A), to a zero surcharge where the value was less than 90 dB(A). The second plan involved a more complicated system also under consideration by the French and Dutch.* It contained five categories of payments and would provide higher penalties for noisy aircraft.

The Swiss Noise Surcharge of November 1980 added one more classification to the four in the first plan and reduced the maximum additional charge to Sfr 300 in accordance with Table i.

**TABLE i**

<table>
<thead>
<tr>
<th>CLASS</th>
<th>SURCHARGE</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Sfr. 300</td>
</tr>
<tr>
<td>II</td>
<td>Sfr. 200</td>
</tr>
<tr>
<td>III</td>
<td>Sfr. 150</td>
</tr>
<tr>
<td>IV</td>
<td>Sfr. 100</td>
</tr>
<tr>
<td>V</td>
<td>Sfr. 0</td>
</tr>
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To determine the class for each type of aircraft, the energetic mean value of the noise level, measured at the monitoring points in residential areas surrounding the airports, is used.** The classes and representative aircraft in them are listed in Table ii.

* Volume I, pp. 83 and 183.

** Switzerland Aeronautical Information Circular 5/80 24 July.
Establishing a standard so that only the DC-8 Series 20, 30, and 40 fall in Class I, with some 707s and DC-8s as low as class three, indicates that the philosophy of the Swiss was to construct a plan whose purpose was to raise funds for noise abatement rather than to impose heavy penalties on noisy aircraft to cause their retirement from service.

The Netherlands: Under the recently amended Aviation Act,*** the government, on application by noise-affected airports, may "designate" airports which are then entitled to receive substantial payments for insulation of homes or other property and for the purchase and demolition of homes. As noted both in Volume I and Volume II, all over the world many individuals have deep roots in their homes and strongly resist attempts to be moved. After much debate, the law, as finally enacted, permitted people to remain in their homes if they did not wish to sell.

*** For a more detailed discussion of the 1978 amendment see Evers, W.R., "Noise Zoning Around Airports in The Netherlands," Air Law, Volume III, No. 2, 1978, pp. 74-90. There is one caveat: The article was written after the Bill was unanimously accepted by Second Chamber of the States General (parliament is divided into two Chambers) but before it was finally enacted. His statement is now incorrect that there was no agreement on purchase price for existing housing is reached compulsory purchase may be invoked. Section 26 specifically states that the termination or use of habitation cannot be demanded of the user or occupant. Therefore, he is not required to sell.
The state is required to pay for these noise countermeasures, but noise charges must be established so that the polluter must pay the state in accordance to the noise made. According to the Director-General of the Civil Aviation Authority, it may take as long as eight years for full implementation of the statute. At present the contours in Kosten Units are being drawn and the amounts of money needed for noise insulation, for moving expenses and for demolition of homes, have been calculated. Using an estimate of 10 to 20 million Dutch Guilders as the amount which could be reasonably spent in the first year, the government then calculated the noise surcharge necessary to cover this expense. Table iii lists the amounts of these initial charges. As soon as the administrative details are worked out for beginning the insulation work (sometime in 1981), charges will be levied.

Table iii compares the new Swiss noise surcharges with those of The Netherlands.

**TABLE iii**

**NEW NOISE-RELATED LANDING CHARGES IN SWITZERLAND AND THE NETHERLANDS**

<table>
<thead>
<tr>
<th>TYPE OF AIRCRAFT</th>
<th>SWITZERLAND (eff. 11/1/80)</th>
<th>THE NETHERLANDS (eff. sometime 1981)</th>
</tr>
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<tbody>
<tr>
<td>747 GE eng.</td>
<td>0</td>
<td>170</td>
</tr>
<tr>
<td>747 P&amp;W</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>DC-10</td>
<td>0</td>
<td>170</td>
</tr>
<tr>
<td>727</td>
<td>91</td>
<td>130</td>
</tr>
<tr>
<td>707</td>
<td>91</td>
<td>580</td>
</tr>
<tr>
<td>DC-8-63</td>
<td>180</td>
<td>610</td>
</tr>
<tr>
<td>DC-9-30</td>
<td>91</td>
<td>180</td>
</tr>
<tr>
<td>A-310</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>A-300-B4</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>757</td>
<td>0</td>
<td>45</td>
</tr>
</tbody>
</table>

Note: These charges are over and above the regular landing fees.

Table date: 9/12/80
A glance at the table shows much higher noise charges for The Netherlands than for Switzerland. For example, the DC-8-63 and the Boeing 707 are charged about $600 per landing more than presently in Holland. The same planes pay $91 and $180 respectively in Switzerland. Further, the widebodies pay from $45 to $180 in Holland, while in Switzerland the charge is zero. Although the Dutch profess to be interested in using the charge only as a revenue measure, the figures reveal a strong element of new aircraft incentive rolled into the formula.

Before concluding this addendum, it is pertinent to note that discussions at the Colloquium confirmed the point made in Volume I and Volume II that the ministries of transport all over the world are continually fending off efforts by various other ministries (Environment, Health, Public Works, etc.) to take over duties historically performed by the former. Thus far, the transport ministries have been reasonably successful in retaining most of their authority. However, in view of the increasing interest in improving the quality of life and in view of the growing power of departments of environment, transport departments are concerned that the day will come when their control over noise regulation will be substantially diminished.

Frank A. Spencer
October 1, 1980
TRANSPORT JET AIRCRAFT NOISE ABATEMENT
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VOL. I - EUROPE

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Final Report - July 1980

This report is provided in the interest of information exchange. Responsibility for its content resides with the author and the organization preparing it.

The Transportation Center
Northwestern University
Evanston, Illinois, 60201
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In the study "Factors Affecting the retirement of Commercial Transport Jet Aircraft" (NASA CR-152308) published in August 1979 by the Transportation Center of Northwestern University, it was found that in the United States growing complaints from citizens concerning aircraft noise had generated proposals for noise abatement laws and regulations which would, when implemented, jeopardize the continued utilization of certain jet aircraft and force their retirement from U.S. fleets. While the airlines and the aircraft manufacturers vigorously contested these proposed measures as being too restrictive, the environmentalists, aided by court decisions, were having some success with their claims that existing regulations were inadequate to protect the public.

Several questions arose. One, how did the noise situation in the United States compare with that in foreign countries. Two, could the U.S. carriers and manufacturers count on foreign air carriers to buy aircraft retired for noise reasons from them at a satisfactory price. On the first question, presentations made by IATA and ICAO representatives at noise hearings suggested that the foreign countries were having similar if not more serious noise problems. The evidence on the second question, while not entirely clear, pointed toward a drying up of the foreign market for used aircraft as quality of life and fuel considerations are accorded higher priorities in equipment decisions.

In the past, U.S. manufacturers have been major suppliers of transport jet aircraft outside of the U.S. However, if because of the growing political power of environmentalists aircraft noise in foreign countries was under even greater attack than in the U.S., and if foreign aircraft manufacturers with help from their governments were responding to the situation by increasing their efforts to produce quieter more efficient aircraft, the U.S. air transport manufacturing industry could very well lose its dominant position. The purchase of a foreign aircraft (Airbus A-300) with American engines (G.E.) by Eastern Airlines, and the purchase of a U.S. airplane (Lockheed L-1011) with foreign engines (Rolls Royce) by Pan American, became a matter of concern in Congress and to the U.S. aircraft manufacturing industry.

Accordingly, because both the U.S. airlines and the U.S. manufacturers must compete in the international marketplace with aircraft which must comply with the rules of each country served, and because the airlines and manufacturers in foreign countries were said to be supported by their governments in efforts to increase their share of the transport aircraft market, NASA commissioned a study to be made of the history, structure and impact of enacted or proposed noise regulations in the major noise sensitive countries of Europe, i.e. the United Kingdom, France, Switzerland, Germany,
Sweden, Denmark and the Netherlands.

A preliminary review of the European results led NASA to expand the study to another geographical area. NASA authorized an addition to the study to include selected countries in the Pacific basin where noise problems had adversely impacted international airline operations or threatened to do so. Hawaii, New Zealand, Australia, Hong Kong, Singapore and Japan were to be included in a later study.


Evanston, Illinois
July 31, 1980
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One doesn't travel overseas for the U.S. Government without the necessary international coordination. Two people at NASA Headquarters, Ms. Lynne Hanold and Harold Broadhurst, provided excellent liaison with the State Department. Mr. Edward Olsen of the Office of Environmental Affairs of the U.S. State Department and the heads of the various international "Desks" arranged for accommodations, appointments, interviews, and translators. I am also indebted to the aviation liaison officers in each U.S. Embassy and Consulate of the countries I visited.

Further, my two typists, Barbara Paley and Marjorie Krohn, are deserving of special thanks for producing a quality text from drafts of dubious quality.

Frank A. Spencer
Evanston, Illinois
June 1980
TABLE OF CONTENTS

FOREWORD ................................................................................ iii

ACKNOWLEDGEMENTS .............................................................. v

EXECUTIVE SUMMARY ............................................................. xiii

PART I - OVERVIEW OF THE PROBLEM

CHAPTER 1. INTRODUCTION
1. U.S. Background ................................................................. 1
2. Impact of Noise and Noise Regulations ............. 4
3. Methodology ................................................................. 5

CHAPTER 2. INTERNATIONAL ORGANIZATIONS DEALING WITH AIRCRAFT NOISE
1. International Civil Aviation Organization (ICAO) ........................................... 7
2. European Civil Aviation Conference (ECAC) ... 8
3. Organization for Economic Cooperation and Development (OECD) ......................... 9
4. European Economic Community (EEC) ............ 10
5. Airport Associations Coordinating Council (AACC) ...................................... 11
6. International Air Transport Association (IATA) ....................•................. 12
7. Other Agencies and Organizations Involved with Aircraft Noise ....................... 14

CHAPTER 3. MEASURING NOISE NUISANCE
1. United States Noise Descriptors ............. 16
2. European Noise Descriptors ............. 17

PART II - EUROPE: AIRCRAFT NOISE REGULATIONS

CHAPTER 4. NOISE AT THE SOURCE REGULATIONS FOR AIRCRAFT
1. Annex 16 Chronology ................................................................. 26
2. Annex 16 Provisions ................................................................. 27
3. Annex 16 and FAR 36 Compared ................................. 34
4. Summary ................................................................. 39

CHAPTER 5. UNITED KINGDOM
1. U.K. Government Noise Structure ............. 42
2. Legal Basis of Noise Control ............. 45
   2.1 Noise at the Source ................................................................. 47
   2.2 Land Compensation Act 1973 ............. 48
   2.3 Noise Insulation Compensation Payments .... 48
   2.4 Land-Use Planning ................................................................. 51
3. Noise at the Source ................................................................. 51
## CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>U.K. Operational Measures for Noise Control</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>4.1 Limitation of Night Jet Movements</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>4.2 Limiting Airport Capacity</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>4.3 Jet Training Limitations</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>4.4 Limitations on Noise at Takeoff</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>4.5 Limitations on Noise on Landing</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>4.6 Minimum Noise Routes</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>4.7 Runway Management</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>4.8 Ground Running Noise</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>4.9 Noise Related Landing Charges</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>4.10 Sanctions</td>
<td>64</td>
</tr>
<tr>
<td>5</td>
<td>Implications of Noise Regulations and Policies</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>Summary</td>
<td>67</td>
</tr>
<tr>
<td>7</td>
<td>Conclusion</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td><strong>CHAPTER 6. FRANCE</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Brief History of Noise Problem in France</td>
<td>73</td>
</tr>
<tr>
<td>2</td>
<td>French Government Noise Structure</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>Legal Basis of Noise Control</td>
<td>76</td>
</tr>
<tr>
<td>4</td>
<td>Noise at the Source</td>
<td>77</td>
</tr>
<tr>
<td>5</td>
<td>Curfews</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>Noise Compensation: Insulation - Noise Related Landing Charges</td>
<td>80</td>
</tr>
<tr>
<td>7</td>
<td>Land-Use Planning and Building Codes</td>
<td>83</td>
</tr>
<tr>
<td>8</td>
<td>Operational Procedures - Noise Monitoring</td>
<td>85</td>
</tr>
<tr>
<td>9</td>
<td>Summary</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td><strong>CHAPTER 7. SWITZERLAND</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Government Structure and Legal Basis of Noise Regulations</td>
<td>89</td>
</tr>
<tr>
<td>2</td>
<td>The German-Swiss International Dispute</td>
<td>92</td>
</tr>
<tr>
<td>3</td>
<td>Noise at the Source</td>
<td>93</td>
</tr>
<tr>
<td>4</td>
<td>Noise Curfews</td>
<td>96</td>
</tr>
<tr>
<td>5</td>
<td>Operational Restrictions</td>
<td>97</td>
</tr>
<tr>
<td>6</td>
<td>Noise Monitoring</td>
<td>98</td>
</tr>
<tr>
<td>7</td>
<td>Noise Zones - Land-Use Planning</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>Noise-Related Landing Charges</td>
<td>114</td>
</tr>
<tr>
<td>9</td>
<td>Summary</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td><strong>CHAPTER 8. FEDERAL REPUBLIC OF GERMANY</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Government Noise Structure</td>
<td>117</td>
</tr>
<tr>
<td>2</td>
<td>Legal Basis of Noise Control</td>
<td>118</td>
</tr>
<tr>
<td>3</td>
<td>Noise at the Source</td>
<td>119</td>
</tr>
<tr>
<td>4</td>
<td>Curfews</td>
<td>121</td>
</tr>
<tr>
<td>5</td>
<td>Operational Restrictions</td>
<td>122</td>
</tr>
</tbody>
</table>
CONTENTS (Continued)

page

7. Land-Use Planning ........................................ 185
8. Summary Comment ................................. 189

APPENDICES

A. SUMMARY OF PEOPLE INTERVIEWED ON EUROPEAN NOISE REGULATION ........................................... 194
B. LONDON/HEATHROW U.K. "AIR PILOT" AND "G.A.F.G." ..... 197
C. ZURICH AIRPORT LOCAL FLIGHT RESTRICTIONS, AIP ...... 200
D. ZURICH AIRPORT NOISE ABATEMENT RULES, AIP ............ 202
E. ZURICH NOISE ABATEMENT DEPARTURE PROCEDURES ........ 207
LIST OF TABLES

Table                                      page
1. Recommended Criteria For Control of Development in Areas Affected By Aircraft Noise 52
2. Night Jet Quotas At Heathrow And Gatwick 58
3. Area Within 95 And 105 PNdB Contours For Selected Aircraft 60
4. Mean Sound Levels (Public Data) - Zurich Airport Runway 28 Departures 101
5. Mean Sound Levels - Period Of Report February 1975 To December 1977 103
6. Lärm Noise Bulletin - Results Of April 1978 No. 144 105
7. German Laws & Regulations Dealing With Aircraft Noise 120
9. Regulations On Run-up Of Engines At The Copenhagen Airport, Kastrup 161
10. Copenhagen, Denmark-Kastrup Noise Abatement Procedures 164
11. Noise Abatement Procedure, Amsterdam, Netherlands - Schiphol 181
12. Noise Monitoring Report - Schiphol 182

LIST OF CHARTS

Chart
1. Aircraft Noise Contours (110 PNdB) 20
2. Aircraft Noise Measurements Compared With Non-Aircraft Noise 21
3. Amsterdam Noise Map - Kosten Index 23
4. NNI Noise Index Map - Zurich 1985 24
5. Proposed Takeoff Noise Levels 31
6. Proposed Noise Levels - Lateral 32
7. Proposed Noise Levels - Approach 33
8. Noise Levels - Takeoff (at 6,500 m. from the start of roll) 35
9. Noise Levels - Lateral (at 450 m. from runway axis) 36
10. Noise Levels - Approach (at 2,000 m. from the threshold) 37
11. Zurich - Airport Noise Monitoring Chart 99
12. Published Average Noise Level 111
13. Kobenhavn Aerodrome - Kastrup, Denmark 158
14. Noise Abatement Procedures - Amsterdam, Netherlands 178
The development and implementation of aircraft noise control varies with the form of government in various European states. Likewise the legal basis for noise damage lawsuits varies, at least technically, from country to country. As an example, Great Britain has a statute stating that aircraft noise in the air cannot be a cause of legal action. In Europe, enforcement of noise control is in a grey area in which some jurisdictions feel their only avenue is "friendly persuasion" while in other jurisdictions criminal penalties are said to be possible.

Because of the international character of air transportation, European states initially leave the matter of aircraft noise emissions to agreement through the International Civil Aviation Organization (ICAO). In theory the results are to be adopted in each country legislatively or by administrative order. The specific rules are spelled out in Annex 16 of the Civil Aviation Convention which is not as restrictive as the correlative U.S. Federal Air Regulation FAR 36 and 91-136. In Europe coordination is facilitated by the European Civil Aviation Conference (ECAC). Additionally, aircraft noise control holds a special attraction for a number of other international groups such as the Organization for Economic Cooperation and Development (OECD) and the European Economic Community (EEC).* Similarly, within each country, a growing number of agencies and departments and subdivisions of departments claim their right either to make inputs into the noise control arena or actually to participate in the formulation of the rules. Much to the annoyance of old line regulatory bodies, various environmental departments which have their origin in recent environmental protection acts are crowding in on the "turf" which old line bodies believe to be theirs.

Airport noise control rules by special operating procedures for takeoff and landing, and also for departure and arrival routes, have been published. To check compliance with these procedures extensive systems of noise monitoring have been developed particularly in Switzerland and Germany and are expanding to other countries. Technical problems stemming from the meteorological effects of cloud cover, humidity, wind, and sound reflection at different angles of bank point to some of the problems in utilizing noise monitoring results. Some personnel whose function is to implement the various noise monitoring programs suggest that better results are obtained by supplementing noise monitoring with radar monitoring and transponders.

The failure of noise abatement operating procedures and the Annex 16 rules, as they apply to current jet fleets, to control

* In Dec. 1979 the Commission of the EEC adopted a Directive which has the force of law in the nine Member States dealing with phasing out of existing non Annex 16 aircraft.
aircraft noise to acceptable limits at night has resulted in the growth of curfews ranging from complete closure of the airport to limiting operations to aircraft whose noise emissions are below a specific level. In spite of the efforts made so far, problems have arisen where the airport of one country is situated so close to the borders of another that arrival or departure entails overflying the terrain of the latter state. Failure of ICAO to take action on noise abatement for the early production noisy jets has led to a program under ECAC in which each member state is to set a date for the elimination of these planes from service in international air transportation. However, ECAC actions in themselves have no force of law.

An airline whose planes are perceived by airport neighbors to be noisy may find itself, irrespective of whether or not its planes meet Annex 16, in such difficulty with an airport authority that its equipment purchasing plans may be affected. In more than one case noise was the overriding consideration in the purchase of new aircraft, even though the size and operating costs favored the noisier plane. Airports with a high concentration of noise-sensitive people living nearby are threatened with restrictions which can harm the economy of their city or region.

Although the airport neighbors seem to be pleased with the noise improvements associated with the wide bodys and their high bypass engines, they are demonstrably disappointed with the lack of improvement in low bypass ratio planes which are heavy users of their airports. As a result most airport authorities presently do not see a relaxation of curfews as more quiet airplanes are introduced but only a possible arresting of the trend toward more severe curfews.

European countries have recognized, albeit somewhat belatedly, that appropriate land-use planning in which homes, schools, and various public buildings are banned from construction in some noise impacted areas, and permitted only with insulation in other areas, is another method for reducing noise complaints and avoiding future land or building purchases, demolition or relocation plans. Although each country has or is about to have such land-use planning laws, the conflicting interests inherent in this type of control between profit maximization for property owners and heightened quality of life aspirations of the public, plus the lengthy procedure and expense in developing acceptable standards and projecting noise contours some years into the future, have delayed effective implementation of land-use planning.

It is concluded that noise annoyance is highly subjective and emotional. No satisfactory quantitative measure has been found. The growing interest in the quality of life effects of various air transport programs resulting in the growth of governmental
environmental protection departments and their increasing power suggests that citizens will not be content with existing aircraft, wide bodies excepted, that just technically meet Annex 16. Accordingly, aircraft purchasers who purchase newly certificated aircraft which meet the lower noise levels of Chapter 3 of Annex 16 will have a marked advantage over those who purchase narrow bodied low bypass aircraft which barely meet the less restrictive standards now applicable to them.

Finally, airport neighbor disappointment with progress in lowering noise emissions and changing the quality of the noise in most narrow body aircraft which are still in production suggests the need for accelerated research leading to lower noise emissions and improved noise quality on small to medium size aircraft. The reluctance of aircraft manufacturers to put their own resources into such development results from: (1) the diseconomies of building smaller aircraft as compared with larger, (2) a long history of growth of passenger traffic which has led to carriers "growing into" ever larger aircraft, and (3) the practice internationally of controlling capacity rather strictly by limiting frequency of schedules much more than by size of aircraft.
PART I

OVERVIEW OF THE PROBLEM
INTERNATIONAL AIRCRAFT NOISE ABATEMENT: EUROPE

Chapter 1.

INTRODUCTION

1. U.S. Background

Commercial jet transportation was introduced to the world by the European de Havilland Comet in 1952. Its initial success was marred by two fatal crashes leading to its removal from service. The jet era, as we know it, was initiated in 1958 with the Boeing 707 and Douglas DC-8 powered by "pure" or "straight pipe" jet engines. Those living or working near airports immediately objected to the noise generated by these new aircraft. Although the "pure" jet type was followed on the production line within a year or two by quieter fan-jets, the noise problem was exacerbated by the sheer increase in number of jet aircraft and by the spread of their use to additional airports.

In the United States, as early as 1959, FAA Administrator Elwood Quesada, awakened nightly by irate citizens telephoning to protest the disturbing effect of jet noise, was forced to obtain an unlisted phone number. \[1\] Almost immediately the FAA began issuing regulations dealing with jet operating procedures while research was intensified to modify existing engines and nacelles, and to design new quieter power plants.

As a result of public pressure, in 1969 the FAA began to issue rules limiting noise emissions by aircraft. The first such regulation,

\[1\] Stuart Rochester, Take Off at Mid-Century, Washington, D.C. Dept. of Transportation, 1976, p. 246.
known as Federal Air Regulation (FAR) 36, dealt only with new type
craft to be certificated in the future. Subsequently it has had
nine tightening amendments. Additionally Rule 91-136 was added."For
our purposes the most important regulations following the original
FAR 36 were:

1. FAR 36 Amendment No. 2 provided that all 2- and 3-
engine jet transports produced after 1 Dec 1973 (13
Dec 1974 for all 4-engined aircraft) must meet FAR 36.

2. FAR 36 Amendment 7, effective 1 Nov 1977, established
more stringent noise standards for subsonic aircraft
certificated after 5 Nov 1975.

3. FAR 36 Amendment 8, effective 3 April 1978, superseded
FAR 36-7 and established noise standards for derivative
aircraft with change applications submitted after

4. FAR 91-136, effective 24 Jan 1977, was a Fleet Compli-
ance Rule which provided that the noisy jet transport
aircraft which had not been covered by the previous
rules must comply with FAR 36 or be phased out of oper-
ation within the U.S. according to a proportioned time-
table, with aircraft all complying or being removed from
service by 1 Jan 1985.

Dissatisfied with the slow speed with which the regulatory pro-
cess was bringing relief by controlling noise at the source - i.e.
the aircraft, the affected citizen groups pressed other alternatives.
As a result, new operating procedures for landing and takeoff, plus
special departure and arrival routes designed to minimize noise, were
developed. Additionally, there has been growing pressure for the
imposition of curfews, restrictions on runups, the banning of the
use of reversing, controlling the use of auxiliary power units (APU)
and other constraints.
In the United States there have been successful suits for damages due to aircraft noise. The courts have held the airport operator, not the owner or operator of the aircraft, to be liable for such noise damages. Costs amounting to many millions of dollars have had to be paid by airport operators. However, because most airports are owned either directly by government or by an airport authority, the burden of damage awards may fall ultimately on citizens (if the airport is subsidized) or on the users who must pay higher landing fees to cover the higher airport costs. Airport owners and business and aviation interests fear that such increases in fees could drive business to other airports, thus adversely affecting not only the economy around the airport but that of the whole city or region. As a consequence, various levels of government are paying increasing attention to developing land-use planning in which the construction of homes or schools is prohibited in certain noise impacted areas and permitted with insulation requirements in others. Insulation may also be required in the construction of industrial plants. Land-use planning of this type has not progressed as far in the United States as abroad.

Methods of reducing noise emissions at the source include:

1. retrofitting the aircraft with sound absorbent material (SAM);
2. replacing engines, often called "re-engining"; or
3. replacing noisy planes with quiet ones. Unlike Europe, as will be shown, a time consuming debate ensued over the desirability of "retrofit" and who should pay for it. A bill providing financial assistance to
airlines to be paid for by the users of the service by allocating a part of their total air fare to retrofit, re-engining or replacement passed the House committee but failed to emerge from the Senate in the closing days of the 95th Congress in 1978. Attached to the bill was an extensive land-use planning section. Increasing airline profitability, coupled with substantial orders for new aircraft, particularly by airlines which only two years previously were listed as so financially weak as to be the prime example of need for assistance, made the introduced financing legislation in 1979 impractical. The air carriers then turned their attention to modify or eliminate legislatively the requirements placed upon them administratively by the phase-compliance rule 91-136. The foregoing represents a brief summary of the aircraft noise abatement picture in the United States which may be used as background for comparison with the treatment of the same subject in Europe.

2. Impact of Noise and Noise Regulations

Noise regulations may have impacts varying from significantly positive to heavily negative on a city's or region's economy, on an airline's equipment purchasing policies, and on the aircraft manufacturing industry. Legislation or regulations which encourage the development and purchase of advanced technology quieter aircraft can, if strong enough, have a positive effect on promoting forbearance on the part of the public from adding further constraints to current operations. On the other hand, unrealistically stiff constraints
such as total airport closure, operational procedures which place a severe economic penalty on the aircraft, or the requirement to spend large sums now for aircraft modifications at the expense of delaying purchases of new quieter, more fuel-efficient aircraft, are ill advised from a public policy viewpoint.

Should a carrier find its operations into airports constrained or even stopped because of noise regulations, its equipment purchasing policies will certainly be affected. Knowing the trend of noise rules is important to the aircraft and engine manufacturer not only for intelligent allocation of resources but even to stay in business. U.S. noise rules are only a part of the story. The U.S. market is now less than one-half of the world market. Currently the U.S. jet fleet is comprised of about 2300 aircraft while the world jet fleet is close to 5,000. Furthermore, in recent years foreign purchases have increased faster than those in the U.S. Therefore, an examination of noise regulations and their prospective course in those parts of the world which have noise problems is an appropriate area for study. The first section of this study involves the more noise-sensitive countries in the European sector, specifically: the United Kingdom (UK), France, Switzerland, Germany, Sweden, Denmark, and the Netherlands. The second section treats such Pacific area countries as New Zealand, Australia, Hong Kong and Japan.

3. Methodology

The methodology was: first, to lay a base for more detailed
foreign country-by-country research. Interviews were conducted with United States aircraft manufacturers, the international representatives on noise at the International Air Transport Association (IATA) and the International Civil Aviation Organization (ICAO). This was followed by an investigatory trip to countries just enumerated. In each country an effort was made to interview the following categories or organizations, agencies or companies:

- Governmental authorities such as departments of Transport, Trade, Industry, Environment, airport authorities, noise commissions, noise monitoring departments, civil aeronautics authorities and the like.

- Airline managements with emphasis on those persons involved with future planning of aircraft acquisitions, the administration of current noise complaints, and engineering requirements.

- Foreign aircraft manufacturers.

- International organizations dealing with the coordination of noise abatement policies of the several sovereign states.

A compilation of the major interviews is found in Appendix A.
INTERNATIONAL ORGANIZATIONS DEALING WITH AIRCRAFT NOISE

Conventional wisdom has it that the addition of more committees and more people to committees usually adds to the difficulties of securing meaningful prompt action on a problem. This is clearly demonstrated in the noise area. From the number of organizations and the number of subcommittees being established in Europe to deal with aircraft noise annoyance, it would appear that the subject has spawned a number of groups often duplicating each other's work. A sample follows: ICAO, ECAC, OECD, EEC, AACC, IATA. There are also manufacturer associations, regional groups and other groups who send delegates to or have observer status in some of the aforementioned organizations. To place the matter in some perspective and aid the reader in sorting them out, the more important ones are now briefly described as follows:

1. ICAO The International Civil Aviation Organization

ICAO is a specialized agency related to the United Nations. Originated in the Convention on International Civil Aviation held in Chicago in 1944, its purpose is the development of principles and techniques of international air navigation and of fostering the development and planning of international air transport. The governing Assembly meets every three years and a 27-member Council meets annually. ICAO's main secretariat is in Montreal.

ICAO's interest in aircraft noise began in 1966 and was followed by the appointment of a Committee on Aircraft Noise (CAWN) which submits resolutions to ICAO. Because of the international nature of
air transportation and the difficulties which could be caused by
unilateral action, the member states (now about 143) have a policy
of adopting into their own laws and regulations the standards
established by ICAO. In the matter of noise emissions at the source,
ICAO has adopted standards in Annex 16. This has been amended four
times. Despite considerable publicity given to the adoption of An-
nex 16 and its amendments, the standards have a time lag of about
two years and are not as stringent as those promulgated by the Fed-
eral Aviation Administration (FAA) in its FAR 36 and 91-136.

2. ECAC The European Civil Aviation Conference

ECAC is a European air transport body organized by ICAO in
1955 with consultative functions and autonomous status, i.e. it is
neither completely independent nor subordinate to ICAO. ECAC's
secretariat is in Paris. Twenty-one European states are members.
Organized into four committees: Scheduled Air Transport, Non-Scheduled
Air Transport, Technical, and Facilitating, ECAC makes non-binding
resolutions which are then subject to approval by the member states.

In 1974 ECAC established a committee of experts for the Abate-
ment of Noise Caused by Air Transport, known by the acronym AHCAT, to
study the problem of retrofit for subsonic jets not meeting Annex
16 Standards of ICAO. ECAC noted that the U.S. was proceeding with
notices of proposed rule making in the areas of retrofit, airport
development, approach abatement procedures, noise standards and
engine emissions without giving ECAC sufficient time to coordinate
comments from its members. In its report entitled "Technical Information on Noise Retrofit: published in 1977, ANCAT, after wrestling with the problems of lack of agreement on the proper noise measuring unit and the benefits and disbenefits of retrofit, recommended that instead of retrofit the noise problem be handled by replacing aircraft not complying with Annex 16 with new complying planes. To accelerate this process ANCAT proposed that any Member State not enter on its register list for international flights any subsonic jet aircraft which did not meet Annex 16 (First edition). The initial date stipulated was "no later than 30 June 1979." ECAC adopted the recommendations and its secretariat now compiles from its Member States the various actions each State has taken in the area of aircraft noise control. The United Kingdom, for example, established the date of 9 September 1978 for no further registration and has in addition set a date of 1 June 1986 after which all non-Annex aircraft will be prohibited from operation.

3. OECD The Organization for Economic Cooperation and Development

The OECD is an organization of twenty western European countries plus Australia, Canada, the United States and Japan, with several other states having special status. Formed in 1961, OECD became involved in environmental policies in 1975. Noise indices


and noise limits standardization are two of its areas of interest, and more recently OECD has studied aircraft noise charges and land-use planning, including compensation for those exposed to aircraft noise.4/

4. EEC The European Economic Community

The EEC, formed in 1958, consists of nine European countries banded together to promote harmonious economic relations by establishing a customs union. The countries are: Belgium, Denmark, France, Germany, Ireland, Italy, Luxembourg, the Netherlands and the U.K. It broadened its interest to include environmental matters. Its organization, headquartered in Brussels, consists of a 13-member Commission, 9-member Council of Ministers, a Court of Justice and a 198-member European Parliament. In 1972 the Parliament asked the Commissions to study aircraft noise. Two years later the Commission said noise standards should be set drawing from work by the ICAO.

In answering the question as to why another organization should enter the noise picture, the report, made to the Commission in 1976, noted that indeed ICAO had adopted Annex 16 and several amendments but that these were recommendations only and, unless enacted into law by the individual states, would not become mandatory. The report noted that EEC countries had no laws at all on aircraft noise.

and that the adoption by others of Annex 16 was not uniform. However, passage by Parliament under Article 100 of the EEC Treaty would make Annex 16 mandatory. A report to the Commission recommended against retrofit and re-engining but instead for an EEC Certificate of Noise Airworthiness as a requirement for all international planes. Finally, on December 20, 1979 the EEC Council adopted a directive having the force of law in the Member States which, in some cases, replaced guidelines with mandatory requirements. The provisions are:

1. Effective one month from notification of the adoption of the directive, each State is to ensure that every aircraft newly registered is noise certificated to comply with the standards of Annex 16 Chapters 2, 3, 5 or 6, Third Edition (July 1978).

2. Specifically exempted are non-Annex aircraft, if retrofit is ordered for installation within two years. Also exempted are leased aircraft, if leased before July 1, 1979 and registered in another State.

3. A State may accept a replacement aircraft for one which was destroyed in an accident if no certified aircraft are available. An operator demonstrating unreasonable hardship may obtain an extension to December 31, 1984.

4. Final phaseout date for non-Annex aircraft is Dec. 31, 1986. However, the date may be extended to Dec. 31, 1988 if a Chapter 3 plane is ordered as a replacement instead of a Chapter 2 aircraft.

5. AACC The Airport Associations Coordinating Council

AACC is composed of the Airport Operators International

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Association (AOCI), the International Civil Airports Association (ICAA), and the Western European Airports Association (WEAA). The organization was established in 1970 to represent airport associations before other international bodies. Its membership currently stands at 250. Through the Secretariat in Geneva, Switzerland, the AACC has observer status with ICAO, and is the only airport body so recognized. Since aircraft noise is a major problem at many airports it is not surprising that AACC has developed policies on noise. However, as a representing organization it, of course, does not make noise rules. In its representations, unlike ICAO, EEC, and IATA, it strongly supports retrofit. Individual airports, often alone or in cooperation with national government regulating authorities, have a significant role in the establishment of curfews, takeoff and arrival procedures, noise sensitive routings, reversing, operation of APU's and ground running of engines. At the May 1979 meeting of CAN (CAN 6) AACC pushed for more stringent noise regulations for noise at the source. The basis for the Council's request, aside from airport neighbor complaints, is the result of one of its studies which showed the higher cost of combating noise by any other means.

6. **IATA** The International Air Transport Association

IATA is a trade association of over 100 airlines. As such it

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does not promulgate noise regulations but has a vital interest in them. Established in its present form in 1945 to bring about stand-
dardized operational, technical, legal and commercial practices, it
has been well known for its role in setting international rates and
fares. This function has been criticized and a significant restruc-
turing is in progress. IATA's headquarters are in the same building
as is ICAO in Montreal.

IATA serves as a clearing house for its members in technical
matters. If member agreement or position has been reached, the
Assistant Director General or other official of IATA may then appear
before a legislative or rule-making body as the voice of the indus-
try. In this connection uniformity in airworthiness certification
is important for international aircraft, and IATA continually strives
for this. When pressure arose to make noise emissions an element in
airworthiness certification, IATA formed an Aircraft Noise and Emis-
sion Advisory Committee to examine solutions and recommend actions
to member airlines. In supporting "reasonable" environmental
rules, IATA has proposed that a carrier complying with such stan-
dards as Annex 16 be removed from liability to suit. Still further,
it urges that the utilization of Annex 16 aircraft should also im-
munize airport authorities from suit. Finally, IATA also has urged,

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7/ J.W.S. Brancker, IATA and What It Does, A.W. Sijthoff (1977)
Leyden, Netherlands, p. 24.
unsuccessfully, that governments refrain from establishing curfews since curfews inhibit the free flow of commerce.

The impact of noise regulations on the international airline industry is made clear to the various governmental regulatory bodies through continuous lobbying by IATA.

7. Other Agencies and Organizations Involved with Aircraft Noise

One of the difficulties in reaching timely uniform international solutions to the aircraft noise problem, aside from the differing cultures and differing economic and social status of those living near airports, is the large number of organizations involved in presenting the widely different views held by those desiring to promote business and those predominantly interested in the quality of life and environment. Later we will come across an example of international complications caused by demand of an idyllic country village in one country that all noise be stopped from a major international airport located a few miles away but in another country.

Originally each country placed air transport in an agency of its own or under a department of transportation. However as air transportation grew and affected more and more people, some authority was either added or was carved away from the original department and the agency was often folded into a larger transportation department. Although the aviation departments set up divisions dealing with the environment, legislation or decrees often established an entirely separate Department of Environment which either pushed
the old line department to action or attempted to take over some of its powers. Similar developments have also emerged at the county and municipal levels. Two types of groups have developed to provide grist for the mill of rule promulgation. First are "airport neighbor" or citizens' environmental groups (in the United Kingdom called "amenity" groups) who push for stricter noise rules. There are many of these but they tend to be local in character. Second are the technical, business, manufacturer and airline organizations who seek to minimize the constraints proposed by the other groups.

An imposing list of both types could be composed. At one airport hearing in Britain over 100 different organizations sought to testify. However, a few examples are: German Airports Association, German Aerospace Industries Association, Frankfurt Advisory Noise Commission, Association of European Airlines (AEA), International Coordinating Council of Aerospace Industries Associations (ICCAIA), aerodrome Owners Limited, and the Association Europeenne des Constructeurs de Materiel Aerospatial (AECMA).

There are two more types of governmental organizations which have an active interest in aircraft noise matters. First, there is the European Conference of Ministers of Transport (ECMT). Secondly, it is not infrequent that several countries come together with noise experts to deal with certification or other aircraft noise matters. The Scandinavian countries are a case in point.
On the surface, the problem of finding a relevant standard of noise measurement (usually called "descriptor") would seem to be simple. However, one soon discovers that acoustics is a discipline in itself with highly qualified scientists talking in a technical jargon to support several different methods. One quickly learns to distinguish between single event and cumulative noise descriptors. Additionally, there are various methods of weighting the measurement to make it conform more to what the ear is presumed to hear, or weighting to take into account some particular factors, i.e.,: annoyance, high frequencies, pure tones, and duration of sound. These measures take on nationalistic characteristics as will become apparent in the description which follows.

1. United States Noise Descriptors

Largely because of a requirement by HUD, the FAA, the U.S. Air Force and the State of California, the United States has pretty well adopted for single event noise descriptions such units as:

- **dB** -- Decibel - the basic unit of sound measurement used to express the intensity or level of sound.

- **dBA** -- "A" = weighted sound level - a measured level of noise which has been filtered to discriminate against the lower frequencies in a manner related to the ear's sensitivity to sound.

- **PNdB** -- Perceived Noise (in decibels) - a calculated level of noise based upon the frequency spectrum of the noise source similar to dBA but weighted more heavily at the higher frequencies.

- **EPNdB** -- Effective Perceived Noise (in decibels) - a common measurement in aircraft noise analysis in which correction
factors are applied to PNdB or dBA to account for pure
tones and the duration of sound. This is the unit speci-
fi ed in the FAA rule FAR 36 and is the unit in ICAO Annex
16.

For the Cumulative Noise Descriptors the U.S. has:

Leq--Equivalent Sound Level - a steady noise level in a stated
period of time.

Ldn--Day-Night Sound Level - an equivalent sound level over a
24-hour period with a 10 decibel "penalty" assigned to
night (10 p.m. to 7 a.m.).

NEF--Noise Exposure Forecast - an index utilizing individual
aircraft source noises expressed in EPNdB, number of
flights, and weighted in proportion to night-time oper-
at ions.

CNR--Composite Noise Rating - This is similar to NEF but is
expressed in PNdB. NEF is generally considered superior.

CNEL--Community Noise Equivalent Level - represents the total
equivalent noise exposure (on an energy basis) over a
24-hour period with a "penalty" of 5 dB's from 7 p.m.
to 10 p.m. and a 10 dB "penalty" from 10 p.m. to 7 a.m.

Agreement within the U.S. that these are ideal units of measure is
far from uniform. Various bills introduced into the U.S. Congress
on land-use planning and noise financing all have had sections dealing
with research to establish some standard agreed upon of measure.

2. **European Noise Descriptors**

In Europe there has been even less agreement. Within the indi-
vidual countries different standards are used, making it necessary
to construct approximate conversion factors when comparisons are
necessary. Some European noise descriptors are:

NNI--Noise and Number Index has been the standard used in the
United Kingdom for some years. Periodic reviews of its merits have resulted in its continued retention even though it is continually challenged. Basically it is said to reduce 72 variables to 2 variables, namely: the mean noise level and the number of flights. It makes no distinction between day and night flights. It has generally been accepted in the United Kingdom to relate NNI 35 to a low annoyance level, NNI 45 to a moderate annoyance level and NNI 55 to a high annoyance level.

NNI=Isopsophic Index--The noise Commission of the French Ministry of Transport developed this unit for France. Unlike NNI the French index differentiates between day and night. Components of the Isopsophic are the noise level of the aircraft, the duration of the noise, and the number of occurrences.

Q-Index--This measure is used in many cases by the Federal Republic of Germany. It considers the maximum points in a noise level history together with the volume of operations as well as weighting for day and night.

WECPNL--The Weighted Equivalent Continuous Perceived Noise Level. A recent French study made use of this standard. It is also used extensively in Japan.

Kosten Index--An index followed in the Netherlands and named after a noted acoustician.

KB--The Critical Noise Level (Sweden)

CNR--A "modified Composite Noise Rating" (Denmark)

TNEL--Total Noise Exposure Level. This method measures the basic physical properties of the noise and calculates the effective perceived noise level (EPNL) in terms of EPNdB and then sums the total for all aircraft giving a Total Noise Exposure Level (TNEL). The method can be modified for day and night and for seasonal periods where higher temperatures may result in more open windows. It is the method stipulated in Annex 16.
Some conversion factors for the various indexes are:

\[ N = \text{NNI} + 38.5 \]
\[ KE = \frac{4}{3} \text{NNI} - 8.2 \]
\[ \text{CNR} = \text{NNI} + 56.5 \text{ (unmodified CNR)} \]

For purposes of noise impact and land-use planning, contours of equal noise levels are drawn around and in the airport area. The number of people living or working in the area are then counted to obtain the number of people exposed to a specific noise level. From these noise maps regulatory bodies, technical experts or environmental ("amenity") groups make judgments as to what level is desired or should be permitted. They also use these to lower noise exposure closer in by such methods as:

1. requiring quieter aircraft through standards contained in their aircraft noise certification requirements.

2. requiring changes in operating procedures such as:
   - arrival and departure procedures and routings,
   - limiting ground runup, operations of the APU,
   - reversing.

3. establishment of curfews or the restricting of night operations to limited types of aircraft.

4. limiting the number of operations at the airport.

5. purchasing property in a sensitive area.

6. establishing building codes which deny residential housing in some areas and permit it with insulation in others.

CHART 1

AIRCRAFT NOISE CONTOURS
(110 PNdB)

Take off  Landing

Commencement of
roll at take off

Touch down

7. using noise monitoring equipment at various points to ascertain those responsible for excessive noise emissions.

8. Establishing a timetable for phasing out older noisy planes.

The noise contours plots of an individual aircraft for various noise contours is called a noise "footprint." Chart 1 from the British Department of Trade illustrates how the equal noise "footprints" of selected aircraft compare and clearly demonstrates the superiority of the high bypass engines powering the 747, TriStar, and A300B.

CHART 2
To equate this noise representation with familiar noises which the public can understand, the British have published the information shown on Chart 2. Other countries publish similar material. It should be understood that the PNdB scale is logarithmic, which means that every increase of 10 represents a doubling of the loudness.

The cumulative noise index forecast charts in units such NNI, CNR, KB, NEF, Kosten, Q and Isopsophic, show noise contours for all departure and arrival routes and for each runway. The charts are extremely time consuming and costly to develop for they involve many predictions for basic data inputs. For example, if the estimate is for 1985 it is necessary to adjust current data for the number and type of airplanes to be used, their time of departure, their gross weights for different seasons, the temperature correction by season, change in number of or alteration of runways or departure and arrival routes.

It is obvious that the accuracy of these noise forecasts involves correct predictions of economic, political and sociological changes. Such maps may be requested every 3 to 5 years. Examples of a cumulative noise index map for Schiphol using the Kosten unit for contours and for Zurich using NNI are depicted on Charts 3 and 4. Using the Zurich chart which employs the NNI index, contours of 35, 45, 55 and 65 are depicted. Generally charts such as these are used by the authorities to determine whether to allow building within the contour and if so with what restrictions. They may also be used to determine
CHART 4

NNI NOISE INDEX MAP - ZURICH 1985

Flughafen Zürich - Fluglärmbelastungskurven in NNI - Ausbauvarianten A u.C Jahr 1985

Zurich Airport
whether homes are eligible for purchase or for insulation allowances under land-use planning "schemes." 9/

Since the noise problem is fraught with emotional overtones (what is annoying to one person may be even pleasing to another), and since the foregoing has indicated the inability or unwillingness of the various countries to agree on specific standards, it is understandable that one may have difficulty in making valid comparisons between countries.

Perhaps the closest standards to uniformity are those dealing with noise at its source in aircraft certification, i.e., the ICAO Annex 16, and the U.S. FAR 36. But even here there are differences; for FAR 36 is slightly more stringent.

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9/ Differences in the meanings of words in European and U.S. usage is not uncommon. Two cases in point: (1) "Scheme" in the U.S. has a connotation of something underhanded. In the U.K. it is merely the substitute word for our word "plan." (2) Where we usually talk of "environmental" or "public interest" group, the conventional term in the U.K. is "amenity" group.
PART II

EUROPE: NOISE REGULATIONS
Chapter 4

NOISE AT THE SOURCE REGULATIONS FOR AIRCRAFT

The problem of aircraft noise in the context of international operation had early recognition. Eventually, through ICAO, standards were adopted and subsequently amended. A brief chronology follows:

1. Annex 16 Chronology

1944 The Convention of Civil Aviation in Chicago provided the basis for an Annex to contain Standards and Recommended Practices for Aircraft Noise.

1966 An International Conference on the Reduction of Noise and Disturbance Caused by Civil Aircraft, called the "London Noise Conference," was held to reach international solutions to noise through ICAO.


1968 (Sept.) The Sixteenth Session of the Assembly of ICAO in Buenos Aires directed the ICAO Council to call an international conference to establish international specifications and guidance material relating to aircraft noise.

1969 (Nov.-Dec.) In response to the above 1968 directive a Special Meeting on Aircraft Noise in the Vicinity of Aerodromes was convened in Montreal to consider:

1. procedures for describing and measuring aircraft noise

2. human tolerance to aircraft noise

3. aircraft noise certification

4. criteria for establishment of aircraft noise abatement operating procedures

5. land-use control; and

6. ground run-up noise abatement procedures.

The meeting developed recommendations and drafted standards and procedures which, after amendments and consultations by the Member
States of ICAO, were placed before the ICAO Council for adoption.  

1970 ICAO established the Committee on Aircraft Noise (CAN).

1971 (April) Recommendations resulting from the 1969 Meeting on Aircraft Noise in the Vicinity of Aerodromes were adopted by the Council as Annex 16. Subsequent to 1971 four amendments were adopted, the last becoming effective 10 Aug 1978.


Annex 16 was adopted 2 April 1971 and became applicable 6 Jan 1972. It provided that Noise Certification by contracting states should be by standards applying to turbojet aircraft over 12,556 lbs. Maximum Certificated Gross Weight (MCGWT); measured by EPNdB at three places (Takeoff, Approach and Sideline); with a maximum of 108 EPNdB for aircraft of MCGWT 599,660 lbs., less 2 EPNdB per halving of the maximum gross weight down to 102 EPNdB for a MCGWT of 74,960 lbs. (Sideline). The allowable noise for takeoff and approach at MCGWT reduced to 93 EPNdB. A provision known as "Trade-off" specified the permitting of some excess noise at one or more places if offset by decreases at others. For measuring points of sound, Sideline was fixed at 0.36NM (650 m), Takeoff 3.5NM (6500m) from start of roll, and Approach 1.08 NM (2000m) from the threshold. Test procedures were specified so that takeoff thrust could be "cut back" at a certain point to attenuate noise. Finally, an approach configuration of full flaps, on a 3° glide slope at not more than 1.3Vs + 10 kts was specified.

Other sections, rather general in nature, were recommendations.
only and involved for monitoring purposes an international noise exposure reference unit for land-use planning, and some suggestions for aircraft noise abatement operating procedures.

As to implementation, the standards did not apply to any aircraft whose application for a type certificate for the prototype was carried out before 1 Jan 1969, or any airplane with bypass ratio of 2 or more whose individual certificate was issued before 1 March, 1972 (nor STOL aircraft).

Annex 16 was, therefore, en futuro since no existing aircraft or future aircraft of a currently produced type, or wide bodies with a bypass ratio greater than 2 if the certification was issued before March 1972, were covered. Thus even the first models of the 747 were exempt. Application to all the above aircraft was to be handled at a future time. The Committee on Aircraft Noise (CAN) was set up to deal with these matters.

Amendment 1: Pressures for more meaningful application of noise emission rules led to two meetings of CAN and Amendment 1, which extended the applicability of the Standards to future production and derived versions of certain older types of subsonic jets not previously covered. This Amendment became applicable 16 Aug 1973.

Amendment 2: As a result of the third meeting of CAN noise regulations for light subsonic jets and prop airplanes were included applicable 27 Feb 1975.
Amendment 3 had its genesis in the work of CAN 4 and became applicable 6 Oct 1977. Annex 16 was then reissued with new material consisting of a new Chapter 3 dealing with jet aircraft certificated on or after 6 Oct 1977.

The environmentalists in the Member States had been pushing their governments for significant noise reduction, even beyond that technically possible, in order to provide a sharp incentive for manufacturers to reduce noise. The manufacturers wished nothing beyond the current state of the art including a buffer to minimize difficulties with tests in certification. The report of CAN 4 (Jan-Feb 1975) indicated the Committee recognized that failure to devise stricter rules might cause some states to promulgate more stringent standards of their own which would jeopardize confidence in ICAO.

It appeared that one way to handle the problem was to enact stiffer requirements which would be publicized as a significant step forward and then word the applicability in such a way as to put its effectiveness sometime in the future. Thus, by defining applicability in terms of the time of application for a prototype certificate, all current airplanes including the wide-bodied DC-10, Lockheed L-1011, 747 and A-300 were uncovered.

Briefly the major differences between Chapter 3 and the Chapter 2 rules at heavy weights are:
Additionally the sideline noise point was moved from 0.35NM to 0.25. How this relates to selected transport types at various weights is shown in Charts 5 through 7.

Amendment 3 also treated propeller driven airplanes (Chapter 5 and 6) and began making recommendations on Auxiliary Power Unit (APU) noise. At the CAN 4 meeting Agenda item 7 dealt with retrofit which sprang from U.S. FAA NPRM 74-14 in 1974, a rule which would have required all non-noise-certified aircraft to meet FAR 36 without trade-offs. Japan was already revising its laws to require retrofit. All the other countries wished to stand back to see what the U.S. would do, resulting in a resolution indicating that retrofitting should be encouraged but with no date set for compliance.

Amendment 4: Annex 16 was reissued as a Third Edition in July 1978 containing Amendment 4 resulting from the fifth meeting of CAN. The members of CAN had second thoughts about the result of CAN 4 and the Amendment introduced a new parameter for aircraft type certified after 6 Oct 1977. The parameter was number of engines as follows:
PROPOSED NOISE LEVELS - TAKE-OFF
WITH REVISED CUT-BACK PROCEDURE

At 6,500 ft

Source: Committee on Aircraft Noise, Fourth Meeting Report (1975)
PROPOSED NOISE LEVELS LATERAL

CURRENT at 650 a

PROPOSED at 450 a

EPTA

110

105

102

100

96

95

90

85

80

75

10

100

1000

TAKE-OFF GROSS WEIGHT = kg x 1000

Source: Committee on Aircraft Noise, Fourth Meeting Report (1975)
PROPOSED NOISE LEVELS-APPROACH

CURRENT

PROPOSED

Source: Committee on Aircraft Noise, Fourth Meeting Report (1975)
<table>
<thead>
<tr>
<th>Takeoff</th>
<th>No. of Engines</th>
<th>EPNdB</th>
<th>MCGWT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-eng.</td>
<td>101</td>
<td>for 848,800 pounds decreasing to 89 using a rate of 4 EPNdB per halving of the weight</td>
</tr>
<tr>
<td></td>
<td>3-eng.</td>
<td>104</td>
<td>848,800 pounds and over</td>
</tr>
<tr>
<td></td>
<td>4-eng.</td>
<td>106</td>
<td>848,800 pounds and over</td>
</tr>
<tr>
<td>Approach</td>
<td></td>
<td>105</td>
<td>descending to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>98</td>
<td>at 77,160 pounds</td>
</tr>
</tbody>
</table>

There were language changes to ensure that the same level of technology was applied to all types of aircraft. The applicability of Amendment 4 was made 10 Aug 1978. How the new amendment affected the previously established standard is shown in Charts 8 through 10. Not all interested parties were happy that some relaxation was found to be necessary in the rules so recently formulated.

3. Annex 16 and FAR 36 Compared

Comparing FAR 36 with Annex 16 is difficult because of the variables involved. Although the EPNdB limits may be the same, the presence or absence of cutback allowances, the different points at which sound is measured, or the permission or prohibition in the use of trade-offs can make a difference. To examine these differences in detail would unduly extend this study. However, it is sufficient to point out that there are aircraft (some of the DC-9 series, for example) which meet Annex 16 but which do not meet FAR 36.
CHART 8
ANNEX 16 AMENDMENTS 3 AND 4 COMPARED

NOISE LEVELS - TAKEOFF
(at 6,500 m. from the start of roll)

Source: Committee on Aircraft Noise, Fifth Meeting Report (1977)
CHART 9
ANNE\x16\x15X 16 AMENDMENTS 3 AND 4 COMPARED

NOISE LEVELS - LATERAL
(at 450 m from runway axis)

Takeoff Weight
(thousands of kilograms)

Source: Committee on Aircraft Noise, Fifth Meeting Report (1977)
CHART 10
ANNEX 16 AMENDMENTS 3 AND 4 COMPARED

NOISE LEVELS - APPROACH
(at 2,000 m from the threshold)

Takeoff Weight
(thousands of kilograms)

Source: Committee on Aircraft Noise, Fifth Meeting Report (1977)
Several members of foreign government bureaus engaged in dealing with the aircraft noise abatement problem exhibited a degree of cynicism over Annex 16. Because all manufacturers in their desire to sell to the large U.S. market must design their aircraft for the more strict regulations of FAR 36, these governmental employees raised the question of the anomaly of spending so much time and money on meetings involving a lesser standard.

However, some U.S. observers pointed out that the meetings of the various working groups in CAN 5 were not without nationalistic bias. For example, at the September 1978 meeting of Working Group D (which was involved in subsonic jet transport standards) some observers felt that the French representatives were trying to write Annex 16 so that the 727, 737 and DC-9's would become illegal. This would enhance the saleability of various models of Airbus Industries' 300 series.

Although the literature on international noise abatement regulations is replete with material relating to Annex 16, and although Annex 16 has received wide publicity, a comparison of dates of applicability and specifics of the resulting rules leads to the conclusion that the United States has led the way with its FAR 36 and amendments. Various interviewees as well as references in the reports indicated that it was primarily the knowledge that the FAA was moving that triggered international meetings on noise emissions standards at the source. Efforts for land-use planning on an international
basis, perhaps because of the absence of Federal legislation in the U.S., has barely been touched. However, this is not to say that land-use planning is behind in other countries. Quite the opposite is true. As will be seen in the discussion of the situation in individual countries, various countries are engaging in a wide range of forward looking activities in this area.

4. Summary

Because international commerce would be severely constrained if each country established its own airworthiness standards. - [Noise being one of the standards] - many countries became members of ICAO. ICAO has adopted various international rules on aircraft noise. By terms of the Chicago Convention, individual member states are supposed to adopt by legislation or by announced policies the standards set by Annex 16. This has not always happened. Several problems have surfaced. First, the measurement of noise annoyance is highly subjective and emotional. Second, acoustical experts in various countries have their own special preferences for the unit to be used. Hence, to agree on the unit of measurement, let alone the numerical value to be used, is difficult.

In establishing and implementing noise limits, the matter of the applicable date of the regulation is very important. ICAO has addressed the date problem very gingerly on the theory that it must be careful not to incur economic penalties which would harm the industry. Thus, ICAO has couched its applicability in terms of the date
of application for a type certificate for a new type of aircraft. Since it takes four or five years to develop and market a new type of aircraft, the benefits of the standards set in this manner do not show until some time in the future. As a result, Annex 16 sometimes appears to be a distant mirage to the airport neighbors.

ICAO also has the problem of determining whether to adopt a regulation which brings some small relief soon at the expense of greater relief in the future. There are those who think the course should be to make new regulations which essentially validate current technology. Others feel that in order to give manufacturers the push to develop (and the airlines the obligation to purchase) quieter planes, Annex 16 should be very strict and even ahead of technology. However, as a result of inflation and the oil crisis, the costs of obtaining technological advances has increased to the point where they may result in new aircraft having a higher operating costs than older aircraft. Should this be the case in the noise area, a carrier has a negative incentive to buy. The development of the high bypass engine involving fuel economy and a significant reduction in noise enabled wide-bodied aircraft to meet FAR 36 and Annex 16. However, present indications are that there is no further improvement of the same magnitude in sight in the near future.

The failure of ICAO to come to grips with the problem of older aircraft which were left uncovered by Annex 16 was quickly perceived by the citizens living near the airports. Largely through ECAC,
member states have been asked to supply information on the status of their individual noise abatement rules, including whether they have adopted Annex 16, and what date, if any, they have set to force the retirement of the older noisy airplanes. The activities of the OECD and EEC have been mentioned in connection with noise. The latter has recently moved in the noise area arguing that ICAO resolutions are only recommendations but that EEC rules are mandatory, at least in countries belonging to EEC.

The proliferation of meetings and the proliferation of the number of organizations holding meetings on aircraft noise has been mentioned. When asked the purpose of so many meetings in so many places, several interviewees commented that due to the popularity of the noise issue a large number of bureaucrats have "latched onto noise" so they can have a specialty and be able to travel to various countries for meetings. Additionally they pointed out that the meetings enable the governments to tell the public that things are being done about noise whether or not it is so. Thus they serve a purpose "in keeping the environmentalists off the government's back."
Although aircraft noise emissions impact the human ear in the same manner regardless of a person's race, color, creed or nationality, and although in the final analysis the approaches taken by various countries in their attempts to handle the jet transport noise problem are quite similar, differences in cultures, customs and forms of government may explain the rather disparate methods and procedures which various countries have utilized to formulate noise control rules. While the United States has developed a time-consuming process of notices on proposed rules followed by comments, followed by proposed rules and more comments, environmental impact statements, hearings and more hearings, the parliamentary form of government as it exists in Great Britain enables government departments to handle matters with less formality before the department issues an order. However, this does not necessarily ensure speedy action. Various inquiries on a fourth London airport have taken years.

1. U.K. Government Noise Structure

In great Britain the major seats of power in the noise area are Parliament, the departments of Trade, Industry, Environment, and with the Department of Defense having some involvement. The most important agency for our purposes is the Department of Trade and its various subsections. Regulations stem from parliamentary legislation, Orders in Council and the Department itself. Airport authorities may be given the right or obligation to make noise rules. In the absence of national rules, municipal bodies owning airports have written "bye
laws" for the control of noise.

The British have developed one of the most extensive set of noise laws and regulations in Europe. However, it is difficult for the government to speak with one voice on noise matters because the conflicting duties and objectives of the various departments. Then there is the inherent desire of each department to add to its "turf". The Department of Industry has as one purpose the protection of the manufacturing industry. It is not surprising that the Department of Trade and the Department of Environment feel that the Department of Industry listens too heavily to the airlines, the manufacturers and other commercial interests. On the other hand, the Department of Industry feels that the Department of Trade leans too heavily on the environmentalists. Yet, if the Department of Trade strays too far from the environmental path it fears it will lose turf to the Department of Environment. At present, legislatively the Department of Trade is in the saddle. However, noise matters are highly fractionated with each department wanting "a piece of the action." One major international airline pointed out that the number of government bureaus and departments involved in aircraft noise had proliferated and gotten "out of hand." The airline indicated that when it was asked to discuss a minor noise matter at Heathrow Airport it sent one man who found forty to fifty people from the Department of Environment, the Airport Authority, the Department of Trade, the Civil Aviation Authority and a group called the Noise Working Party all gathered for the informal minor meeting.
The normal handling of aircraft noise matters is a function of government departments. However, if an individual or amenity group is dissatisfied he or it may be able to interest a Member of Parliament (MP) in asking a question in Parliament of the appropriate official. Thus, an MP might put the question to the Secretary of State for Trade (the equivalent of the U.S. Secretary of Transportation). Should the answer be too difficult to obtain without further study the Secretary might decide to hold a "Public Inquiry." The "Inquiry", which is roughly equivalent to "hearings" in the U.S., might be conducted by an inspector with assessors (assistants). Such an "Inquiry" took place in regard to building the fourth terminal at Heathrow. Inquiries provide a broad forum for public discussion. To illustrate the depth of the investigations it may be pointed out that in the case of the Roskill commission over 1,000 organizations were asked for comments.

There is no shortage of "amenity" groups, some with interesting acronyms such as FHANG, for the Federation of Heathrow Antinoise Groups; HACAN, Heathrow Association for control of Aircraft Noise; LAANC, Local Authorities Aircraft Noise Council; HADAG, Haslemere Aircraft Disturbance Action Group, and the BCPRC, Brentford and Chiswick Public Relations Council. A number of the amenity groups are quite professional. First they thoroughly acquaint themselves with the facts, seek widespread publicity, and make their desires known to the government staff. They have their biggest weapon when they can interest an MP living near an airport. Although an MP
living near Heathrow must interest himself in aircraft noise, those interviewed indicated that the power of amenity groups was not strong enough to cause an MP to fear losing his political job should his vote disagree with their desires.

Ownership and operation of airports in Great Britain is quite different from the U.S. where, except for Dulles and Washington National, the federal government does not own and operate the airport. The British Airports Authority (BAA) is a nationalized institution owning and operating the seven major U.K. airports. In many cases, the Department of Trade can simply order the BAA to do certain things.

2. Legal Basis of Noise Control

In an early period of aviation development Winston Churchill, noting restrictions placed upon railroads in the formative period and fearing that such a development could cost England dearly if it spread to aviation, sponsored a provision in the Air Navigation Act of 1920, outlawing suits for damage due to aircraft noise in flight. The same rule was extended to aircraft on the ground in 1947. These two items were consolidated into the Civil Aviation Act of 1949. Finally noise caused by aircraft is also excluded from the provision on the Noise Abatement Act of 1960.\(^{10}\) At first blush this would

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\(^{10}\) J.V. Danks, Noise Policy Manager, BAA, 30 Nov 78.
seem to give the airlines a free ride on noise. In the U.S., airport operators have been held liable for such noise damages totaling millions of dollars and hence would deem such a law to be their salvation. However, provisions of other U.K. laws severely countervail the apparent "pass" given to noise. In fact, it is often held that because of the law the Government is very careful to take measures to reduce noise. Failure to do so could increase the probability for the law's repeal.

Power to control aircraft noise at airports comes from Section 29 of the Civil Aviation Act of 1971. By the simple act of "Designating" an airport the Secretary of Trade is clothed with the power to

- make takeoff and landing requirements to mitigate noise
- limit the number of planes which can take off or land at certain hours
- give orders to airport operator to mitigate noise: prescribe minimum noise routes
- require the airport operator to buy and operate noise monitoring equipment
- control ground running of engines

Under the Civil Aviation Act of 1978 non-designated airports can make "bye-laws" limiting noise. The four main BAA airports are designated airports. Non-designated airports have little alternative but to go along if asked to do so by the DOT. Failure could mean "designation." At seven other non-designated airports (Liverpool, Luton, Manchester among them) noise abatement procedures are in effect and have the force of law under local act powers and general management
powers. The airport manager has the statutory duty to ensure compliance. He may detain an aircraft from taking off but not from landing. Other sanctions are not mentioned. British Airports Authority airports derive their powers in this regard from the Airports Authority Act of 1975 as amended by the Civil Aviation Act of 1978.

2.1 Noise at the Source. Noise at the source regulations require an aircraft to have a noise certification certificate meeting specific standards. The legal basis is found in the Civil Aviation Act of 1949 stipulating that an Order in Council may be made in this regard. The Air Navigation (Noise Certification) Order 1970 as amended in 1972 embodies requirements parallel to those agreed to in Annex 16 pursuant to the U.K.'s international agreement with ICAO.

In 1978 the Civil Aviation Act gave an additional tool to the airport manager by empowering him to levy charges for the noise made by an aircraft. Further, the Secretary of State for Trade may require a manager to introduce such charges and may specify the form they should take.

The sheer impossibility of quickly replacing noisy aircraft with quieter planes, the early failure to engage in effective land-use planning, and the pressure of airport neighbors for relief at Heathrow, the busiest international airport in the world, caused the British to design and implement other types of "schemes" to alleviate the noise problem. Some of these are broader than just
aircraft noise. The Land Compensation Act, noise insulation schemes, and efforts to institute land-use planning with aircraft noise as an element are examples.

2.2 Land Compensation Act 1973. The part of this act dealing with aircraft noise provides compensation including interest for a decrease in property value when a new airport is built, or when a new runway is added, or when major additions are made to an existing runway or ramp areas. This is a "one shot" situation which applies only to events taking place after 7 Oct 1969. Administration is under the Department of Environment. According to a Ministry of Defence position paper, military aerodromes will be treated the same way. The law also covers home loss payments, rehousing, compulsory and discretionary purchase.

2.3 Noise Insulation Compensation Payments. Blocked by the unique provisions of the Air Navigation Act of 1920 and the Civil Aviation Act of 1949 excluding suits for noise, and further restrained by the omission of aircraft noise from the Noise Abatement Act of 1960, citizens pressed for soundproofing assistance immediately after the introduction of the noisy jets. A 1963 report of the Wilson Committee on Noise recommended assistance and, under authority of the Airports Authority Act of 1965, set up the first noise insulation scheme. Limited to Heathrow, it provided up to 100 British pounds for quieting bedrooms and living rooms only. The British apparently place a
low value on work in the kitchen. Effective in 1966 the first plan was followed by a series of others and extended to Gatwick as well. On the theory that people who bought or rented after 1 Jan 1966 near Heathrow, and 1 Jan 1973 near Gatwick were not overtaken by noise but had chosen deliberately to accept it, such people were made ineligible for insulation grants.

The grants are contained in Statutory Instruments No. 916 and 917, 1975 as amended by No. 813 in 1977 and simply provide that the owner or occupier (renter) of a dwelling in the 60 NNI "Special Area" may receive compensation toward the cost of specified noise insulation, the amount being 100% of the cost up to 750 English pounds ($1400). For the "Standard Area" with a 55 NNI boundary compensation is limited to 85% of the cost but not more than 470 English pounds ($760). Response to the early schemes was small because owners and renters felt their contribution was more than they could afford. Recent schemes have attempted to compensate for inflation and have otherwise liberalized the provisions.

By their terms these schemes expired recently, but on 2 Nov 1978 the Government announced its decision to introduce new and improved noise insulation schemes for areas near those two airports. Under local act powers Luton and Manchester have introduced their own but similar insulation plans. Statutory instruments have been developed requiring the BAA to pay for insulation of schools near Heathrow. The source of funds for payments is airport revenues.
Complaints that the previous schemes experienced a low level of acceptance because the owners' and renters' contributions were high enough to cause them not to participate, and because those who had moved into the area after 1966 (Heathrow) and 1973 (Gatwick) were not eligible for grants, led to more liberal insulation schemes under Statutory Instruments 1980 No. 153 and 154 for the two London Airports.

First, the new program is now applicable to all dwellings completed before April 1, 1980, thus making it available to all those in the noise affected area. Applications for grants must be made by March 31, 1983 and the work completed by April 1985.

In addition to the 50 NNI contour as a parameter for the new schemes, there is added a new parameter, the 95 PNdB noise footprints for Annex 16 aircraft, as a figure above which insulation grants will be made. The 95 PNdB is the noise level below which current evidence suggests that an aircraft is unlikely to waken the average person. Thus, the schemes concentrate on those areas which are currently most affected and which will continue to be subject to comparatively high noise levels in the mid-1980s. In addition, the schemes focus on the areas within which there is the greatest disturbance caused by night movements likely to awaken people.

The amount of compensation has been raised to 100 percent of the eligible insulation, subject only to maximum prices per unit of certain equipment and material. Each eligible dwelling is entitled to the insulation of two living rooms and all bedrooms.

Finally, the new schemes are estimated to cost the British Airports Authority over 50 million U.S. dollars at March 1980 prices.
2.4 Land-Use Planning. The tendency of people and businesses to move near an airport for convenience or business purposes and later complain about aircraft noise has been manifest in the U.K. as elsewhere. Among the solutions to this problem is land-use planning in which there are building codes and restrictions on the type of building, if any, that can be constructed within a given noise exposure area, usually identified in terms of its NNI number. Only buildings compatible with the land use are permitted. Although no statutory plan was in effect, on 19 Jan 1973 the Secretary of State for Environment and the Secretary of State for Wales issued Circular 10/73 setting forth certain guidelines for local authorities and indicated the specifics of the criteria which those two secretaries would be using in the future.

Perhaps highlighting the disinclination of one government department to agree with another when there is some disagreement of who should have the predominant role, the Department of Environment did not break down noise annoyance into the same NNI divisions as does the Department of Trade. For example, Table 1 shows four areas with a top of 60 NNI instead of the more conventional 35, 45 and 55 NNI areas. Having completed a survey of the legal basis for noise control in the United Kingdom, we now turn to some of the major regulations developed under the legal structure.

3. Noise at the Source

Since the United Kingdom was the first to inaugurate jet
### Table 1

**RECOMMENDED CRITERIA FOR CONTROL OF DEVELOPMENT IN AREAS AFFECTED BY AIRCRAFT NOISE**

<table>
<thead>
<tr>
<th>Level of aircraft noise to which site is, or is expected to be exposed</th>
<th>60 NNI &amp; above</th>
<th>50 — 59 NNI</th>
<th>40 — 49 NNI</th>
<th>35 — 39 NNI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwellings</td>
<td>Refuse</td>
<td>No major new developments. Infilling only with appropriate sound-insulation — see Appendix 3</td>
<td></td>
<td>Permission not to be refused on noise grounds alone</td>
</tr>
<tr>
<td>Schools</td>
<td>Refuse</td>
<td>Most undesirable. When, exceptionally, it is necessary to give permission, eg for a replacement school, sound insulation should be required to a standard consistent with DES Guidelines (see footnote to para 7 of this Circular)</td>
<td>Undesirable</td>
<td>Permission not to be refused on noise grounds alone</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Refuse</td>
<td>Undesirable</td>
<td>Each case to be considered on its merits</td>
<td>Suitable sound-insulation to be required</td>
</tr>
<tr>
<td>Offices</td>
<td>Undesirable</td>
<td>Permit</td>
<td>Permit but advise insulation of Conference Rooms depending upon position, aspect etc.</td>
<td></td>
</tr>
<tr>
<td>Factories, warehouses etc.</td>
<td></td>
<td></td>
<td>Permit</td>
<td>(It will be for the occupier to take necessary precautions in particular parts of the factory depending on the processes and occupancy expected. But see paras 25-32 of this Circular for control of new factories etc. in relation to their noise EMISSIONS)</td>
</tr>
</tbody>
</table>

Source: Circular 10/73, Department of the Environment, 19 January 1973
transport service it was the first to suffer the consequent noise annoyance. It is not surprising, then, that the U.K. has been in the forefront of activities in ICAO to limit noise emitted by the aircraft itself. It has been the policy of the United Kingdom to adopt the standards set by ICAO in Annex 16 and thus has adopted Chapters 1, 2 and 3 of the Third Edition of the Annex. Thus, each aircraft on the British register must have a noise certificate of compliance. As previously indicated, coverage includes aircraft certificated after 1972, derived versions of production of earlier type certified aircraft, and more stringent rules for aircraft certified after 6 Oct 1977. The noise reduction between the non-Annex 16 and Annex 16 aircraft is significant. In actual numbers a government White Paper 11/ shows 113 EPNdB for takeoff of a non-certificated Boeing 707-320B compared with 103 EPNdB for the Lockheed 1011. The progress is highlighted by remembering that a decrease of 10 decibels is equivalent to halving the apparent noisiness.

We have already noted that no international rule has been made requiring the retrofitting or re-engining or replacement of jet transports which were certified before the applicability of Annex 16. Initial thinking, based on service life experience of propeller aircraft with the original purchasing carrier, was that quieter airplanes for the whole fleet were just around the corner. However,

calculations in 1975 showed that two-thirds of the airline fleets did not meet Annex 16. Further studies indicated that there was no known fatigue life for the aircraft frame and usage of twenty to thirty or more years was within reach. Finally, as traffic loads increased and as derivatives came into play, existing aircraft became heavier and noisier. As a result, airport amenity groups began to push for something to be done about non-Annex 16 aircraft. They argued that another ten to twenty years of service for these noisy aircraft was too much to be endured.

In the absence of meaningful action by ICAO in this area, the United Kingdom Government has been working more closely with ECAC toward restricting the use of such aircraft. In the White Paper of February 1978 the Secretary of State for Trade announced two important decisions. First, United Kingdom operators would not be allowed to register acquisitions of non-noise certificated aircraft after 30 September 1978; and secondly, all of the existing non-certificated aircraft must be phased out by 1 Jan 1986. These rules are substantially similar to the U.S. requirement in 91-136.

The United Kingdom action is but one of several; more are in prospect. Although the impact of such actions will hasten the removal of the aircraft from countries following the ECAC plan, it will also gradually add more noisy aircraft to an ever smaller market and thus adversely affect the price of these used aircraft. Currently there are still enough developing countries desiring these jet aircraft,
which are cheap in comparison with the price of new aircraft, to enable the craft to be sold at prices substantially above book value, thus aiding the seller with cash flow for his new aircraft program. However, sharply rising fuel prices are rapidly diminishing the attractiveness of such aircraft even to developing countries.

4. Operational Measures for Noise Control

As has been indicated, reduction of noise at the source entails a long lead time from design to the utilization of significant numbers of planes on scheduled operations - perhaps four to eight years. The dates of applicability of the various parts of Annex 16 and its failure to deal with non-Annex aircraft have done little to accelerate the introduction of quieter aircraft. In fact it may be argued with some logic that Annex 16 has merely validated the state of the art. Land-use planning, another approach to limiting noise, seeks to control noise by moving the airport neighbors further from the noise either physically or synthetically by noise insulation. Here too similar long periods of time are involved.

It is not surprising, therefore, that amenity groups sought immediate action on the noise problem in the form of operating restrictions of two types. One type ostensibly permitted unlimited operations but required the crew to use (1) minimum noise routes, (2) specific higher and therefore less noisy altitudes, and (3) reduced thrust (noise being function of power). Additionally, pressure
was applied to reduce reversing, limit the use of the APU, and to control ground runups.

The second type proposed and implemented contained more stringent restrictions which reduced the number of flights in order to affect the cumulative noise index. These restrictions included various forms of curfews such as a complete ban on landings and/or take-offs during certain hours, the permission of only mail flights during the night, or a quota system allowing either a flat or decreasing number of noisy aircraft to use the field or a runway during stated hours. Finally, bans were sought on the use of training flights at noise sensitive airports.

The following are some of the restrictions implemented using Heathrow and Gatwick as examples.

4.1 Limitation of Night Jet Movements: Strong complaints relative to the noise of the new jets led to the imposition of night restrictions at Heathrow as long ago as 1962. At that time night was defined as 2300 to 0700 hours, and a quota of 3,000 was established as to the number of landings and/or takeoffs permitted.\(^\text{12}\) Through a scheduling or "slot" committee made up of airline representatives, the airlines divided the quota among themselves. In 1965 "night" was shortened to 2330 to 0600. Summer restrictions at Gatwick

began in 1971. The system was significantly revised in 1972 when the quota system was abandoned in favor of an outright ban on jet takeoffs with no limits on landings. Total movements increased and the system was quickly revised in 1973 by reimposing limits on the total number of movements. As a result of public pressure the government has since 1973 adopted a policy of progressively reducing the quotas for jet operations with a lower quota for winter than summer. In 1975, to encourage the use of quieter aircraft, a plan was begun to establish a night subquota for quiet aircraft while reducing the quota for other aircraft.

However, in 1977, public pressure again led to a proposal to ban all night jet operations. In lieu of an outright ban, in February 1978, the government announced the progressive phasing out of noisy aircraft at night over a ten-year period by reducing the quota of noisy planes and increasing the quota of the quieter planes. To provide still more flexibility the definition of noisy currently does not depend on noise at the maximum certificated gross weight. Planes which do not meet the noise standards at full gross may make reduced weight takeoffs if such will permit them to comply with the standard. Table 2 presents the details of the new quota arrangements determined by the Government. Night time is 2330-0630 six days a week at Heathrow, with some leeway for noise certificated aircraft on Sunday, when "night" time stretches to 2330-0800 and applies for all other aircraft. A jet aircraft will qualify for the quieter
### Table 2

**NIGHT JET QUOTAS AT HEATHROW AND GATWICK**

<table>
<thead>
<tr>
<th>Noisier Quotas</th>
<th>Heathrow</th>
<th>Gatwick</th>
<th>Winter</th>
<th>Heathrow</th>
<th>Gatwick</th>
</tr>
</thead>
<tbody>
<tr>
<td>(including the number of noisier take-offs in brackets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>1800 (135)</td>
<td>2200</td>
<td>1979/80</td>
<td>1800</td>
<td>1100</td>
</tr>
<tr>
<td>1980</td>
<td>1900 (105)</td>
<td>1900</td>
<td>1980/81</td>
<td>1400</td>
<td>950</td>
</tr>
<tr>
<td>1981</td>
<td>1400 (90)</td>
<td>1600</td>
<td>1981/82</td>
<td>1200</td>
<td>800</td>
</tr>
<tr>
<td>1982</td>
<td>1200 (75)</td>
<td>1400</td>
<td>1982/83</td>
<td>1000</td>
<td>700</td>
</tr>
<tr>
<td>1983</td>
<td>1000 (60)</td>
<td>1100</td>
<td>1983/84</td>
<td>800</td>
<td>650</td>
</tr>
<tr>
<td>1984</td>
<td>800 (45)</td>
<td>800</td>
<td>1984/85</td>
<td>600</td>
<td>450</td>
</tr>
<tr>
<td>1985</td>
<td>600 (30)</td>
<td>600</td>
<td>1985/86</td>
<td>400</td>
<td>250</td>
</tr>
<tr>
<td>1986</td>
<td>400 (15)</td>
<td>300</td>
<td>1986/87</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>1987</td>
<td>0 (0)</td>
<td>0</td>
<td>1987/88</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Quieter Quotas**

(These cover all non-jet aircraft, the quieter jets and, to the extent that this can be demonstrated in practice, other jets whose take-off at reduced weight matches that of the quieter aircraft at maximum weight.)

<table>
<thead>
<tr>
<th>Sumner</th>
<th>Heathrow</th>
<th>Gatwick</th>
<th>Winter</th>
<th>Heathrow</th>
<th>Gatwick</th>
</tr>
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<tbody>
<tr>
<td>1978</td>
<td>1700</td>
<td>3100</td>
<td>1978/79</td>
<td>1400</td>
<td>1700</td>
</tr>
<tr>
<td>1979</td>
<td>1900</td>
<td>3400</td>
<td>1979/80</td>
<td>1600</td>
<td>1800</td>
</tr>
<tr>
<td>1981</td>
<td>2000</td>
<td>4000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: British Airports Authority Annual Report and Accounts 1977/78, p. 73.
quota if its noise footprint as measured by a 95 PNdB contour embraces less than 4 square miles on takeoff and 2.5 square miles on landing. The area within the 95 and 105 PNdB contours and the population contour within 95 PNdB are shown in Table 3.

According to the Department of Trade, 95 PNdB is the noise level below which, on "current evidence," was considered questionable and a three-year research program on the relationship between aircraft noise and sleep disturbance was established. Its announced purpose was to provide information for deciding whether night movements of quieter aircraft would be banned. In pointing out the effectiveness of the new plan the Department of Trade indicated that only the quietest modern jets would be able to meet the standard and gave as examples: (1) for takeoff the A300B, two L1011 models and the DC10-10; and (2) for landing: the same planes plus the DC9-40 and 2 B747 models. The 95 PNdB referred to is an outdoor reading. Given the transmission losses through walls the resulting indoor level would be between 70 and 80 PNdB which was just below the threshold of awakening. This standard plus the noise insulation schemes suggest that British families do not have the same penchant for outdoor living as do their counterparts in the United States.

4.2 Limiting Airport Capacity. Another method of recent origin in attacking noise at Heathrow, though congestion was equally important, was placing a limit on airport capacity. At present Heathrow, the largest international airport in the world, also has the most serious
## TABLE 3

AREA WITHIN 95 AND 105 PNdB CONTOURS FOR SELECTED AIRCRAFT

<table>
<thead>
<tr>
<th></th>
<th>Departure</th>
<th></th>
<th></th>
<th></th>
<th>Landing</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A300B</td>
<td>TriStar/DC10</td>
<td>Viscount/Vanguard</td>
<td>B707/DC8</td>
<td>A300B</td>
<td>TriStar/DC10</td>
<td>Viscount/Vanguard</td>
<td>B707/DC8</td>
</tr>
<tr>
<td>Area within 95 PNdB contour (square miles)</td>
<td>2.5</td>
<td>3.9</td>
<td>4.6</td>
<td>28.5</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
<td>10.1</td>
</tr>
<tr>
<td>Area within 105 PNdB contour (square miles)</td>
<td>0.7</td>
<td>1.0</td>
<td>1.0</td>
<td>4.8</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>2.8</td>
</tr>
</tbody>
</table>

### Population within 95 PNdB contour

<table>
<thead>
<tr>
<th></th>
<th>Departure</th>
<th></th>
<th></th>
<th></th>
<th>Landing</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A300B</td>
<td>TriStar/DC10</td>
<td>Viscount/Vanguard</td>
<td>B707/DC8</td>
<td>A300B</td>
<td>TriStar/DC10</td>
<td>Viscount/Vanguard</td>
<td>B707/DC8</td>
</tr>
<tr>
<td>HEATHROW</td>
<td>28R (westerly) 4,000</td>
<td>6,900</td>
<td>7,400</td>
<td>78,100</td>
<td>9,000</td>
<td>12,400</td>
<td>14,200</td>
<td>116,600</td>
</tr>
<tr>
<td></td>
<td>28L (&quot;</td>
<td>3,700</td>
<td>6,300</td>
<td>5,300</td>
<td>62,800</td>
<td>6,400</td>
<td>9,100</td>
<td>8,700</td>
</tr>
<tr>
<td></td>
<td>10R (easterly) 4,900</td>
<td>13,700</td>
<td>13,500</td>
<td>246,300</td>
<td>500</td>
<td>800</td>
<td>700</td>
<td>5,600</td>
</tr>
<tr>
<td></td>
<td>10L (&quot;</td>
<td>3,900</td>
<td>20,300</td>
<td>20,300</td>
<td>387,600</td>
<td>2,200</td>
<td>3,000</td>
<td>2,800</td>
</tr>
<tr>
<td>GATWICK</td>
<td>Westerly 200</td>
<td>200</td>
<td>500</td>
<td>9,500</td>
<td>500</td>
<td>800</td>
<td>500</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>Easterly 500</td>
<td>1,000</td>
<td>1,500</td>
<td>18,000</td>
<td>Less than Less than Less than Less than</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>1,600</td>
</tr>
</tbody>
</table>

noise problem. Currently it has 3 terminals which are about to reach capacity. At one time 5 terminals were envisaged. Because progress on noise would be inhibited if the airport were allowed unlimited expansion, plans for the fifth terminal were dropped. In fact, only recently a 4th terminal was approved, but only after a lengthy public inquiry. A similar public inquiry has been authorized to look into a second terminal at Gatwick.

As a part of the capacity control program the Government has ordered several airlines to move to Gatwick which has new facilities as well as a convenient rail line to London direct from the passenger terminal. From 1 April 1978 no whole plane charters of British and overseas airlines have had access to Heathrow. The new U.S. routes from Houston and Atlanta were ordered to use Gatwick. However, directives of the U.K. Department of Trade to Iberia of Spain and TAP of Portugal to move were contested in court with the result that the directive was declared illegal. At one time feelings were so intense that Spain suspended British Caledonian's rights to fly DC-10s via Madrid to and from South America. It appears that directing airlines to move to other airports will have to be accomplished by friendly persuasion rather than direct order. Airlines which have been at Heathrow feel they have "squatters' rights" and a move would cost them a share of the connecting business at Heathrow.

One way for an airline to combat capacity and noise problems is to purchase quiet but very large jets. The reduced frequency
required by larger aircraft contribute to a reduction in cumulative effect. It may be more than a coincidence that British Airways which is beholden to the government is the first to be pushing for a still larger 747.

4.3 Jet Training Limitations. There is an almost complete ban on jet training at Heathrow, and restrictions on the time and total amount of training at Gatwick and Standsted. Other airports have similar restrictions.

4.4 Limitations on Noise at Takeoff. Noise limits, backed up by noise monitoring equipment, are established at Heathrow and Gatwick. Gatwick has 4 monitoring points while the larger Heathrow employs 13. If the noise limit is exceeded the matter is taken up with the offending airline by the Department of Trade. Altitudes, rates of climb and thrust settings are prescribed, and in general are the IATA procedures.

4.5 Limitations on Noise on Landing. In the air minimum noise altitudes are established and aircraft must fly to avoid certain built-up areas. To quiet the landing roll pilots are asked, but for safety reasons not required, to avoid the use of reverse thrust.

4.6 Minimum Noise Routes. Although differing views have been expressed about their value, an elaborate network of minimum noise routes has been established. The U.K. "Air Pilot" and "G.A.F.G." lists 25 for Heathrow alone. See Appendix B for duplication of several pages of the "Air Pilot" and "G.A.F.G.".
4.7 Runway Management. The Heathrow preferential runway system has two aspects. One, there is a preferred direction of takeoff to the west to avoid congested metropolitan London to the east of the airport. Two, landings and departures are alternated on a weekly basis with landings on the northern runway one week from 0700 to 1500 and on the southern runway from 1500 to 2300 hours. The following week the procedure is reversed. Similar procedures are utilized at other U.K. airports.

4.8 Ground Running Noise. The airport authorities have the power to and do restrict engine test runups at night to certain parts of the airport and to certain times. This includes the use of "mufflers" to quiet the sound. The rules are restricting the use of the APU.

4.9 Noise Related Landing Charges. Except for Manchester where there has been a 20% landing fee rebate for the use of quiet planes, there have been no noise related landing charges. However, the Government now believes that a landing fee based on noise should be established and is engaged with ECAC and OECD in studying the matter. Noise charges are not new but those with experience in the matter point out that landing fees are such a small part of total operating expenses that the cost of substituting an improperly sized but quiet airplane would be more than that of paying a noise charge. If a very high charge were levied, service might be diverted to another city or nearby country whose airport did not have the same noise problem. The statement in the White Paper that the CAA will take noise into
account in licensing new companies and granting new route authority is a form of economic incentive to purchase quiet airplanes. In the same category is the quota rule giving advantage to Annex 16 aircraft.

4.10 Sanctions. Inquiry was made into the methods of enforcement of its noise rules. For example, what happens if a night curfew for an out-of-quota aircraft is violated? Oddly enough, so far, nothing happens. In 1978, at Gatwick a captain reported that he could not depart before the deadline and was ordered not to take off. Notwithstanding the detaining order, he took off anyway. No prosecution ensued because as the British Airports Authority interpreted the law a detaining order had to be physically affixed to the aircraft for the detention to be official. While the authorities were accomplishing the paper work, the pilot departed.

When noise excesses are recorded by the noise monitor, the practice has been to call in the offending carrier who takes it up further with the crew involved and reports back. Inasmuch as angle of bank, meteorological conditions and other elements affect the noise readings and inasmuch as deviations are sometimes caused by traffic control where perhaps safety is involved, the authorities find "friendly persuasion" much better than confrontation. This brings up a delicate point involving the command authority of the captain. Thus, legal action is viewed with some trepidation. In this area the U.K. treads a little more lightly than other countries, Germany for example.
5. **Implications of Noise Regulations and Policies**

In its 1978 Airports Policy White Paper, and in the 1977-78 British Airports Authority Annual Report, the Government paints an encouraging assessment of its noise programs. According to those documents, the peak of noise annoyance has now been reached and, with the introduction of new quieter aircraft, there will be a "dramatic" decrease in the noise annoyance level over the next 15 years. Shortly after the announcement that the Government would take noise into account in considering applicants for transport, Sir Freddie Laker stressed the low noise emissions of his new wide-bodied aircraft and argued for the relaxation of curfew restrictions for such aircraft.

A British Airways executive pointed out that his company was under heavy pressure to phase out the noisy Trident, BAC-111 and the VC-10. Although the BAC-111 could be hushed to meet Annex 16, there was the fear that the quality of the noise would still be unsatisfactory, regardless of technically meeting the standards. Based on Swissair's experience with the public's reaction to the DC-9-50 (discussed later), and considering quality as well as quantity of noise, BA turned to the Boeing 757 to replace noisy aircraft.

There has been general agreement that the new wide-bodies have acceptable noise emissions. However, concern was expressed that the lack of planes with similar low noise emission characteristics in the 100-160 seat category was a negative factor in dealing with the
public and even in pushing for a relaxation of curfews for the quieter aircraft. With a large number of what the public perceive to be noisy aircraft not only still existent, but still being produced and purchased, the public feels it dare not relax its guard lest it loses the noise relief which it has so painfully gained.

After the close of 1978 with its unusually large increase in traffic, several interviewees were again contacted and asked whether growth rates in excess of that predicted would not dim their optimism for future noise relief. Their consensus was that the increase, if prolonged, would be taken care of by larger equipment which would itself be quieter. Thus the number of movements would not increase. However, at that time the dimensions of the new Carter international aviation policy had not yet become clear. The freer exit and entry and invitation to lower fares implies more movements and unless the movements are in very quiet aircraft, more noise.

The resultant decisions were to: (1) revive the insulation grants schemes, (2) push for landing charges based on noise, (3) move further into land-use planning, (4) phase out noisy jets, (5) and move to press for special rules and incentives for the quietest airplanes. The foregoing indicate to the airline and manufacturing industry the extent of the U.K.'s commitment to improving the quality of life for airport neighbors. This is not to say that the government rules are responsible for all improvements. The engine manufacturers such as Rolls-Royce, have been heavily committed to
designing quieter engines. However, the manufacturers are caught in a trade-off problem. Reducing noise emissions is a costly process, and where noise control entails designs which are not cost effective the manufacturers, understandably, hesitate to proceed.

6. Summary

The U.K. has a very extensive aggregation of noise rules. Although damage suits for aircraft noise are forbidden, other wide-ranging rules compensate for this seeming "pass" to the industry. Administratively, although other departments are also involved, the Department of Trade has the primary responsibility for aircraft noise control. Compensation for decreases in property values is made under the Land Compensation Act of 1973. To aid in quieting the noise at the home of recipients of noise, the Government has provided grants for insulation purposes. Though by terms of their statutes the early grants expired in 1978, new legislation in 1980 provides greater benefits and broader coverage. While land-use planning in the past has been by publishing guide lines only, the Government is pushing mandatory planning and indeed has set up an inquiry for the 4th terminal at Heathrow.

With regard to noise at the source, the U.K. not only supports all of Annex 16 but has gone farther in two respects. First, after 30 September, 1978 no carrier can enter on the U.K. register an aircraft not meeting the standards of Annex 16. Secondly, the carriers are required to phase out of their operations by 1986 all
non Annex 16 aircraft currently on the U.K. register.

For immediate relief with the tools at hand, the U.K. employs just about all the techniques available in the operational field. There are stipulations as to take-off and landing procedures and configurations, the provision of minimum noise routes and altitudes -- all of which are subject to noise monitoring. Some operations such as training flights are either banned or severely restricted. On the ground, limits on the use of the APU and the ground running of engines during night hours are increasingly found. Finally, there are strong "suggestions" limiting the use of reversing. To minimize noise, over the more populated areas immediately off the landing and take-off runways, not only are preferential runways specified but their use is alternated in such a fashion as to spread the noise.

Two types of capacity controls, one whose sole purpose is to limit noise, and the other, with an ancillary purpose of noise control, have been developed. First, to put a ceiling on noise, a quota for night movements has been established which will eventually ban all noisy aircraft at night. Second, to limit congestion, and to aid in noise control, the Government has placed a ceiling on the capacity of certain airports. This is accomplished by limiting the terminal facilities available. The Secretary of State for Trade has announced that a 5th terminal at Heathrow will not be built. However, after a public inquiry, a 4th terminal has been authorized.
Finally, in the matter of financial incentives for the purchase of quieter planes, the U.K. is proceeding very gingerly. The Department of Trade is interested in adding a landing fee containing a noise charge element to its arsenal. Although Manchester has had a rebate system for less noisy aircraft, no study has yet emerged analyzing the benefits and disbenefits of such a charge.

If the case of the Gatwick pilot who willfully violated a curfew limit but was not prosecuted because the "paper work" was not completed in time to paste the detaining order on the airplane is any criterion, the enforcement of sanctions seems to be weak in the U.K. However, the Government and the industry agree that working for quiet through "friendly persuasion" is better than by confrontation.

Another incentive for purchasing quiet aircraft is the relaxation of curfew restrictions for such aircraft. On this point one of the interviewees was moved to remark "Night is really no; the big problem it is made out to be. Neither the crews of ground employees or passengers want to be up that late anyway."

7. Conclusion

Unless the new international air policy of the United States of "open skies" and little rate control leads to a major increase in operations there is light at the end of the tunnel for the noise problem in the United Kingdom. However, the environmentalists point out that 15 years is a long time to wait and they, therefore, will
continue their pressure for stronger measures. To a certain extent the U.K. public has been unimpressed by statements that compliance with Annex 16 Chapter 2 means acceptably quiet airplanes. To a significant portion of the public Annex 16 represents a mere validation of the state of art and its ultimate benefits are too far in the future. This perception seems to have impressed management so that re-equipment decisions are often being realistically made with consideration for the public concept of noise annoyance and not whether or not the plane meets a technical noise standard.
# APPENDIX 2

**RECOMMENDED CRITERIA FOR CONTROL OF DEVELOPMENT IN AREAS AFFECTED BY AIRCRAFT NOISE**

<table>
<thead>
<tr>
<th>Level of aircraft noise to which site is, or is expected to be exposed</th>
<th>60 NNI &amp; above</th>
<th>50 — 59 NNI</th>
<th>40 — 49 NNI</th>
<th>35 — 59 NNI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dwellings</strong></td>
<td>Refuse</td>
<td>No major new developments. Infilling only with appropriate sound-insulation — see Appendix 3</td>
<td>Permission not to be refused on noise grounds alone</td>
<td></td>
</tr>
<tr>
<td><strong>Schools</strong></td>
<td>Refuse</td>
<td>Most undesirable. When, exceptionally, it is necessary to give permission, eg for a replacement school, sound insulation should be required to a standard consistent with DES Guidelines (see footnote to para 7 of this circular)</td>
<td>Undesirable</td>
<td>Permission not to be refused on noise grounds alone</td>
</tr>
<tr>
<td><strong>Hospitals</strong></td>
<td>Refuse</td>
<td>Undesirable</td>
<td>Each case to be considered on its merits</td>
<td>Permission not to be refused on noise grounds alone</td>
</tr>
<tr>
<td><strong>Offices</strong></td>
<td>Undesirable</td>
<td>Permit</td>
<td>Permit but advise insulation of Conference Rooms depending upon position, aspect etc.</td>
<td></td>
</tr>
<tr>
<td><strong>Factories, warehouses etc.</strong></td>
<td></td>
<td></td>
<td></td>
<td>Permit</td>
</tr>
</tbody>
</table>

(It will be for the occupier to take necessary precautions in particular parts of the factory depending on the processes and occupancy expected. But see paras 25-32 of this Circular for control of new factories etc. in relation to their noise EMISSIONS.)
Minimum noise routes –
Heathrow Airport – London

Routes followed by aircraft taking off to the
East
South-west
West
Having examined aircraft noise regulations in Great Britain, we proceed across the English Channel to France where, despite the nearness of the two countries and the common problem of aircraft noise, the treatment of this nuisance may be different. Long standing commercial rivalry and cultural differences account for the disparity.

1. Brief History of Noise Problem in France

According to a French technical expert long associated with the French noise situation, noise was not treated seriously as a problem until much later than in England. As a matter of fact, government funding of noise research did not begin until 1967; and the first curfew at Orly did not occur until 1968 (cf Heathrow 1962). Once the French started to work on the subject, they worked more closely with the U.S. along the lines of FAR 36 than with the United Kingdom. Although the French joined ICAO to standardize on a common noise descriptor, internally they have hung on to their Isopsonic index (see page 13) and are currently working on some modification of it.

The power of Air France and French aircraft manufacturers to lobby effectively against constraining regulations is, because of the degree of ownership of Air France by the government, much less than that of their counterparts in the U.S. One dare not lobby very hard against one's employer. Apparently the initial Orly curfew was

13/ Interview with Jacques Balazard, SNIAS R&D, formerly Chargés de Mission Environment Nuisances.
put on suddenly by one person in the ministry over the objection of the
airport authorities, and once established it was impossible to remove.
The inhabitants around Orly have kept pressure on the legislators to
maintain the curfew.

Desiring to enhance its competitive position vis-a-vis Great
Britain, France resolved to build a modern, 24-hour operation, air-
port at Roissy, now known as the Charles De Gaulle International Air-
port (CDG). With this facility the French would be happy if the Great
Britain authorities placed increased night-time restrictions on London
airports. CDG is ready to accept the noisy aircraft which may be
barred elsewhere. Despite French government plans to avoid the pro-
blems of permitting homes near the airport, people have moved close
enough to complain and seek a curfew. The present government, be-
cause of the commercial impact of a curfew, is strongly opposed. One
can not predict what a different administration might do. Some French-
men argue that with no constraints there is no incentive for purchas-
ing quieter planes. They argue that a curfew for planes whose noise
emissions are above a certain value should be established. Noise re-
lated landing charges also have been urged. At present the closest
approach to an incentive for quieter airplanes is a rule applicable
to one runway at CDG enabling the pilot to continue a straight course
after takeoff if he is piloting a quieter airplane. Additionally, a
proposal has been made to lift the night curfew at Orly for Annex 16,
Ch. 3 aircraft, but it has not been adopted.

The question was asked of several French noise experts "Given
the increasing number of quieter aircraft such as the 747, DC-10, L-1011, A-300 and the planned development of a smaller quiet plane, do you see a relaxation of the trend toward curfews?" The answer, which was also given in some but not all European countries, was "No". The feeling was that tolerance of noise is inversely related to affluence so that given the rising tide of expectations and affluence there will be greater demands for noise suppression and more curfews will result even if there is some decrease in the various levels of noise. Despite the wishes of government authorities, a curfew could possibly come to General Charles DeGaulle Airport.

2. French Government Noise Structure

Civil aviation is one of several transportation modes under the Minister of Transport. Aircraft noise matters receive strong representation at the Minister's level through the Director of Civil Aviation whose current Director, Claude Abraham, was formerly the French representative on the Committee on Aircraft Noise (CAN) in ICAO. The director has under him a Mission (Department) for Environmental Nuisances. Members of this staff are active in advocating the French noise position within ICAO. As is the case in the U.S., Great Britain and other countries, France has a separate Department for Environment which would like to carve a piece of turf in noise matters from the Department of Civil Aviation. Both industry and the Department of Civil Aviation allege that the Department for Environment is
bent on "harassing" aviation. It will be recalled a similar situation exists in Great Britain. Instruments dealing with noise control are issued in the form of codes (laws), decrees (decisions under executive power carrying regulatory force), ordinances (adopted by government but subject to ratification), circulares (rules of conduct for interpretation within the administration), and arrêtés (decisions by civil authority such as ministers or mayors).14/

Ownership of airports: Some airports (Orly, Charles De Gaulle) are government owned and operated; while others (Nice) are private. The degree of emphasis on noise control may vary with the ownership or control of the airport. For example, the Nice Airport, a close-in airport, is controlled by the Nice Chamber of Commerce whose interests are in promoting tourism. Its own noise abatement department has not been successful in appeasing local inhabitants with the result that individual citizens have filed legal action against Air France.

3. Legal Basis of Noise Control

Unlike the law in Great Britain, the French Code of Civil Aviation contains no specific exclusion of aircraft noise as a basis for litigation. However, the code (Book I Title III Chap. 1 Art. L. 141-142) states that the operator of an aircraft is responsible for

14/ A compilation of noise laws and regulations of the French Republic, called Recueil Des Textes Relatifs Au Bruit Doc. 1383, was published in 1978.
damages caused by operations of aircraft, or objects detached from it, to persons and goods on the surface. Since noise is not mentioned, attempts, so far unsuccessful, have been made to argue that the law contemplates only physical damage by falling objects. Some years ago Pan Am, TWA, and Air France were sued for soundproofing expenses made necessary by aircraft noise. Judgment was rendered against the named airlines. However, appeals have been winding through the French courts for years with the end not in sight.

4. Noise At The Source

Control over noise at the source is provided by Art. R. 135 (Decree no. 73-256, Mar. 6, 1973, art. 3) which mandates as a part of the aircraft certification requirement that an aircraft have a valid "certification of limitation of nuisances (noise)". For aircraft of French registry, a decree of April 18, 1974, adopted Annex 16, 1st ed., Aug 1971, including amendment 1 to the Chicago Convention.

A Decree of July 30, 1975 established further conditions for issuance of noise limitation certificates including application to aircraft not listed on the French register but which fly over French territory. Additionally, Article 15 requires that imported aircraft must satisfy French requirements, or those of the exporting country plus any additional requirements made by the French government to insure the same noise limitation as if the plane had been built in France.

Another modification of the regulations was effected by the Decree of June 2, 1978, permitting a non-Annex 16 plane to replace
a non-Annex plane which was destroyed, if replacement was within one year. Also, additional non-Annex craft could be purchased and used if the owner had purchased and agreed to install within one year such sound modification equipment as would cause the aircraft to comply with Annex 16. Essentially, with the limited exceptions just noted, since 1978 a non-Annex 16 Ch. II aircraft cannot be entered on the French aircraft register, thus freezing the number of noisy aircraft.

Finally, two other items indicate that the French are listening to noise complaints and taking a strong position favoring quieter airplanes. First, although it has not yet been technically accomplished, the French are adopting Chapter 3 of Annex 16 (3rd ed.) into French law. French aircraft manufacturers are proceeding on the instruction that any newly certificated plane will have to meet ch. 3. The strictest provision of Chapter 3 apply to aircraft whose application for certificate is after Oct. 6, 1977 (U.S. Stage 3). Secondly, at the ICAO CAN meeting (May-June 1979), the French urged that internationally no non-Annex 16 Chapter 2 airplane be permitted to operate after 1 Jan 1985 unless its owner had a firm contract for a Chapter 3 replacement which was to be delivered before 1 Jan 1988. After 1 Jan 1988 registration of non-Annex 16 ch. 3 be stopped. Finally, the proposal was made that as of 1 Jan 1995 only Chapter 3 Annex 16 planes be permitted to operate.

15/ ICAO, CAN 6 Working Paper No. 49.
French efforts and those of their supporters to cut off the operation of Chapter 2 aircraft were unsuccessful. Some observers, pointing out that the French manufacture the Chapter 3 (Stage 3) Airbus 300 series, question whether the French would be as aggressive if they had a profitable line of Stage 2 aircraft to sell. Similarly observers indicate that it is no coincidence that the U.S., whose Boeing Company has a profitable line of 727s and 737s which do not meet Stage 3, did not support the proposal.\textsuperscript{16/} One can suggest that members of this "impartial" technical body are often found advancing positions which mirror the current commercial or national interests of the country they represent. The structure of ICAO lends itself to this result. While all the voting members of ICAO are government officials who do not necessarily possess technical expertise in the field, they have constantly at their elbow in preparation for and during the meetings the technicians from industry whose job is to provide information and advice. In France it is quite normal for an individual to float back and forth between industry and government. Obviously these technicians either consciously or unconsciously support those proposals which will be advantageous to the manufacturers or carriers in their country.

\textsuperscript{16/} ICAO, Can 6 Working Paper No. 65.
5. Curfews

At the present, the main curfew in France is at Orly where jet landings are prohibited between 2330-0615 and take-offs from 2315 to 0600. At Baale-Mulhouse (Franco/Swiss Airport) there are time slots in which the number of take-offs/landings are limited for non-Annex 16 aircraft. At Nice there is a winter period in which take-offs between 2200 and 0500 are prohibited. In summer the time is 2100-0600. Le Bourget prohibits take-offs from 2330-0600.

French commercial jet aircraft manufacturing is concentrated at Toulouse in the south of France. Although there have been complaints on noise, mainly because of the Concorde and military flying, no curfew has been established. The airport has endeavored to purchase land impacted by noise, but, ever so, the vibrations associated with the noise have torn tiles off the roof of farms and the airport has had to made restitution. This brings up a conflict in French law. We noted previously that one law makes the operator of aircraft responsible for damages. But, in addition there is another law which makes the airport responsible. There seems to be no concerted effort to resolve this discrepancy.


Because the regulations dealing with noise at the source

(emissions) give relief only sometime in the future, efforts have been to reduce the noise reaching the recipients through insulation and land use planning. Controlling sound through insulation of buildings is called "immission" control. Since 1973 (a prior law was held technically invalid because the wrong people had signed the law) the French have established a head tax of one franc for domestic passengers and three francs for international passengers to be used to pay for noise insulation of such buildings as residences, schools and hospitals. At CDG the payment could include the acquisition of residential buildings, or relocation of residents, depending on the zone involved. For example, at CDG payment could only be made in the closest in area called zone A.

To prevent individuals from taking advantage of the situation by building and then seeking payment, the decree limits residential compensation to property whose title was acquired or whose construction was authorized before the noise problem at CDG was foreseen - July 1, 1970. Financial aid cannot exceed 66% of the price of the work done (except for families receiving public aid). However, non-residential buildings can qualify if they were completed before July 1, 1974; this is the case at CDG. The monetary limit is 6,000 Fr. for collective lodgings and 10,500 Fr. for individual lodgings - 3 rooms per lodging. A final feature of the law is the absence of cross-subsidy - the money from CDG goes for noise around CDG and the money at Orly stays with Orly.

The French themselves have recognized some inequities in this
noise scheme. First, the law is redistributive in nature - it takes money from each passenger and distributes the amount for abating the noise immission. Secondly, since the tax applies equally to passengers aboard noisy planes and quiet planes, there is no incentive to purchase quiet aircraft. For several years the French have been working on an incentive scheme which would relate all or a part of the landing charge to the noise emitted by the aircraft in such a fashion as to induce airlines to buy quiet aircraft.

A plan, which was very recently on the point of being introduced when some legal and administrative problems caused it to be pulled back, has been constructed to charge for noise based on the weight of the aircraft and its deviation from the maximum permissible noise under Annex 16 Chapter 2, called "reference noise"-RN. The aircraft emission noise would be called "characteristic noise"-CN and would be the sum of the noise levels of three measuring points expressed in EPNdB as defined by Annex 16 Chapter 2. Aircraft would be classified into five categories as follows:18/

Category I if CN > RN;

Category II if CN is equal to or lower than RN by a maximum of 9 EPNdB;

Category III if CN is lower than RN by no less than 9 EPNdB and no more than 18 EPNdB;

Category IV if CN is lower than RN by no less than 18 EPNdB and no more than 27 EPNdB;

18/ Ibid. pp. 77-78.
Category V if CN is lower than RN by more than 27 EPNdB.

The charge would be calculated by applying a rate of:

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate (t Francs per ton of maximum take-off weight)</th>
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<td>III</td>
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</table>

The basic rate t could amount to 4.4 francs. Such a charge would be between 5-10% of landing charges for the Category III aircraft and up to 20% for the noisiest ones.

Many, including some responsible for developing this formula, feel that incentive charges of this nature will never work. They point out that inevitably there appears to be at least one plane whose combination of weight and noise in comparison with another makes its noise charge inconsistent with that of a similar airplane. Additionally, it is unlikely that any one rate will work over the wide scale of available aircraft to provide the incentive for quieter planes. If the charge is too low, it may be faulted for merely being a "license to pollute"; and if too high it can have serious economic implications for not only the operator of the aircraft but the region served by the airport itself.

7. Land-Use Planning and Building Codes

In addition to noise insulation schemes and the plans for noise-related landing charges, the French government is engaged in land-use planning. By a 1973 law each airport must publish a noise
contour map based upon forecast traffic for 1985. This map uses the Isopsophic index. Within zone A (Isopsophic 9€) only necessary airport buildings are allowed. In zone B commercial buildings must have soundproofing and double glazed windows which will reduce noise to 35 dB and residential building is not permitted. Zone C is a moderate noise zone in which no large developments are permitted. Such residences as are permitted must be soundproofed and meet the requirements listed in the building permit. Even outside of zone C special studies are encouraged to determine whether large commercial and apartment buildings require soundproofing.

In connection with the building permit situation several interviewees made the point that building rules in France were very, very strict and had a "more important effect on peoples' lives than all other laws put together". The government can refuse a permit to build, give no reason, and pay no compensation. 1978 legislation, entitled Plan du Occupation du Sol, involves the right to build or not to build and covers building codes and zoning. This is in addition to the Sept. 1977 Decree 77-1066 on National Planning for the construction within airport noise zones. Airport noise maps are made available to town planning authorities as a basis for development schemes and land-use planning. On the other hand, individuals finding themselves in zone A at CDG or Orly can ask to have their homes bought by the government and when bought, they must move away. A commission established for appraisal purposes determines compensation. Having found that when someone moves out, no matter how
noisy the area is, squatters will rush in, the government has found it necessary to demolish the homes immediately. About 90% of the people applying have accepted the commission's price.

Thus, at present, airport planning in France must take noise into account.

8. Operational Procedures - Noise Monitoring

The two major Paris airports, CDG and Orly, have a wide range of operational rules for noise abatement purposes. As a result of legal action by nearby residents, minimum noise departure and arrival routes have been established. Minimum altitudes are prescribed. On the ground, run-up suppressors must be used. Strict noise abatement take-off and climb procedures are in effect. An extensive noise monitoring system is employed to record aircraft noise. Overall average noise is monitored to see whether the noise routes are being followed. Marked excesses over the average or a pattern of one airline's planes making more noise than that of similar types of other airlines, results in written notice to the airline involved. The airline must and does investigate and answer in writing. Officially the airlines are to use the standard IATA noise abatement procedure for takeoff. The vice president of an American airline utilizing CDG expressed pleasure at the willingness of the airport authorities to try out and approve modifications of the IATA procedures when such modifications provided lower noise emissions from a particular type
of equipment.19/

9. Summary

Although starting somewhat later than the U.K. in acting on aircraft noise, the French have developed an extensive system of noise control at its Paris airports. Problems at other airports are not major. The present government, for competitive reasons, has a policy of keeping the General Charles DeGaulle airport open 24 hours a day. Through zoning and building regulations as well as through acquisition of property in noisy areas the government is attempting to blunt any attempt to impose a curfew there.

Within ICAO France has aggressively been favoring a rule which would require 4-engine aircraft to meet Annex 16, Ch. 2, by 1 Jan 1985. The same rule would apply to 2- and 3-engine unless by that date there was a signed order for the quieter Chapter 3 aircraft. And finally France has proposed halting the registration of planes not meeting Ch. 3 as of 1 Jan 1985 for planes over 50 tons in weight and 1 Jan 1988 for all aircraft. By 1995 all planes operating would have to meet Chapter 3.20/ Finally, France is at the point of formally adopting Annex 16, Ch. 3.

French law is not favorable toward successful prosecution of

19/ Interview with Claude Girard, SR. V.P. Operations for Europe, TWA.

law suits for aircraft noise. Since the law apparently requires the suit to be against either the pilot or the owner of the aircraft, the suits against cumulative noise are difficult. The practical question is, how does one apportion noise damages if a large number of aircraft of varying sizes and noise characteristics are involved?

Recognizing that present airport head tax for distributing funds for noise insulation penalizes quiet airplanes as well as noisy ones, the Department of Civil Aviation has a plan before the Minister to install a noise related landing charge the purpose of which is to provide an incentive for the purchase of quieter aircraft.
Switzerland, a landlocked country amid mountains of unmatched scenery, with superb technical industrial skill, with political and economic stability, is a banking and insurance center and has long been a favorite for tourists and businessmen alike. The introduction of commercial jet aircraft and the attendant cutting of travel time and cost accentuated air travel for business and pleasure to and from Switzerland. Air transportation became vital to the economy of this small (16,000 square mile, 6.5 million population) nation. Because of the topography and population concentration, airport locations are not only extremely limited in number but the possibility of significant expansion of existing airports is small to nil. A postwar housing shortage resulted in housing being constructed over the objection of airport authorities in locations much closer to the airports than would otherwise have been the case.

The well known independence of the Swiss, and the proclivity of their states (cantons) to subject legislative proposals to repeated referendums, has inhibited timely solutions to the aircraft noise problem. Pressure from the Swiss citizenry and neighboring country inhabitants who do not wish their well ordered lives disturbed by aircraft noise has, in recent years, resulted in the establishment of one of the strictest set of noise rules in Europe or the world. So strong are the Swiss feelings on aircraft noise that Swissair felt it necessary to exert heavy pressures on manufacturers and to place noise characteristics ahead of economics in a
recent equipment purchase. Their alternative, was to face a possible closure of the Zurich airport.

1. Government Structure and Legal Basis of Noise Regulations

The Swiss two-house parliament adopted a basic federal law on air transportation in 1948. The law has been amended several times. Under this legislation the Federal Department of Transport and Communications and of Energy (DFTCE) exercises surveillance over air transport through its Federal Air Office (OFA). By a concession the federal government gives to the cantons (equivalent to our states) the right to own, construct and operate airports. Thus, for example, it is the canton of Geneva and not the city of Geneva which controls the Geneva airport. That airport was built in 1919 in the only place available and, with some runway extensions, has remained in the same place. Subsequently a number of cities have sprung up around it. However, the cities cannot control the noise problem directly, it being a cantonal function. In Zurich the situation is somewhat similar. As indicated earlier, a shortage of housing in the 1955-65 period led to approval by the cantons of many housing projects located near airports, notwithstanding requests by the OFA that this not be done. At that time land-use planning had not been developed. Up to 1970 there were no special noise regulations except perhaps some restrictions on night run-ups.

As a result of increasing complaints over the noise generated by the growing number of jets flying into Switzerland, there were enacted,
starting in 1971, a series of laws and regulations. The first was noise-at-the-source legislations in 1971 and curfew regulations in 1972. There followed a number of laws, amendments, and regulations which tightened noise-at-the-source rules, prohibited supersonic flight over Swiss air space, provided for land-use planning or zoning, a noise index, a limit on the number of aircraft operations, the right of eminent domain, indemnity for less of value due to noise, noise monitoring, and many operational rules applicable on the ground as well as in the air. Additionally each aircraft was required to have a noise certificate. During this period the Department of the Interior and the Federal Environmental Protection Office obtained roles in noise abatement. Finally, in 1978, a law was enacted which dealt with future phasing out of noisy aircraft.

As yet no sanctions have been levied against pilots or companies exceeding the noise limits. Rather, friendly persuasion and publicity of offenders have been employed. In any event, by Swiss law a pilot cannot personally be responsible because he is doing his duty for his company. It is the company which is responsible for damages caused by a plane in flight to persons on the ground. However, this was held to be corporal damage, not loss of value or loss of sleep. It was dissatisfaction with the corporal damage concept, among other things, which led to specific laws providing for noise zones and certain indemnification for other than physical damage.²¹/²¹/²¹/²¹/²¹/

²¹/ Interview with Dr. Bernhard Staehelm, Deputy Secretary General Swissair, October 1978.
The cantons are not completely free to do as they wish on airport matters. Not too long ago a canton wished to extend the runways at an airport. This would require the federal government to advance money for construction to be paid back through landing charges. Parliament refused, saying that longer runways mean more traffic and more noise. Its advice was to stop growing and limit the number of movements.

Among the various bodies with inputs to the noise problem and legislation is the Federal Air Navigation Commission - a counseling body with a minimum of seven members containing representatives from the airlines and noise abatement societies. Each canton also has a commission appointed by the canton containing people from ATC, the airlines and the environment. This commission is active in making recommendations to the government, particularly on noise.

From the above discussion one might assume that the Swiss have a complete and effective operating mechanism for handling the noise problem. While the legislative framework is there, implementation is another matter. For example, the Zurich canton law since 1972 and the 1977 amendment provided for noise zones and land-use planning; but dissatisfaction with some of the provisions and the Swiss system of a popular vote being required on so many items have resulted in delays. The requirement of drawing noise contours for ten years in advance was time consuming. Citizens had a year to protest the results. The contours at Zurich were based on a longer planned runway which was subsequently disapproved. Accordingly, the contours have had to be adjusted.
The above problems are mild compared with those which would have resulted if the environmentalists had had their way. They proposed to amend the Swiss Constitution to provide: (1) A complete ban on night flights unless an airline could prove its plane would not disturb sleep. Since the onus was on the airline, this is an exception which would not be an exception. (2) Swiss airports and Swiss airspace could be used only if it could be proved that the population would not be molested by noise. And (3), if an airport were to be built or modified, an impact statement would have to be submitted after which the airport or modification would be subject to approval of a vote by all Swiss cantons, a vote which would require two majorities: (a) popular vote, and (b) a majority in the canton. If approved there would have to be another vote on the financing. Should all that come to pass, the environmentalists proposed the right of appeal to a court.

2. The German-Swiss International Dispute

The proximity of airports in Europe to the border of another country can lead to serious noise problems with international repercussions. Traffic out of Zurich on runway 34 after crossing the Rhine a few miles after take-off passes over several German villages. A number of these villages are unchanged from early times and might be called "idyllic" spots to get away from modern-day pressures. In 1977, after some increased usage of runway 34 at Zurich, serious opposition to the resulting noise developed in an area centered at Hohentengen, Germany. When the Swiss and German authorities met to
work out some solution, the German villagers took the hard line that they would accept no noise at all from a foreign country. Two property owners in Germany sued the canton of Zurich in a German court, creating a jurisdictional problem, and demanded that over-flying cease or damages be paid. Bonn reacted vigorously and demanded a change in departure routes so that no flights to and from Zurich would fly over German territory between midnight and 5 a.m. To the consternation of the people of Zurich the Swiss federal authorities bowed to the major part of the Bonn demands. However, in less than two months the Swiss resumed their earlier procedure. The consensus is that the matter was more political than real for the Hohentengen people did not want the noise to be measured. Studies seemed to indicate that the noise level complained of was much lower than had been considered unobjectionable elsewhere. Indeed, the German airline, Lufthansa, was hopeful that the Swiss would win the argument lest a new lower standard of noise be established in Germany with which it would have to comply. No final resolution has been published.

3. Noise at the Source

Given their sensitivity to the noise problem, it is not surprising that the Swiss have formally incorporated into their ordinances the latest of the Annex 16 standards. Since 1972 subsonic jets presented for noise certification before Oct. 6, 1977, must meet
Annex 16 Ch. 2. Applications made after Oct. 7, 1977, must meet
Annex 16 Ch. 3. Because of the long time it took ICAO to agree on
the standards in the first place, and the time lag to the effective
date, plus dissatisfaction with the results, the Swiss citizenry have
been unimpressed with relief accorded by compliance with Annex 16.
They seek more relief by other means.

Lack of ICAO action on phasing out the early jets led Switzerland
to welcome the ECAC recommendation (Ch. 2 p. 9) of establishing dates
to phase out noisy aircraft. Switzerland decreed that after March 6,
1978, no non-Annex 16 plane may be entered on the Swiss register.
Further, those aircraft not meeting the Annex but already on the regis­
ter may not fly after Dec. 31, 1984. Thus, this date marks the end
of Swiss registered DC-8s and DC-9-32s, if they are not phased out
before that. Finally, an aircraft registered under the 1971 law will
not retain registration after Dec. 13, 1982, unless it has noise
certificate meeting the requirements of the new law.

A brief review of Swissair's equipment experience with the efficacy
of Annex 16 is informative. The Caravelle and the DC-8 were the first
jets to raise the noise problem. The frequency of Caravelle flying
was such that extreme public pressure was applied for relief. How­
ever, economics rather than noise regulations led to the early re­
placement of the Caravelle by the DC-9-10. The latter because of its
growth possibilities, was chosen over noisier BAC-111. Between 1967
and 1970 the DC-9-10's were exchanged for the larger, heavier, but
noisier DC-9-32s which did not quite meet Annex 16. Later, the larger, heavier DC-9-50 was developed and by terms of existing regulations was required to meet Annex 16. Swissair, thinking it had the solution, ordered the DC-9-50 series and embarked on a public relations program telling the citizens to be patient because the company had just purchased new planes meeting the noise requirements set by an international body - ICAO.

When the new airplanes arrived the citizens were disappointed and felt betrayed. The DC-9-50s were louder and the noise characteristics were more annoying than the DC-9-32s. Apparently neither the company nor the people had focused on the fact that under the noise emission limits in the Annex 16 formula a heavier, larger airplane (DC-9-50) is permitted to make more noise than a lighter, smaller craft. Thus it is quite possible for light aircraft to fail to meet a noise standard and be quieter than a heavier aircraft which meets the standard. Actually, the noise characteristics themselves of engine installation in the DC-9-50 served to accentuate the problem.

Except for the noise, Swissair was very happy with the DC-9-50. However, the growing complaints of the inhabitants around the airports and the damage to Swissair's corporate image, plus a recognition that the planes were indeed noisy, led the company to look for a quieter replacement and perhaps an exhaust mixer for the DC-9-50s. The president of Swissair indicated that the problem was so serious that he
would not dare purchase more DC-9-50s or turn to either the 737 or the 727 because they were all powered by the same engine. Real noise relief was a must. Ultimately, under the persistent prodding of Swissair, Douglas developed the DC-9-80, a much quieter plane but more expensive in price and in operating costs per seat-mile than the DC-9-50. Notwithstanding this apparent economic penalty, Swissair purchased the aircraft on the basis of its low noise characteristics.  

With this purchase the company "hoped" for a long-run pay back from the good will gained from airport neighbors, which might be translated into a relaxation of night curfews for this particular type of plane. Such a relaxation would, in turn, permit greater utilization of the aircraft and lower its unit operating costs.

4. Noise Curfews

In 1972 the Federal Air Office, acting under authority of federal law, established a uniform curfew for Swiss airports. Also, a noise monitoring program was begun. Over the years both of these programs have been refined. The basic curfew is from 10:00 p.m. local to 6:00 a.m. for both take-offs and landings. However, a limited number of operations are permitted scheduled carriers up to midnight and

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Interviews with Armin Baltensweiler, President Swissair; Prof. Max Berchtold, Member of Board of Directors, Swissair and Prof. of Mechanical Engineering, Swiss Federal Institute of Technology; Peter Gysel, Corporate Planning Manager Flight Performance, Swissair; and Peter Hablutzel, Division Manager, Engineering Studies, Swissair.
even a tolerance to 0030. Additionally, several mail and turboprop flights are permitted at still later hours; however, they are subject to a maximum noise limit of 75 dBA.

Some of the rules present anomalies. For example, a noisy commercial 707 might operate till 0030 but a quieter private A300 Airbus could not. However, the airports are open to emergency traffic all night. Some airports may be closed on Sundays or holidays or on "Federal Fast Day" if consultative commissions so direct. Details of these general rules are found in the Aeronautical Information Publication (AIP), Appendix C; and the rules particularly applicable at Zurich, in Appendix D. The curfew hours are such that long non-stop flights from the U.S. and Canada must leave in the early evening and arrive in Switzerland in early or mid morning after an all-night flight.

5. Operational Restrictions

While curfews abate noise during the period of curfew operation, unless the flight operations are cancelled, the noise is merely transferred to other periods of the day. A series of operational procedures have been instituted to minimize this problem. For example, at Zurich operational rules include noise abatement landing, take-off and climb procedures, special departure routes, minimum noise routes, minimum altitudes, arrival procedures, and restrictions on reverse thrust after landing. A preferential runway system is used up to

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23/ See Appendix D for the procedures contained in the Swiss AIP for Zurich.
9:00 p.m., after which the inhabitants receive a rest while runway 34 towards Germany is used, or runway 16. A political decision was made which allowed only landings on Runway 14. Runway 16 is preferred for short flights. Aircraft producing more than 95 dB(A) cannot use Runway 34 at certain times. Appendix E is given as an example of a portion of the plethora of instructions facing pilots on departures.

Ground noise has been a particular problem in Switzerland. Swissair has spent over 6.5 million, Sfr, on ground mufflers and silencing equipment. Additionally, there are strict time periods for engine run-ups and rules requiring the use of mufflers. Auxiliary power unit operation is limited to 60 minutes before scheduled departure and 20 minutes after arrival.

6. Noise Monitoring

To ensure that the various procedures are being followed and to detect deviations from noise standards, the Swiss operate a sophisticated noise monitoring system and from the data generate several kinds of statistical reports. The reports are circulated to the carriers and to government and are also published in a slightly different form for public information.

An example of this monitoring system at Zurich follows. Nine microphones are placed at strategic locations as shown in the Zurich map, Chart 11. The average noise level of all movements of each type of aircraft is computed. A limit for a given aircraft type is then set using the average of the lowest 99% of the cases. Each of the
Zurich - Airport
Noise monitoring chart
nine monitors records on tape the noise of each aircraft which exceeds a preset level. The results are matched to the flight number and equipment of the flight involved and exclusions above the limit noted. Every excess over the limit is immediately called to the attention of the airline. A 4 dB tolerance factor is used to take care of varying flight conditions and no written explanations of such excesses are necessary. Excesses of 5 or more dB require a written explanation from the company. Table 4 displays the format of the averages for runway 28 at monitoring points 1 and 2 for a 22 month period ending December 1977. Table 5 is for Runway 34.

Each month there is published and circulated to all airlines operating into Zurich a document showing the monitoring results. Each airline not only sees how its aircraft are performing, but also how each of its competitors are doing. Table 6 is a partial reproduction of one such report. The report to the public is considerably less detailed, containing only the dB(A) averages at certain points (Chart 12).

While the system has its critics, it appears to have some positive results. It was reported that one airline, on finding a particular pilot was habitually exceeding the limits, removed him from flying into Zurich.

7. Noise Zones - Land-Use Planning

Current Swiss law covering noise zones and land-use planning
### TABLE 4

**MEAN SOUND LEVELS**

**PERIOD OF REPORT:** FEBRUARY 1975 TO DECEMBER 1977

**DATE OF ISSUE:** 25.01.78

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# Table 5

## Mean Sound Levels

Period of Report: February 1975 to December 1977

Date of Issue: 25.01.78

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### Mean Sound Levels

**Period of Report: February 1975 to December 1977**

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**Table 5 (Concl.)**
Gentlemen:

Enclosed please find the results of the sound level measurements of the permanently installed noise monitoring equipment at Zurich Airport showing the excesses when taking-off.

The limits in dB(A) read as follows:

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<th>4</th>
<th>5</th>
<th>6</th>
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Based on the measuring results will you please investigate - together with the responsible Pilots - why single flights of your Company have exceeded the limits and take the necessary steps in order to avoid similar incidents in the future.

CIVIL AVIATION DEPARTMENT ZURICH

Aircraft Noise Abatement

C. Schurter

cc: Federal Air Office
TABLE 6 (contd.)

1. Monitoring points and statistics of aircraft movements (IFR traffic only)

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<th>take-offs</th>
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PERCENTAGE OF AIRCRAFT EXCEEDING THE ICAO 16 REQUIREMENTS = 21.16 %

2. The following companies have not exceeded the limits:

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### TABLE 6 (contd.)

#### 3. CHART OF LIMIT EXCEEDS

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**GENERAL AVIATION (IFR only)** 840

**AIRCRAFTS WITHOUT LIMIT EXCEEDS** 1'140

| TOTAL   | 5'013 | 67.0% | 1.335 | 39   | 5    | 19   | 8    | 6    | 6    | 0    | 0    |

* Take-off with more than one limit excess
* Note: no excesses at points 8 and 9.
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* Note: no excesses at points 7, 8, and 9.
CHART 12
PUBLISHED AVERAGE NOISE LEVEL

TAGES-BURCHSCHNITTWERE DER LÄRMBELASTUNG BEI DEN FESTEN MIKROPHON-MESSSTELLEN
Bewertungsverfahren: Äquivalenter Dauerschallpegel
MONAT: JANUAR 1975

SEKTOR NORD

SEKTOR SÜD

Anmerkung: 1) Windseinfluss

PUBLISHED AVERAGE NOISE LEVEL
is found in the Air Navigation Law of 1973 as Amended in 1977 and 1978. Each airport operator must establish and file a plan containing noise zones. The cantonal governments, the OFA, and, since 1977, the Federal Office for the Protection of Environment have inputs. The DFTCE establishes the noise limits for each zone, but there is a right of appeal. Once the plan is established the airport operator cannot change it; and the plan is obligatory — not a guide line.

Buildings can be constructed near the airport "if construction is compatible with the inconvenience cause by noise." The standards are prescribed by the DFTCE in consultation with the Department of Interior. Three zones have been established as follows:

Zone A: 65NNI  
No buildings other than necessary airport buildings adequately soundproofed. Reserved for agriculture (green belt), warehouses and military installations.

Zone B: 55-65NNI  
Everything in A, plus "industrial and artisanal construction, soundproofed commercial buildings and offices, soundproofed lodgings for concierges."

Zone C: 45-55NNI  
All uses in A and B, plus commercial buildings and offices, soundproofed dwellings.

Modification of existing buildings is also covered. Below 45NNI there is no restriction. To avoid the complication of what to do when a zone line cuts through a house or piece of property, the regulations provide that limits of zones may be drawn to follow lines of terrain, roads, waterways, forests and fields but should
not depart too greatly from established noise curves.

Since control of building may limit the options of the owner of property as to its use and may decrease the value of his property, the right of indemnification is given. However, the property claim must be made within 5 years of publication of the zone plan. The property owner must prove loss of value equivalent to confiscation.

Although efforts at zoning began in 1972, progress has been less than spectacular. First, the drawing of contours is a time consuming process. The law specified they should be drawn for the traffic and equipment which would be in existence 10 years from 1975. Gross weights of aircraft, number of operations, direction of take-off by hours of the day and time of the year, and noise emission with the engines of the period are but some of the assumptions involved. When the first Zurich project was completed, there was much negative comment, some of it surprising. A number of people perceived things quite differently when they found their property in a noise zone and hence restricted from building. Some of those whose property was very close to the zone line wanted to have the zone redrawn so they would be outside of the zone. They liked land-use planning until it hit their purse. At the time of this investigator's field trip, the Zurich land-use plan was still in litigation. Given the Swiss penchant for public referendums and the problems involved, one hesitates to forecast the date for actual implementation.
8. Noise-Related Landing Charges

At present there are no incentive noise-related landing charges in Switzerland. Currently, according to one knowledgeable authority, there is imbedded in the landing charge in Zurich an additional amount which produces money to purchase land for noise abatement purposes; however, it may not be used to purchase residences. One authority interviewed took the view that punitive landing charges are not allowed under Swiss law. However, the Swiss have been considering two different incentive noise schemes. Under the first there would be 4 categories of payments as follows:

<table>
<thead>
<tr>
<th>Noise Values</th>
<th>Landing Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 100 dB(A)</td>
<td>400 SFr</td>
</tr>
<tr>
<td>96 to 100 dB(A)</td>
<td>200</td>
</tr>
<tr>
<td>91 to 95 dB(A)</td>
<td>100</td>
</tr>
<tr>
<td>Less than 90 dB(A)</td>
<td>0</td>
</tr>
</tbody>
</table>

The above scheme has had the approval of the OFA but needs cantonal approval.24/ According to an ICAO document,25/ the Swiss second plan is to consider the French scheme in which five categories of payments are developed from noise differentials above the Annex 16 standard in varying amounts up to 27 EPNdB.

24/ Interview with Ueli Degele, Deputy Director, Zurich Airport.

9. **Summary**

The Swiss experience again illustrates the difficulties which result from failing to address the noise problem in a timely fashion. Spurred on by an irate citizenry, the Swiss have made considerable progress in dealing with the noise problem. Land-use planning has been proposed and, although still in debate, has kept people from moving toward noise; and it also has encouraged the use of building insulation to decrease noise emissions at the recipient level. The Swiss adoption of: (1) Annex 16 Chapter 3, (2) phase out rules for non-Annex 16 aircraft, (3) curfews and (4) operational rules indicate a wide range of antinoise activities. Further, the monitoring of noise emissions of each flight, and publication of the results to the airlines and the public, serves to keep the operating people alert to the necessity of taking all possible steps to hold aircraft noise to a minimum.

The implications for airline managements and aircraft manufacturers is clear. Swissair quite candidly pointed out that noise was the controlling factor in selecting the DC-9-80, notwithstanding a higher first cost, higher operating cost, and a larger capacity than was desired. Given the continued pressure for a tighter curfew, the possibility of landing charges related to noise, the possibility of relaxed curfews for Chapter 3 aircraft, the direction indicted for aircraft and engine designers is clear. Finally, the conflict internationally between Switzerland and Germany over the take-off route
over the nearby German village of Hohentengen shows how serious some citizens view aircraft noise disturbance.
Chapter 8

FEDERAL REPUBLIC OF GERMANY

Early in Chapter 7 we noted that Switzerland had "one of the strictest set of noise rules in Europe or the world". Vying with Switzerland for top honors is Germany. Airline operators questioned on the subject seem to think it is a standoff between the two. However, pilots sometimes, because the issue of criminal prosecution for noise excesses has been raised (but not activated) in Germany, tend to give the nod to that country. As in Switzerland, the impact of the noise regulations has been sufficient to be a significant factor in the equipment selection process of Germany's main international airline. Politically, noise is a significant issue.

1. Government Noise Structure

Although the Ministry of Transport in Bonn handles the federal civil air administration under numerous federal acts, the Länder (States) supervise the airports by overseeing private companies which operate the airports. Although there are 429 airports only about 40 international and military come under the noise control zone laws. Because of its importance we will focus primarily on the Frankfurt Airport, the largest international airport in Germany.

At the federal level, the Minister of Transport and the Minister of the Interior establish an Advisory Committee which hears proposals for noise regulations and new noise legislation. On this Committee, are representatives of science and technology, of airport operators, of airlines, of municipal organizations, of the Federal Association Against Noise, of airport commissions and of the "supreme state
authorities”. At the airport level, each airport with a noise zone has a 15 member commission “for the protection from aircraft noise”. This commission, appointed by the licensing authority, is composed of representatives from: neighboring communities, the Federal Association Against Aircraft Noise, aircraft operators, air traffic control, airport operators and the "supreme Länder" (State) authority. Each of the large airports has by virtue of Federal Law a Federal Noise Abatement Delegate who handles such things as noise violations turned up by the federally required monitoring system. Additionally a broad series of federal laws and regulations cover noise at the source, air traffic rules dealing with noise in a large number of operational situations, noise zones around airports, building requirements to minimize immissions, and landing charges.

Actual administration of laws and formulation of regulations are by each of the Länder. As an example, for Frankfurt it is the office of the Hessian Minister for Economics and Technology in Wiesbaden which issues curfew orders.

2. Legal Basis of Noise Control

The regulation of German air transport (including noise) is authorized at the federal level primarily by the Aeronautics Act and the Law on Protection Against Aircraft Noise of 1971, as amended. The latter, in addition to being the seminal legislation on airport noise zoning, also amended the Aeronautics Act to include protecting
the people from aircraft noise as one of its purposes. It also mandated Federal Noise Monitoring and made airport operators, airline operators and pilots responsible for limiting unavoidable noise to a minimum.

A letter from the German Ministry of Transport in a response to a request from ECAC for information on German laws and regulations to mitigate aircraft noise lists the 20 examples reproduced in Table 7.

It is the Law for the Protection From Aircraft Noise which furnished authority to establish federal standards for construction in noise zones and provides compensation by the airport authority for (1) loss in value of property occasioned by building restrictions and (2) compensation for required soundproofing. The Federal Immis­sion Control Law, the Air Traffic Noise Control Law, the establish­ment of the Federal Environmental Agency, and the environmental pro­grams of the States are the further bases of noise control.

3. Noise at the Source

Under German law and regulation each aircraft must have an ap­proved noise certificate. By NOTAM II, number 65 in 1973 and number 59 in 1976 the standard is that of Annex 16, as amended. As yet Annex 16, Chapter 3 has not been formally enacted into law. However, government authorities indicated that since the law stipulates that the latest state of the art must be employed and since the authorities are directed to minimize noise, Annex 16, Chapter 3 is administratively in effect. In a similar vein, Lufthansa representatives indicated
TABLE 7
German Laws & Regulations
Dealing With Aircraft Noise

1. Law on the Protection Against Aircraft Noise - Federal Law Gazette I, 30 March 1971
2. Structural Sound Insulation Requirements - Sound Insulation Order - Federal Law Gazette I, 5 April 1974
4. Noise Reduction Regulation - Aeronautics Act, Art. 29 b (1) and (2)
8. Actual Technology - Aeronautics Act - Article 2 (1) No. 4
9. Actual Technology - Order on the Licensing of Air Traffic - Article 3, No. 2 b
10. Noise Limits for Propeller Aircraft - NOTAM II - 47/75 of 17 July 1975, NOTAM II - 99/77 (Summary of Noise Measurement Results)
11. Noise Certification - NOTAM II -114/76 of 19 November 1976
12. Rolling Take-offs - NOTAM I - 46/74 of 4 February 1974
13. Noise Abatement Procedures For Approach and Take-off - NOTAM I - 308/75 of 8 September 1975; Approach Procedures of Deutsche Lufthansa
17. Airport Authorization and Noise - Aeronautics Act - Art. 6 (2), Order on the Licensing of Air Traffic - Art. 52 (1) - This deals with extending runways and building new airports.
18. Thrust reversal, Ground Run-up - Aeronautics Act - Art. 6 (2), AIP Germany - Part AGA-2
19. Night Flying Restrictions at Airports - Aeronautics Act - Art. 6 (2), AIP Germany - Part AGA-2
20. Graduation of Landing Charges - NOTAM I - 334/75 and 55/76 and AIP Germany - Part FAL-3-1
that their policy is to push for quieter aircraft with emission levels of Chapter 3 or better.

Since 1973 no non-Annex 16 aircraft could be added to the German register. The earlier non-Annex certified aircraft by policy must be removed from the register no later than 1 Jan, 1985. There is no regulation concerning the phase out of Chapter 2 aircraft, primarily because no consensus has been reached in ICAO or ECAC.

4. Curfews

As has been previously noted, noise relief resulting from implementation of internationally agreed upon Annex 16 rules comes extremely slowly. In fact, it is argued that this Annex does little more than publicize the existing state of the art. For more current, urgent relief, curfews and operational restraints have been instigated.

Appropriate ministries in the various German states have established curfews at Berlin, Bremen, Dusseldorf, Frankfurt, Koln-Bonn, Munich-Riem, Nurenbarg and Stuttgart. Being tailored to the needs of the airport neighbors and the environmental conditions around the airport, the curfews vary in the periods covered and in the flexibility allowed. Space does not permit a compilation of all the rules. At Frankfurt the curfew is from 10 p.m. to 6 a.m., local time, but with a number of exceptions, some applicable to only "good airlines"; i.e., those with good records on the noise monitor. For example, a 1978 curfew modification permits Annex 16 Chapter 2 airplanes and others "successfully practicing the noise-abating approach procedures
as per Nfl I dated Oct 9, 1975" to land between 0500 and 0600. Landings are permitted when Frankfurt is used as an alternate airport. However, there are no take-off curfews for scheduled airlines operating aircraft of over 5.7 tons gross weight.

In general, the German authorities establish curfews and then provide areas of flexibility or exceptions, often after formal request, for weather, technical or safety reasons. In most cases Annex 16 Chapter 2 (latest version) aircraft receives benefits not accorded to non-Annex aircraft.

5. **Operational Restrictions**

Where aircraft noise is a problem in daytime operations, the Germans attempt to move the noise away via aircraft routings and operational techniques. German operational rules are similar to those we found in other countries. Briefly, in addition to the usual noise abatement take-off and climb noise procedures, there are noise constrained instrument departures and minimum noise routes for departure and arrival. Also, there are rules relative to ground operations such as reversing, ground run-up, and rolling take-off.

6. **Noise Monitoring**

The noise monitoring system consists of 16 microphones which are rotated among 27 monitoring locations. The system, probably partially because the strict standards stipulated and the fact that it operates under a mandate of statutory law (Aeronautics Act and
Law on protecting against aircraft noise, has enhanced Germany's reputation of being "tough" on aircraft noise. The laws further specify how the noise measurements are to be made, and the distribution of publicity concerning the results.

For example, equivalent continuous sound levels ($L_{eq}$), given in dB(A), are measured by a formula which combines the maximum sound level of noise and duration of noise for each passing aircraft. The period in which the sound level is 10 dB(A) below maximum is taken as the duration. To provide a base line, measurements are made for the six busiest months of the year, with different weighting formulas being applied for the day period (0600-2200) and night (2200-0600).

The Noise Abatement Department of the airport operates the monitoring system and assembles and publishes the results to the airlines, the airport authority, the federal licensing authority, the airport commission and other interested parties. The report, a portion of which is reproduced in Table 8, contains five categories of information as follows:

1. **Part A. Type Level.** The average noise level for each type of aircraft is computed by summing the $L_{eq}$ caused by the same type of aircraft and, after eliminating the quietest 5% and the noisiest 5%, dividing the result by the number of departures or approaches.

2. **Part B. Fleet Noise Level and Rank Order of Fleet.** A compilation is made of the fleet noise level of each type of aircraft by individual airline company. The results are then published in rank order from the quietest to the noisiest. The results of several months are then set out in comparison with the current month. Additionally, listed for all to see is the rank order of the noisy companies.
Part C. Meteorological Influences. Since airline operators often complain that meteorological conditions heavily influence noise monitoring results, (high temperatures, low winds, high humidity). The report further breaks down the operations into 6 different temperature, wind and humidity categories. Noise levels for the categories are identified.

Part D. Excesses. Noise which exceeds the standard allowed for a given type of aircraft by 4 dB(A) or more is considered to be avoidable. Each such excess is identified on the table by time, date, carrier and flight number, amount of noise and weather category involved. The companies are notified and an explanation required.

Properly operated, the German noise monitoring system is not without advantages to the operator, the government authorities, and the public. It may be a protection for the pilot and airline company in cases where irresponsible or faulty complaints are made. The first step in relation to a complaint is to check the monitor for the record of the flight. If the monitor shows the flight well within the limits, the authorities do not bother the airline with the matter and give the complainant little attention. When a politically or financially important person complains about aircraft noise around his area, a complaint which elsewhere might bring about special treatment for the VIP, the head of the Noise Abatement Division may respond by advising that his department will be happy to monitor the noise for several months in the noisiest location picked by the complainant. The VIP picks the spot; the test goes on and may well show a satisfactory noise level. When the VIP receives the response that the noise level was satisfactory, he may not be satisfied. However, if he still finds fault after being reminded that the test was
### TABLE 8
#### FRANKFURT NOISE REPORT
August 1978

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<tr>
<th>2 Letter Airline Code</th>
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<td>Air Algerie</td>
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<td>British Caledonian Airways</td>
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<td>BV</td>
<td>Bavaria Germanair GmbH</td>
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<td>BM</td>
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<td>CL</td>
<td>Capitol International Airways (USA)</td>
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<td>CP</td>
<td>Canadian Pacific Airlines</td>
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<td>DAN AIR SERVICKS (GR)</td>
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<td>DF</td>
<td>Condor Flugdienst GmbH</td>
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<td>DM</td>
<td>Maerskair</td>
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<td>EI</td>
<td>Aer Lingus (IRL)</td>
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<td>ET</td>
<td>Ethiopian Airlines</td>
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<td>ARIANA Afghan Airlines</td>
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<td>FT</td>
<td>Flying Tiger (USA)</td>
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<td>JJ</td>
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<td>JM</td>
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<td>JP</td>
<td>Inex Adria Airways (YU)</td>
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<td>Jugoslovenski Aero Transport</td>
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<td>JR</td>
<td>Jugair</td>
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<td>KL</td>
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<td>Air Malta</td>
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<td>KU</td>
<td>Kuwait Airways</td>
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<td>Karair-Oy (SF)</td>
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TABLE 8 (continued)

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<th>Code</th>
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<td>LH</td>
<td>Deutshe Lufthansa (D)</td>
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<tr>
<td>LO</td>
<td>Polnishe Fluglien (LOT)</td>
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<tr>
<td>LT</td>
<td>LTU Lufttransport</td>
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<td>EL-AL Israel Airlines</td>
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TABLE 8 (continued)

NOISE REPORT
APPROACHES ON RWY 25

A Type Level

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<tr>
<th>857 OF THE SAME TYPE OF A/C MEASURED DURING COMPARABLE WEATHER CONDITIONS</th>
<th>CAIRED AN AVERAGE NOISE LEVEL (TYPE LEVEL)</th>
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B Fleet Noise Level and Rank Order of Fleet

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<tr>
<th>APR-AUG 1978 COMP WITH 210 APPROACHES</th>
<th>AUGUST 1978 COMP WITH 21 APPROACHES</th>
<th>QUALIFICATION</th>
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</table>

* Companies below or within the type level
TABLE 8 (continued)

C Meteorological Influences

<table>
<thead>
<tr>
<th>METEOROLOGICAL HUMIDITY</th>
<th>WIND COMPONENT</th>
<th>TEMPERATURE</th>
<th>TYPE LEVEL</th>
<th>WEATHER CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30%</td>
<td>&lt; 5 knots</td>
<td>&gt; 25 °C</td>
<td>-</td>
<td>212</td>
</tr>
<tr>
<td>30-90%</td>
<td>&lt; 5 knots</td>
<td>&lt; 25 °C</td>
<td>85</td>
<td>811*</td>
</tr>
<tr>
<td>30-90%</td>
<td>&lt; 5 knots</td>
<td>&gt; 25 °C</td>
<td>83</td>
<td>812</td>
</tr>
<tr>
<td>30-90%</td>
<td>&gt; 5 knots</td>
<td>&lt; 25 °C</td>
<td>84</td>
<td>331</td>
</tr>
<tr>
<td>&gt; 90%</td>
<td>&lt; 5 knots</td>
<td>&gt; 25 °C</td>
<td>86</td>
<td>911</td>
</tr>
<tr>
<td>&gt; 90%</td>
<td>&gt; 5 knots</td>
<td>&gt; 25 °C</td>
<td>88</td>
<td>931</td>
</tr>
</tbody>
</table>

*The rank order table shown in part B is based on this category

D Excesses AUGUST 1978

<table>
<thead>
<tr>
<th>DAY</th>
<th>ATA</th>
<th>FLIGHT NO</th>
<th>NOISE 40(A)</th>
<th>WEATHER CATEGORY</th>
<th>TYPE LEVEL</th>
<th>REMARKS</th>
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</thead>
<tbody>
<tr>
<td>13.</td>
<td>08.57</td>
<td>BA 3611</td>
<td>89</td>
<td>811</td>
<td>85</td>
<td></td>
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<tr>
<td>15.</td>
<td>08.39</td>
<td>FW 0763</td>
<td>89</td>
<td>811</td>
<td>85</td>
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<tr>
<td>25.</td>
<td>15.22</td>
<td>GE 7663</td>
<td>92</td>
<td>831</td>
<td>86</td>
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<tr>
<td>26.</td>
<td>16.54</td>
<td>MS 0787</td>
<td>89</td>
<td>811</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>14.09</td>
<td>EU 0717</td>
<td>89</td>
<td>811</td>
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<tr>
<td>31.</td>
<td>12.32</td>
<td>LY 0357</td>
<td>92</td>
<td>931</td>
<td>88</td>
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</tr>
</tbody>
</table>

Approaches exceeding the type level of the corresponding weather category by more than 3 dB(A) caused avoidable noise. Exceptions are cases of emergency and special ATC advices. They should be reported immediately.
### TABLE 8 (continued)

#### NOISE REPORT

**APPROACHES ON RWY 25**

#### A Type Level

<table>
<thead>
<tr>
<th>Type Level</th>
<th>CJ-300 (Annex 16)</th>
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</thead>
<tbody>
<tr>
<td>026</td>
<td></td>
</tr>
<tr>
<td>OF THE RANK TYPE OF A/C</td>
<td></td>
</tr>
<tr>
<td>MEASURED</td>
<td></td>
</tr>
<tr>
<td>DURING COMPAREABLE</td>
<td></td>
</tr>
<tr>
<td>WEATHER CONDITIONS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>GB(A)</td>
</tr>
</tbody>
</table>

#### B Fleet Noise Level and Rank Order of Fleet

<table>
<thead>
<tr>
<th>Comp.</th>
<th>APR-AUG 1978</th>
<th>AUGUST 1978</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comp with 210 Approaches</td>
<td>Comp with 21 Approaches</td>
</tr>
<tr>
<td></td>
<td>Comp</td>
<td>GB(A)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LH</td>
<td>74</td>
<td>763</td>
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<td>MS</td>
<td>75</td>
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</tr>
<tr>
<td></td>
<td>75</td>
<td>12</td>
</tr>
</tbody>
</table>

* Companies below or within the type level
TABLE 8 (continued)

---

**C Meteorological Influences**

<table>
<thead>
<tr>
<th>METEOROLOGICAL RANGE AT THE AIRPORT</th>
<th>WIND COMPONENT</th>
<th>TEMPERATURE</th>
<th>TYPE LEVEL BASED ON 2-20 APPROACHES</th>
<th>WEATHER CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-90% &lt; 5 knots</td>
<td>&gt; 25 °C</td>
<td>77</td>
<td>811</td>
<td></td>
</tr>
<tr>
<td>30-90% ≥ 5 knots</td>
<td>&gt; 25 °C</td>
<td>76</td>
<td>812</td>
<td></td>
</tr>
<tr>
<td>30-90% &gt; 5 knots</td>
<td>&gt; 25 °C</td>
<td>76</td>
<td>831</td>
<td></td>
</tr>
<tr>
<td>&gt; 90% &lt; 5 knots</td>
<td>&lt; 25 °C</td>
<td>77</td>
<td>911</td>
<td></td>
</tr>
<tr>
<td>&gt; 90% &gt; 5 knots</td>
<td>&lt; 25 °C</td>
<td>78</td>
<td>931</td>
<td></td>
</tr>
</tbody>
</table>

*The rank order table shown in part B is based on this category.

---

**D Excesses AUGUST 1978**

<table>
<thead>
<tr>
<th>DAY</th>
<th>ATA</th>
<th>FLIGHT No</th>
<th>NOISE 4(A)</th>
<th>WEATHER CATEGORY</th>
<th>TYPE LEVEL</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

Approaches exceeding the type level of the corresponding weather category by more than 3 dB(A) caused avoidable noise. Exceptions are cases of emergency and special ATC advices. They should be reported immediately.
conducted at the spot he specified, he is likely to get no cooperation from any other authority he approaches because the facts are against him.

Of course, the system is not perfect. A number of excesses upon investigation are found to be justified. For example, the excess can be due to following a routing specified by departure control, or to a very heavy airplane on a hot day with high humidity and little wind, or even because of angle of bank and existing cloud cover. While the writer was examining the system, a bell sounded and a red light indicating an excess came on. However, no airplanes were taking off; instead, a teenager was riding his motorcycle in a field close to the monitoring microphone.

6.1 Sanctions. Although the Frankfurt system results in very close observation of all operations, the rumors of fines, jail sentences, and license revocations for excesses, do not appear to be based on fact. Although criminal prosecution with a 5,000 DM fine and license withdrawal are authorized under certain cases of airway traffic control violations (which could involve a noise routing), apparently the Frankfurt authorities so far have had sufficient success with cajoling and "friendly persuasion" that further action was unnecessary.26/ In Frankfurt, there is good cooperation between ATC.

26/ The situation in Dusseldorf was reported to be not as harmonious. Bad feeling was engendered when a lawyer involved in administration attempted to exact punishment.
the noise authorities, and the airlines. However, the individual companies have taken what amounts to disciplinary action against pilots who have had repeated noise excesses. One such action involves removing pilots from schedules into Frankfurt and requiring further training on noise abatement procedures.

Although the government authorities went to some lengths to maintain that using the monitoring system as a policeman or as an enforcement tool was not their purpose, nevertheless, when the writer was in Copenhagen, the head of the Scandinavian Pilots Association indicated he was very glad to have that information because he was leaving the next day for Germany to represent a pilot who was in trouble on a noise problem.

The results of the noise monitoring are used in connection with requests for exceptions to the curfew. To carrier A with a good record the answer would be yes; to carrier B with a poor record the answer would be no.

7. Noise-Related Landing Charges

Germany has experimented in a modest way with noise-related landing charges for international airports. Initially in 1976 there was established as a part of the landing charge related to gross weight a surcharge of 5-percent for non-Annex 16/FAR 36 aircraft. The resulting cost differential was so small that the objective of giving an incentive to utilize quieter aircraft was not met. The rate was increased in 1977. In November 1978 the charges were
increased a second time. This time to a surcharge of 5% for Annex 16 compliant aircraft and 14% for non-certified aircraft. Again, the authorities consider the new charges inadequate to serve as an incentive to substitute a quieter airplane. Little interest has been expressed in further experimentation in rates.

8. Land-Use Planning - Law on Protection Against Aircraft Noise

Germany early recognized that the ability of individuals or companies to construct dwellings, schools, hospitals and business offices or plants, absent a concern for noise, vitiated the benefits laboriously and expensively acquired through noise at the source rules. The convenience of living or working near an airport, and the commercial value for businesses located near an airport, provides incentives to move close to an airport and then subsequently complain about noise. Shortly after the introduction of the jets, agitation and planning began to force the enactment of laws which would (1) prevent people from moving toward the noise, (2) provide construction standards which would control immissions, and (3) provide some compensation for insulation where it was required by the government.

In 1971 after ten years of effort, a major piece of federal legislation, the Law on Protection Against Aircraft Noise, was enacted. From this law, as well as the Federal Immission Control Law, the Air
Traffic Control Noise Law, and the establishment of the Federal Environmental Agency, much was expected. These laws were supplemented by various environmental programs of the several states. Since noise sources and affected areas are located predominately in populated areas, a great deal of cooperative effort has to be made by the regional and urban planning authorities. As one gets closer to zoning at the urban level, the conflict between the desire for profit made by building multi-unit housing vs. restrictions imposed by zoning becomes evident. Many in the ownership class lose their zeal for quiet when it hits their pocketbook. It is not surprising that realtors and developers are active in town councils to "assist with proper zoning and building codes".

8.1 Noise Protection Zones. Although there are over 400 airports in Germany, the Law on Protection Against Airport Noise, in setting up noise protection zones (NPZ), mandates their establishment for just two categories of airports: (1) international airports providing scheduled air transportation; and (2) military airfields with jet operations. The NPZ is defined by the area outside of the airport in which the equivalent constant sound level exceeds 67 dB(A). At each airport the NPZ is divided into two Protection Areas. In Protection Area 1, the noisiest area, the sound level exceeds 75 dB(A). Protection Area 2 covers the sound between 75 dB(A) and 67 dB(A). Different restrictions and different compensation are accorded in each area.
The establishment of the NPZ for commercial airports is a joint function of the Federal Minister of Transport and the Federal Minister of the Interior. Military airport NPZs require coordination of the Minister of Defence and the Bundesrat. Maps of the two areas are published for everyone to see. To provide for up-to-date information the initial zone determination was 10 years in the future and there must be an update every 5 years or when the sound level increases by 4 dB(A), (a doubling of the energy) whichever comes first.

8.2 Construction Prohibitions. Having determined the extent of the NPZs and their standards, the act proceeds to outline the construction prohibitions applicable to each area. Specifically no hospitals, old-age homes, convalescent homes, schools or similar institutions may be built in an NPZ subject to the provision that a state may make exceptions in the public interest. No housing is permitted in area one. However, there are exceptions such as construction approved before the act was passed, barracks for the armed forces, housing authorized by a special public law, and housing for owners and managers of "works".

8.3 Sound Insulation. The Federal Government is empowered by the Law on Protection Against Aircraft Noise (Art. 6 and Art. 7) to determine with the concurrence of the Bundesrat the requirements for sound insulation in such buildings as are permitted in the NPZ.

8.4 Compensation for Prohibition on Building. (Art. 8) Where a construction permit is denied or cancelled and the value of the
real estate thereby reduced, the owner can claim reasonable monetary compensation. He can also claim compensation if he made preparations for building on the assumption that his current permission would continue.

8.5 Compensation for Expenditures for Sound Insulation. Owners of property in Area 1 (the noisiest Area) and owners of buildings permitted by exceptions may be recompened for expenditures on sound-proofing provided claims are made within five years of the establishment of the zone. The law limits compensation to 100 DM per square meter of living area. However, in recognition of spiralling costs the Government, with the concurrence of the Bundesrat, may increase this amount. The obligation to pay the amounts rest with the operator of the airport who in turn expects to obtain the funds through landing charges.

8.6 Implementation and Problems. As is almost universal experience where popular government is vogue, the implementation of a law which includes Federal, State and local jurisdictions and which involves conflicts between various categories of individuals, is very slow. It was five years after the Noise Protection Law was passed before the noise contours for Frankfurt were established. Because results were unsatisfactory to some, they sought changes in the contours. For example, unlike the Swiss arrangement where a contour may follow property lines or roads, the German contour may go right
through the middle of a house or apartment thus including the property in the zone. By so doing it may prevent an owner from building at all, but entitle him to insulation payments. Or, in the outer area his building may miss the boundary by 1 foot whereas otherwise he might be entitled to considerable noise insulation payments. Appeals of this nature have delayed implementation. By the time the contours can be agreed upon it is time for the 5 year update.

Critics of the legislation point out the failure to exclude all housing from Area 2. Under the law housing may still approach the airport environs and, if noise decreases, may come still closer. A representative of the Ministry of the Interior recommends that housing should be excluded up to 62 Leq.27/ Others think the area for reimbursement too small. It is reported that at Dusseldorf the authorities pay for insulation in Area 2 though not required to do so.

9. Summary - Impact of Noise Rules on Carriers and Manufacturers

The noise caused by jet aircraft has generated heavy pressure on the government and on the airlines to bring this type of noise under control. With respect to noise at the source, the government adopted Annex 16 Chapter 2 and administratively applies Chapter 3. It further has banned any additions of non-Annex aircraft to its

register and is forcing existing non-Annex planes to be retrofitted or be removed from the register. For immediate relief the Government has for each type of aircraft set noise limits which are carefully monitored and the results publicized. A series of curfews have been established with increasing flexibility for Chapter 2 and Chapter 3 aircraft.

In the area of long range planning, Germany has enacted at the Federal Level a land use planning law based initially on a 10 year forecast of noise exposure and subject to revision every five years. Supplementary actions are taken by the states and municipalities. The subjective nature of noise annoyance and the political and economic trade-offs involved make implementation of land use planning very difficult. When the authorities find that some cities complain more than others for a given level of noise, or when they find that people of affluence complain at noise levels which do not cause the poor to complain, the decision on where to draw the line is a problem.

Frankfurt, the main international airport in Germany, has a natural advantage of being surrounded on several sides by forests. Its major problem is the nearby town of Offenbach (100,000 pop.). The Mayor of Offenbach happens to be head of the Frankfurt Noise Commission. However, the commission seems to be working relatively harmoniously. For example, the Mayor of Offenbach advised that he would vote for a test of the quiet Airbus during curfew hours. The aircraft would, of course, fly over his town in the course of determining
whether a relaxation of the curfew for this plane was in order.

Since a good deal of time of Lufthansa officials is taken up fighting noise constraints, it is not surprising that they constantly press for quieter aircraft. Lufthansa authorities indicated some unhappiness with the lack of zeal which American manufacturers employed in pursuing the noise problem. Lufthansa representatives pointed out that they contributed to 747 development by demanding a noise guarantee for a specific mission, namely New York to Frankfurt. They emphasized that noise was a definite factor in making equipment decisions. Although Lufthansa demanded and received a noise guarantee on the 737, complaints about noise emissions were received. Responding to these complaints, and anticipating further tightening of noise rules, Lufthansa in its most recent order replaced all its 737s with the later advanced 737-200s equipped with extra noise absorbing materials and a "mixer" to reduce aircraft noise. In deciding to purchase the A-300 and subsequently the Airbus 310, Lufthansa was favorably influenced by noise monitoring results shown for the A-300. The head of the Frankfurt Noise Monitoring Department, in commenting on the noise levels of the various types of planes using Frankfurt, noted that the A-300 "is the quietest plane we have"..."splendid noise characteristics"..."the noise is sometimes so low that officially we cannot measure it."

When government and airline representatives were asked for a prognostication, the general response was that in the past 6 years,
because of the reduction in total operations occasioned by the use of larger capacity aircraft employing quieter engines, not only has the increase in noise been arrested but there has been some small diminution in total noise levels. The combination of the implementation of land-use planning and phasing out of non-Annex aircraft suggest a further but slow improvement. However, because of political pressure from inhabitants who are reluctant to give up any gains they already have, those interviewed concluded there was no chance of reaching a curfew-free Germany, but some chance of selective relaxation of curfews for Chapter 3 aircraft. Given the extensive investment in Chapter 2 aircraft, Lufthansa does not favor a mandatory early phase-out of Chapter 2 aircraft but hopes that manufacturers will develop modifications to bring such aircraft into compliance with Chapter 3 requirements.
Chapter 9

SWEDEN

The Scandinavian country of Sweden has a population of eight million of whom one and one-half million live in the capital city, Stockholm. Despite the fact that its new international airport, called Arlanda, was placed 20 miles from the city in a country environment where there were a very few homes, with the conviction that there would be no noise problem, noise problems have arisen. The domestic Stockholm Airport, called Bromma, located in a heavily populated area only 4 miles from the central business district, has developed such serious noise problems with the advent of jets that all jets except for a limited F-28 operation have been banned. Further, political battles at the local and national level have raged over the closing of Bromma for noise reasons. The matter has also reached the highest court in the land. Finally, noise regulations have influenced both Scandinavian Airlines (SAS) and its domestic affiliate Linjeflyg (LIN) in their equipment acquisition programs. Since Stockholm is the largest and most important city in Sweden, has a severe noise problem, and is the headquarters of SAS and LIN, we concentrate on aircraft noise constraints in the Swedish capital.

1. Government Structure

Sweden is governed by a unicameral parliament, the Riksdag which is established by the Constitution. The Government is led by a Prime Minister and is administered by 12 ministries or departments. Since Sweden is a unitary and not a federal state, all laws are made at the national level. County and municipal governments implement
the decisions of the departments. To a certain extent the county and local governments can make local regulations dealing with health, air pollution and noise, but the national law can supersede. Given the absence of state levels and the supremacy of national law, it would appear at first blush that Sweden would have an easier time handling aircraft noise problems than countries with multiple levels of government. However, such is not the case.

For one thing, the Government has not enacted a National Noise Law but has done such things as recommend insulation and that houses should not be built near Arlanda. Sweden's Environmental Protection Agency is entering the field of aircraft noise control, but a provision in the Aviation Act giving the Board of Civil Aviation the right to alleviate noise around the airport (so long as it is consistent with Annex 16) limits the EPA's powers. A National Building Act deals in a limited way with housing around airports and a new building and planning law is under consideration.

Sweden's Public Health Act deals with emissions in such a limited way that the 1976 noise report of the Traffic Noise Committee recommended amending the act to provide more detailed coverage. Stockholm itself has a Health and Environment Department which has been endeavoring, so far unsuccessfully, to close the Bromma Airport as a health hazard. However, on top of this department is a political committee which has been active in the matter of Bromma. Finally, the Bromma matter has been before the courts and Parliament at the same time.
As in the U.S., under Swedish law the airport operator is responsible for noise originating on the airport or in the takeoff or landing process. Since the Civil Aviation Administration owns the airports by way of a concession it is casting about for ways to pay for such costs as insulation through charges on passengers or landing fees.

Generally speaking, the Scandinavian countries of Denmark, Norway and Sweden work jointly with ICAO in the handling of certification and navigation matters. Each government owns a substantial share of the Scandinavian Airlines System (SAS). In Sweden the major airports are owned by the National Government.

2. Noise at the Source

In an amendment to the Air Law of 1957, Parliament required each aircraft to have an environmental certificate. In implementing the portion of the certificate dealing with aircraft noise, Swedish Civil Air Regulations have adopted ICAO Annex 16, Third Edition, October 1978. To prevent the spread of noise by the purchase or lease of previously built non-Annex aircraft, no such aircraft have been permitted Swedish registration since June 30, 1979. Limited exceptions are permitted to replace a destroyed aircraft and to permit temporary operation of non-Annex aircraft pending an early agreed upon retrofit. No regulations exist to phase out non-Annex 16 aircraft, but there is a proposal to fix the year at 1988. There appear to be no discussions on eventually limiting the acquisition of new Chapter 2 aircraft.
An absolute ban exists on supersonic civil flights. Some years ago SAS determined for noise reasons to buy only FAR 36 aircraft. However, when one type of aircraft failed to meet FAR 36, SAS managed to have it certified to Annex 16 which had two advantages. One, SAS could say to the public, "We comply with international noise regulations." Two, compliance with Annex 16 enabled the company to qualify for lower landing charges in Frankfurt where noise-related landing charges were in effect.

3. Curfews

Despite complaints about aircraft noise by inhabitants in the growing new town of Märsta (most of the inhabitants moved in during and after the construction of Arlanda), the airport has no curfew. The only concession to noise complaints is the establishment of departure and arrival routes to take noise into account.

The noise situation at Bromma is treated in more detail later. However, at Bromma there is a 10:00 PM to 6:00 AM curfew on a scheduled basis. However, a bit of flexibility is provided by permitting late departures from the gate up to 10:27 PM if the aircraft are Annex 16 certificated. Similarly, late arrivals are permitted if they are within 20 miles of the airport by 10:55 PM. Finally, at the time of the survey, except for the F-28, all jets were banned from Bromma.

4. Operational Restrictions

Except for the departure and arrival routes at Arlanda
and the takeoff and climb procedures at Bromma there are few operational constraints. Training flights are severely restricted at Bromma. At Göteborg, Sweden's second largest city, we have an example of operational constraints being applied at a new airport. The old close-in (6 mile) airport at Torslanda was determined to be unsuitable for expansion due to noise and obstructions. After a number of studies a new airport was built 12 miles away at Landvetter. However, environmentalists' complaints at the new airport led to the establishment of approach procedures to abate noise. Although the airport is substantially larger than Torslanda and contains fewer obstructions, the location of the VOR and the consequent maneuvering to follow the noise procedures has caused pilots to dislike flying approaches to the airport.

5. Land-Use Planning

When Arlanda was being planned in 1959 the Committee on Airport Noise established a "Critical Noise Zone" in which no buildings were to be erected. Although the Government stated that housing would be prohibited in the zone, it did not pass a law. Implementation was left to the local authorities who failed to follow through. By 1967 a new town, Märsta, had been built, coincident with the airport construction, in the critical zone. This situation prompted the Regional Planning Office of Stockholm County Council to make an investigation of the noise at Arlanda. The investigation included predicting noise exposure for 1985 and the
year 2000. Representatives from the County of Stockholm, communities, railroad companies, etc. have been working together on a zoning system for planning under the 1969 Environment Protection Act and its successor. The results, published in 1976, recommended calling for guidelines. They have not been accepted by the Swedish government.

Thus Arlanda is one more example of an airport built on the assumption that since at the time of planning there was no noise problem in its sparsely inhabited area, the area would remain sparsely populated merely because of National Government guidelines for airport planning. As elsewhere, absent mandatory zoning, the expected quiet failed to materialize because of the commercial and convenience advantage of locating near an airport.

We have also pointed out that even the new airport at Göteborg has developed noise problems. Complaints from inhabitants of a small nearby village resulted in modifications of approach routes, but this has been followed by pilot complaints about the difficulties of executing maneuvers required to follow noise abatement patterns.

Generally speaking, noise control around airports belongs to the local health and building departments. The Environmental Protection Act prescribes that serious environmental complaints should be examined by the Special Concession Board of Environmental Protection. Although a noise committee has suggested establishing noise zones using yet another noise unit, the FBN (said to be
approximately the same as Ldn. Parliament has taken no action. An Expropriation Act permits the acquisition of land or rights in land to further public transport.

6. The Efforts To Close Bromma

Since Bromma is only a few minutes from central Stockholm and is served by frequent low cost public transit, efforts to close the entire airport for noise reasons has r.øt been popular with airline companies (SAS and LIN have their corporate headquarters there) or business and pleasure travelers. The airport has more traffic than Arlanda, including general aviation, and has some shielding by hills at the edge of the airport and by hangars and terminal buildings. Takeoffs are the source of the noise problem. One recent study showed 83,000 people adversely affected by noise. Some houses are little more than 750 feet from a runway where noise in excess of 100 dB is frequently experienced.

For about 15 years there has been a running battle between environmentalists and commercial interests over noise regulations for Bromma. The environmentalists have been close to success in closing the airport, thus causing domestic passengers to travel to Arlanda by the more inconvenient and more costly limousine or taxi. However, partially as a result of a two-volume study, Parliament, in 1977, after calculating the economic cost of closing the airport and upon finding that to reduce the noise level to that desired would logically involve banning cars and trucks as well, decided to keep Bromma open for non-jet commercial and general aviation
while the airport received improvements. LIN was to go to Arlanda by 1979 while the airport modifications were made and come back later.

LIN, of course, did not wish to move its short-haul jets to far-away Arlanda and sued in the "Chamber Court" asking that its jet F-28s not be declared a "sanitary nuisance" and thereby be required to leave Bromma in January 1979. However, since the necessary arrangements could not be made, the court on appeal extended the period to the end of 1980. Later, on July 13, 1979, the tribunal handling environmental matters, the Koncessionsnamnden, permitted the airport to stay open for domestic commercial and general aviation under the following conditions: (1) that the Fokker F-28-4000 be banned no later than 30 June 1981; (2) noise from other aircraft must be 9dB(A) less than the F-28; and (3) that the equivalent noise level around the airport must not exceed FBN (approximately the same as Ldn) 55 and dB(A) 65. This latter is such a strict condition that the airport is appealing this facet of the decision. Thus, efforts continue to be made to keep Bromma open for some domestic traffic until the expected arrival of quieter planes in the 1980's.

7. Noise Monitoring

Unlike a number of the countries previously surveyed, Sweden makes little use of noise monitoring. Arlanda has a unit for test purposes only. The county administration for the Göteborg Landvetter Airport has prescribed a noise and radar monitoring
8. Noise-Related Landing Charges

No special noise-related landing charges have been imposed in Sweden. A Noise Committee which presents proposals to the Swedish Government does exist. It has suggested that such charges be considered.

9. Impact of Noise Regulations

As we have seen elsewhere, the arrival of the jets triggered the critical noise problem. At Stockholm initially it was the Caravelle, particularly the Caravelle III, which generated pressure to control noise at the source or close the airport. When Arlanda was being built, it was proposed to move all jets there since there would "never be a noise problem there." Because of its noise and because of the runway lengths required, the DC-8 could not land at Bromma anyway. Thus, SAS and LIN looked forward to the DC-9-21 as a means of getting back to Bromma. LIN contracted for the DC-9 but when the public did not like the noise from a simulated test, the company was forced to cancel the DC-9 contract. The Fokker F-28 was the next candidate. Although it was somewhat quieter, the F-28 still did not meet the desired standards. Nevertheless, primarily because of the lack of alternatives, the authorities reluctantly authorized its use at Bromma. Later Parliament ordered all jets out of Bromma pending airport improvements and, hopefully, modifications to the F-28 which would reduce its noise emissions. As previously
indicated, the aircraft now has a reprieve to June 30, 1981.

The closing of Bromma would be a serious blow to Stockholm and to LIN. Just to keep the F-28 at Bromma has caused LIN to expend much time and money in developing special abatement procedures. Certainly LIN's equipment planning has to be heavily oriented toward noise at the source control.

SAS has found it necessary to devote more attention to noise in managing and purchasing its flight equipment than it expected. Seeing the growing problem of aircraft noise, and wishing to be responsive to the desires of the Government and the public, the company decided that its future would be confined to purchases of DC-9 aircraft certified to FAR 36 - a stricter standard in some cases than Annex 16. The airline already had some uncertified DC-9's. As the new DC-9-40's built up in the fleet, the question arose as to what standards were met should it be desirable during the course of maintenance to use a non-FAR engine on an FAR-36 airplane. Douglas preliminary studies indicated that such an aircraft could meet Annex 16 but no longer meet FAR-36. When the FAA would not certificate the DC-9's to Annex 16 without running the full series of certification tests - a very expensive and time consuming procedure - SAS contracted for a formal study by Douglas with the understanding from the Scandinavian authorities that if the FAA said the study was valid and if it showed compliance with Annex 16, the Scandinavian authorities would certify the plane so configured to Annex 16.
The study was made; the FAA said it was valid; and the airplanes were so certified. Thus, for a modest study, said to cost about $36,000, SAS received certification. As previously indicated, this maneuver enabled SAS (1) to publicize that its planes meet the international noise rules, and (2) to reduce its landing charges at Frankfurt. Additionally, it reduced the number of spare engines required to keep the fleet operating, a positive economic benefit.

Because of the international character of its operations and the current traffic restraints in the countries it serves, SAS is not as interested in quiet replacement airplanes of the DC-9 size as are some carriers. The company points out that as an international carrier it flies to major capitals of Europe where there are very long runways and where the noise from a light DC-9 which is uncertified may be less than a heavy 747/DC-10 or L-1011 which is certified. Thus the DC-9 can sneak in under certain dB limits. Secondly, the company feels its future is in the 747 and DC-10 with their lower operating cost per seat-mile. The expectation is that traffic growth will justify the use of wide-bodies. This is more true in Europe where capacity controlled traffic rights make it more difficult to add frequencies than to substitute a larger plane.28/

10. Summary

The Parliament, the Board of Civil Aviation, local governing bodies, environmentalists and commercial interests have been at

28/ Interview with Birger Holmer, V.P. Aircraft Research and Development, SAS.
odds for a number of years over the handling of the aircraft noise problem in the Stockholm area. Failure to foresee that mandatory zoning rules were needed to prevent the encroachment of population into noise impacted areas when a new airport was established has led to the expansion of the small new town of Mårsta near Stockholm's Arlanda International Airport. Because of the convenience and need for the closer airport, Bromma, to serve short-haul domestic flights, efforts by the environmentalists to close the airport have not been successful. However, their efforts to impose a curfew and ban all jets but one type have been successful. Various tools extensively used elsewhere in noise control efforts such as the establishment of zoning for compatible land use, noise monitoring, payments for insulation and for the acquisition of noise-impacted land are of minor use in Sweden. Except for the rather prompt adoption of Annex 16 3rd edition most noise rules are in guideline form and the guidelines have not been followed.

The two major Swedish carriers, SAS and LIN, have different roles and different circumstances. SAS concentrates on large capacity wide-bodies which have low-noise fuel-efficient engines and operates out of Arlanda. On the other hand, LIN, the short-haul domestic line, suffers from the lack of a quiet substitute for the F-28, and from the constant pressure to constrain or eliminate operations at Bromma. Were it not for the political backing it receives as a result of its Government ownership, the viability of the carrier might well be jeopardized.
Efforts in Sweden to bring aircraft noise, particularly with regard to emissions and land use planning around airports, under more strict national control are proceeding slowly indeed.
Chapter 10.

DENMARK

Although Denmark includes the northern part of the Jutland Peninsula, the Faroe Islands and the large mass of Greenland, we focus, because of its noise problems, on the Copenhagen area in which one-third of the 5 million inhabitants live. The location of housing relative to aircraft ground operations has resulted not only in an extensive set of regulations governing ground run-ups, but also in proposals, now fairly inactive, to move the main airport (Kastrup) to the island of Saltholm about four miles away. A 1971 law brought extensions of vital runways to a halt. Growing traffic finally led to the extensions - but only over strong protests. As we have seen in other countries, the growing strength of the Ministry of the Environment under an environmental protection act has been instrumental in forcing the aviation authorities to promulgate constraining regulations which otherwise might not have been issued.

1. Government Structure

Denmark is a constitutional monarchy governed by a one-chamber house (the Folketing) of 179 members. Executive power is exercised through a 19-member council of state headed by the Prime Minister. For our purposes the two most important ministers are the Minister of Public Works who issues regulations under the Air Transport Law and the Minister for Environment. The former oversees the Copenhagen Airport (CPH) and the Civil Aviation Authority, and the latter exerts pressure (sometimes not appreciated by the CAA) for
more stringent aircraft and airport noise regulations. For example, after two reports by the Ministry of the Environment a series of aircraft-related noise regulations was issued by the airport authority.

Further evidence of a shift in power toward the Department of the Environment is indicated by the 1977 takeover by that department of noise control and the handling of noise complaints at Kastrup. The inhabitants concerned about noise did not feel that the airport authorities and the Civil Aviation Authority were responsive enough to their problems. Negotiations between the Minister of Public Works and the Minister for Environment, with input from the municipalities involved, were followed by further discussions between the Minister for Environment and the Minister for Traffic. These discussions in turn were followed by an announcement by the Minister for Environment that his department was taking over noise matters as well as the approval of new construction projects at airports. The latter had been previously under the jurisdiction of the Copenhagen capital committee.

In explaining the takeover the minister said,

"The handling of noise cases at airports assumes expert knowledge more likely found in the Department of the Environment than in municipalities. An improvement in the noise situation will, however, require close ongoing cooperation with the airport authorities. So for this reason too it is more practical to gather up the threads into the Department of the Environment." 29

At the time of takeover the procedure for handling noise complaints was reversed so that individual complaints to the airport

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29/ Copenhagen Airport Annual Report 1977-1978, p. 29 (translation from Danish)
had to be recorded immediately and information gathered and reported to the Department of the Environment with a copy to the complainant so that the individual would know his complaint was being processed. Previously complaints were made first to the municipalities. Finally, a joint committee, advisory in nature, composed of representatives from the Ministry of Public Works, the Ministry of the Environment, the Copenhagen city government and representatives from surrounding municipalities was established to suggest improvements in noise control and improvements in procedures for dealing with complaints. The foregoing indicates the type of political tug-of-war going on not only in Denmark but in other countries as well.

2. Noise at the Source and Noise at the Receiver

Section 9 of the Air Navigation Act provides the legal basis for control of noise at the source and, since July 10, 1969, has, by order of the Minister of Public Works, required noise certification to meet Annex 16. The implementation date was earlier than that in the ICAO resolution. Since 27 Feb. 1975 no non-Annex 16 could be registered. Denmark has joined the list of states prohibiting (by Law 235 in 1972) civil supersonic flight over their territories. Denmark provides for limited exceptions on a request basis. The prohibition includes fines for violations, even if the violations are unintentional. More recently, in order to induce carriers to purchase quiet aircraft, Denmark has adopted Ch. 3 of Annex 16. Since Denmark is a member of EEC it is bound by the December 1979 Directive setting a 31 Dec. 1986 date for
phasing out old non-Annex aircraft. Denmark is participating with ECAC on discussions for phasing out Chapter 2 aircraft.

As illustrated on the Copenhagen airport map, Chart 13, runway 30 to the northwest is the critical runway as departures immediately fly over heavily populated areas. Therefore, a noise limit of 110 PNdB for takeoff has been established. In 1978 about ten percent of the takeoffs from runway 30 exceeded this limit. After each excess the CAA requested an explanation from the carrier involved.

3. Curfews

At the time of the interviews, Kastrup had no curfew for takeoffs or landing. However, personnel in the Directorate of Civil Aviation indicated they would not be surprised to see the establishment of a curfew for non-Annex 16 aircraft. As has been indicated, the weakness of a slavish application to non-Annex rules lies in the fact that it might permit a heavier and noisier Annex 16 aircraft to operate while denying that right to a quieter non-Annex 16 plane.

4. Noise Monitoring

The adoption of extensive noise monitoring in Denmark has lagged behind that in other countries. Problems of airport capacity and increasing air congestion, coupled with an increase in noise complaints and the desire for longer runways, led to studies
CHART 13

KØBENHAVN AERODROME
KASTRUP, DENMARK
on whether to abandon Kastrup and build a new airport on the nearby (4 mi.) island of Saltholm. Plans to install monitoring at Kastrup were delayed awaiting a decision. However, when, because of the expense involved, a move became less likely, a noise monitoring system, but on a considerably smaller scale than that at Frankfurt and Zurich, was authorized in connection with the takeover of noise control by the Department of the Environment.

Of eleven microphones planned, five are for ground run-up positions; the others are planned for use in conjunction with radar monitoring to see that noise departure routes are being followed and to check the noise levels. For departures on 22R and 22L the radar picture is continuously recorded on film to obtain statistical information about the flight path for documentation in connection with complaints from airport neighbors. Danish civil servants suggested two services the monitoring service could provide: (1) by publicizing the results, the utilization of monitoring could either hasten or avoid the establishment of night curfews, and (2) the very existence of the system would tend to make the citizens believe that something was being done about noise.

5. **Operational Rules for Noise Abatement**

The adverse reaction to noise generated by the few early long-range jets intensified as frequency of operation increased and as additional sizes were introduced to serve the market within Europe. The slow technical progress in reducing noise at the source, partly
caused by the difficulties and delays in reaching international agreement within ICAO on future noise limits, and partly due to the long lead time before implementation of the noise limits finally established, would have led to completely unacceptable noise levels at Kastrup but for the series of operational rules tailored to the needs of the communities around the airport. These rules are of two types: (1) dealing with airborne noise, and (2) dealing with ground running of aircraft engines and the auxiliary power unit (APU).

The location of habitable buildings in relation to areas where engines are run up for test purposes has resulted in the issuance of two pages of regulations dealing with run-ups alone. These range from an outright ban of run-ups between 2300 hours GMT and 0500 hours GMT to regulating the time, place and conditions under which any run-up may be made. The two-page document is reproduced in Table 9. It should be noted that there are special rules for run-up on Sunday, public holidays and on Constitution Day.

Other rules to mitigate ground noise include restrictions on reversing and the use of the APU. Although the APU rule has been in effect since 1967, the directorate indicates that the use limit of 15 minutes before departure and 5 minutes after arrival may be lifted for the A-300 because of the low level of emissions from its APU. As noted above, Kastrup has a preferential runway system which
1. RUN-UP OF ENGINES: In this context run-up of engines means that the engine is started up and run at a higher degree than idle for the purpose of testing the engine in question or other installations of the aircraft.

1.2 IDLE RUN OF ENGINES: In this context idle run of engines means that the engine is started up and run at idling adjustment for the purpose of testing the engine in question or other installations of the aircraft.

1.3 APPLICABILITY OF THE REGULATIONS: These regulations apply to run-up of all types of aircraft engines, except for APU (Auxiliary Power Units). Piston engines, turbo-propeller engines as well as jet engines are all comprehended by the regulations. However, run-up made immediately before a planned takeoff forming part of the takeoff procedure in question is not included by the regulations.

1.4 TIME-LIMIT OF BAN ON RUN-UP: The period of ban lasts from 2300 hours GMT to 0500 hours GMT.

1.5 RESTRICTED HOURS (CURFEW): The period of restricted hours lasts from 1900 hours GMT to 2300 hours GMT and from 0500 hours GMT to 0700 hours GMT, including as well the curfew imposed on Sundays and public holidays lasting from midnight to midnight. On Constitution Day, however, only the period from 1200 hours GMT to 2400 hours GMT.

1.6 TEST AREAS: In this context test areas refer to the areas described in the enclosed map of Copenhagen Airport, Kastrup.

1.7 COMPASS HEADING: By compass heading is meant the direction towards which the nose of the aircraft points.

2. GENERAL PROVISIONS

2.1 Run-up of engines must not be made during the period of ban (however, see section 2.6 as well).

2.2 During the restricted hours run-up of engines may only be made if it is essential for proper conduct of planned flights. Consequently, run-up of engines during curfew is not allowed in cases of preparing solely for a reserve aircraft.
TABLE 9 (Continued)

2.3 Run-up of engines must only be made in certain test areas.

2.4 In the restricted hours as well as during the period of ban all aircraft to be moved to/from hangar and test areas are to be towed by tractor. The engine of the aircraft must be brought to a halt during the towage.

2.5 Idle run of engines must only be made in the test areas and on numbered stands.

2.6 In the test areas no restrictions but those connected with the individual test areas are imposed in general on idle run of engines.

2.7 Idle run of engines on numbered stands must only be made if the following conditions are met:
   a) Permission is to be obtained from Apron Tower (within the time-limit 2300 hours GMT to 0700 hours GMT from Tower). Normally, such permission will be granted, though provided that the idle run can be carried through without troubling the other activities in the area.
   b) The idle run of one aircraft must not exceed 5 minutes in duration.
   c) Only one engine at a time is comprehended by the idle run.

2.8 All run-up and idle run of engines are to be reported to the Copenhagen Airports Authority in accordance with the current rules of reporting.

2.9 The companies are ordered to ensure the shortest possible lapse of time used for run-up and idle run of engines.

3.0 In areas in which no special rules apply for the orientation of the aircraft, a choice, within the range of the orientation possibilities the wind conditions permit, has to be taken of an orientation which minimizes the noise load on the residential districts.

Source: Submission to ECAC by Directorate of Civil Aviation, June 30, 1978.
attempts to avoid using runway 30 unless cross-wind or tail wind components on other runways make the use of 30 unavoidable.

The usual airborne restrictions of minimum noise altitudes, minimum noise routes, noise abatement takeoff procedures (including reduced thrust) and restrictions on flight training have been instituted. The public, however, is not yet satisfied with the relief afforded by the operational rules. Neither are the carriers or the pilots satisfied. Carriers dislike the extra cost involved in the longer arrival and departure routes, the constraints on their maintenance operations, and the continued criticism of the noise. Finally, the pilots complain of having to modify normal operating procedures which they consider to be safer than, for example, having to contend with undesired cross-wind components to avoid the use of runway 30. Except for the inflight aircraft power instruction most of the Noise Abatement Procedures presented for pilot consumption are found in Table 10.

6. Land-Use Planning

The principle of land-use planning is, of course, sound. Either purchasing land in a quiet area, followed by establishing zones to restrict people from encroaching in areas of potential noise problems, or by instituting strict building codes and buying up homes in a noisy area to clear the property or provide easements is necessary lest noise at the source rules become merely temporary palliatives. One handicap for the Danish government is its lack of
TABLE 10
COPENHAGEN, DENMARK
KASTRUP

NOISE ABATEMENT PROCEDURES

GENERAL
The minimum noise procedures specified below shall apply to all aircraft taking-off from
and landing at Copenhagen, Kastrup airport.

Overflying Greater Copenhagen is prohibited to JET aircraft below 2300 ft (conventional
aircraft below 1500 ft) during intermediate approach. Generally these restrictions
apply to landings on RWY 12 during final approach.

The following rules apply to aircraft with a maximum permissible take-off weight of
not less than 17,000 kg (37,450 lbs) as well as to all JET aircraft.

APPLICABILITY OF RUNWAY SYSTEM:
TAKE-OFF:
PREFERENTIAL RUNWAY SYSTEM
RWY 04 and 22, shall be used up to cross-wind component of 15 KT.
• RWY 12, shall be used as follows: a) with JET aircraft from position C.
b) with PROP aircraft from position B or C.
RWY 30, shall be used from threshold. JET aircraft shall proceed in a manner not to
exceed 110PHN dB, over northwest corner of airfield.
RWY 04R, from position A, B, or C with JET aircraft.
RWY 22L from position A or B.

LANDING:
PREFERENTIAL RUNWAY SYSTEM
RWY 04 and 22 shall be used up to cross-wind component of 15 KT, except:
•a. Ceiling and/or ground visibility are less than 300 ft/1200m, RWY 12 shall
be used when weather conditions permit.
b. RWYs 04 R/L and 22 R/L are closed, RWYs 12 and 30 shall be used.
c. RWY 30 is active.

RWY 12, ILS glide path shall be followed, also in VMC. Below an altitude of 200 ft do not
underfly ILS glide path. Touchdown shall be made after displaced threshold.

SUPPLEMENTARY PROVISIONS
ATC may, at any time, based on its discretion, on weather/runway conditions or on
pilots request grant clearances in exceptions to the above rules.

TRAINING FLIGHTS
Such flights shall be approved by the Airport Authority. Permission will not be granted
for flights from 1800-0600 hrs and on Sundays and Holidays.

REVERSE THRUST
Between 2100-0500 reverse thrust shall not be used when runway length or runway conditions allow
aircraft to stop with wheel brakes alone.

- When runway direction 22 is in use during the period 2100-0600, RWY 22L shall
preferably be used.

CHANGES: Reverse thrust procedures. Green RWY 4, 3. JET procedure.

[Image of the table]
authority to acquire property in noise afflicted areas. The effectiveness of master plans or guidelines issued by national or federal governments has been severely diluted by federal-state-local jurisdictional problems and because local governments, under pressure from property owners or developers who foresee constraints on the value of the property, fail to translate the recommended guidelines into mandatory zoning laws.

In Denmark there is no land-use planning law of a mandatory nature. At the ministerial level there are guidelines or recommendations which almost have the force of law. However, unresolved is how the national authority cuts across that of the local governments. In essence the matter becomes a political football.

Many citizens living near the run-up areas moved there in the 1920's before noise became a problem. It is agreed when their habitation is overtaken by noise they have a justifiable complaint. However, later a new runway was constructed after which people moved closer to the noise. How to treat them is another matter. Consideration of how to solve the noise problem, as well as that of airport capacity, led to a 1972 report recommending an agreement with Sweden to move Kastrup about 4 miles over water east to the island of Saltholm where an appropriate-sized airport with property zoning could be built. Such an agreement was executed. However, another report, in 1975, after the unsettling developments of the oil crisis, found that at a cost of 8 billion kroner the move would be too
expensive and, therefore, favored a new runway and other improvements at Kastrup. The proposal for Saltholm is now all but dead.

In recent years the role of the environmentalists has been enhanced by the passage of the Law on Protection of the Environment. Section 35 of the law states that special permission is needed to modify an existing airport or establish a new one. In 1977, under this act, a circular was issued indicating that airport planning done under the Local Government Act on Planning must take noise measures:

"to secure ample distance which separates areas sensitive to pollution. Requirements for distances to be complied with are recommended to be 3-5 km, though provided that a somewhat greater distance has to be reckoned with in cases of distances from the take-off and landing extension of runways."

The circular goes on to provide that the final determination of these sensitive areas (zones) must be based upon a forecast of the volume of future traffic, its pattern and its dispersion over time of day. At present there are no provisions in Danish law for compensation for insulation in areas affected by airport noise. However, a draft bill for the enlargement of the Copenhagen Airport does contain such a legislation.

In summary, while Denmark has a framework for land-use planning, politics, the conflicting jurisdiction between different levels of government, and the usual pressure from property owners and builders have resulted in very limited results of an aircraft noise abatement nature from land-use planning.
7. Impact of Aircraft Noise - Denmark

The Copenhagen area has experienced the same type of noise annoyance as other European cities with one specific difference. Because of the large maintenance base at Kastrup and the location of the run-up areas relative to housing, for a number of years the predominant number of noise complaints came from ground operations, particularly the ground testing of engines. The response has been a number of regulations to mitigate this type of complaint. Although Denmark has been prompt in adopting Annex 1b to indicate its posture in the international noise area, the citizens near the airport have in more recent years turned to complaining about noise from airborne aircraft. The response to these complaints has been the adoption of rules governing the manner in which pilots are to fly their aircraft. To abate noise over the most sensitive area, the northwest of the airport, a preferential runway system was established with the northwest runway, number 30, limited to use in times of adverse cross-winds on other runways.

Under pressure from the Ministry for Environment Protection more attention is being focused on noise monitoring as a tool in obtaining facts on the level of noise and identifying which type of planes produce the most serious complaints. Except for the 110PNdB limit applicable to takeoffs from runway 30 - a limit in effect since 1972 - no compliance limits have been set for other locations at or around the airport. While the Government has sought
to employ land use planning and, to some extent, building codes to control noise around the airport, the typical problems of split or conflicting jurisdictions, and conflicts between the inhabitants and property owners who perceive they will suffer financially and those who perceive environmental benefits from noise rules have resulted in little improvement being made through these approaches.

The matter of impact on carriers has been discussed in the chapter on Sweden. SAS, as we have said, is owned by Denmark, Norway and Sweden. Although it has major operations at Kastrup its headquarters are at Bromma-Stockholm. Essentially, the noise problem at Copenhagen was one of a series of factors leading SAS to make its policy decision of purchasing only the quietest aircraft available. The increasing annoyance of the local communities with noise is passed on to the Government authorities who in turn, threaten the airlines with further constraints unless progress is made in reducing noise. This pressure conflicts with the wishes of those desiring to encourage tourism and international commerce.
Chapter 11

THE NETHERLANDS

The Netherlands is a small (12,500 square miles) densely populated country much of whose land has been reclaimed from the sea and, therefore, is a country short of land for airport purposes. With a maximum distance between its borders of about 150 miles, one can understand why there is only one major airport, Schiphol, and why it is located in the major city of Amsterdam where one million of the 14 million inhabitants live. Since 92 percent of the air traffic of the Netherlands passes through Schiphol, and because of its noise problems arising from population growth around the airport and from its location only 6 miles from the city center, we focus on the Amsterdam/Schiphol noise regulations. We therefore will not discuss Rotterdam which is also an international airport. The current runway complex at Schiphol became operative in 1968 as a result of plans made in 1955. Although noise was said to be considered in the planning, noise protests in 1970 reached such a stage that demonstrations took place in which cars were set on fire and even approach lights destroyed. 30/

As a result of the oil crisis and subsequent economic downturn, traffic growth after 1973 leveled off. Additionally, the adoption of

30/ For this and much other material in this chapter I draw heavily on interviews and subsequent correspondence with A.A. Maurits, Head, Bureau of Noise Affairs in the Dutch Civil Aviation Department; Douwes Dekker, Deputy Managing Director, Schiphol Airport Authority and H.H. Blaauwgeers, R & D Department of Schiphol Airport Authority.
operational rules, the introduction of noise monitoring, the gradual introduction of high bypass quiet engines, the passage of a 1978 amendment to the Aviation Act involving land-use planning, and the expected replacement of old aircraft by Annex 16, Ch. 3 (3d ed) aircraft have generated a feeling, at least by the airport authorities, that the noise levels have reached their peak in the Netherlands.

1. **Government Structure**

The country of the Netherlands is a constitutional monarchy governed by a parliament made up of two chambers. Proposals for legislation originate in the governmental departments and are presented to both chambers of the Parliament for enactment into law. A number of ministries implement the laws. The transport function is in the hands of the Ministry of Transport and Public Works which contains a Civil Aviation Department to oversee air transport. Administration of the technical aspects of noise, such as noise monitoring and licensing for noise and airworthiness standards, is a function of the Aeronautical Inspection Directorate of the Civil Aviation Department (CAD). The legal basis for the regulations is found in the Aviation Act of 1971 as amended.

In the Netherlands, as in other countries, aircraft noise emissions, immissions and their effects have become of interest to other departments of the central government as well as to the governments of the provinces and municipalities, thus creating complex jurisdictional problems. For example, when the Aviation Act was amended in
1978 to strengthen land-use planning, roles were given not only to the Minister of Transport and Public Works but also to the Minister of Defense, the Minister of Housing and Urban Planning and the Minister of Public Health and Environmental Hygiene. It will, therefore, take several years before coordination between these departments can take place so that even modest results in land-use planning can ensue.

A brief history of noise control planning in the case of the development of Schiphol, an airport for which most of the planning took place after the introduction of jets, illustrates once again the failure of all concerned to come to grips with the noise problem. In 1961 the Minister of Transport and Public Works established an Advisory Committee on Aircraft Noise Nuisance to suggest actions for controlling aircraft noise. Two years later, in 1963, an inquiry was held among the inhabitants near Schiphol to define a method for determining noise exposure. In its final report issued in 1967, the year of Schiphol's opening, the Advisory Committee recommended the adoption of the Kosten Unit as the noise descriptor, and also recommended that the Aviation Act be amended to provide for land-use planning.

After seven years of controversy, finally, in 1974, proposals on land-use planning were presented to Parliament. Additional controversy ensued so that it was not until 1973 that legislation was

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31/ The name derives from Professor Kosten who was deeply involved with the development of Schiphol. The unit is somewhat similar to NNI but has a series of increasing weights for various periods of night and morning.
approved by both chambers. The authorities now estimate it will take several years before the law can have any effect. More will be said later in the section on land-use planning. It is sufficient here to point out that now, some twenty years after the establishment of the Advisory Committee on Aircraft Noise Nuisance, hearings will finally be held on determining noise zones. They will be held on the question of extending and/or changing the direction of the runways at Schiphol and not for establishing the zones for an airport in its planning stage as was originally intended.

Schiphol is owned by the Schiphol Airport Authority which in turn is owned through shareholdings by the national government, the city of Amsterdam and the government of Rotterdam. A council appoints the airport director. Also, the national government has a 75 percent ownership in KLM, the national airline. With the central government having such a large stake in the national airline and the airport facility it tends to look with favor on permitting increases in airport capacity for political and economic reasons. But, on the other hand, the local communities around the airport have been pressing for restrictions on capacity because of aircraft noise on the ground and in the air.

2. Noise at the Source

Prior to 1968 there was "tie in the Netherlands' statutes, ordinances, decrees or regulations on controlling noise at the source. Since that time, amendments to the Aviation Act have strengthened the
government's authority in this matter and as a result a number of ordinances, decrees and regulations have been issued pertaining to overall operations and noise. In June 1968 the Director General of the Civil Aviation Department by decree enlarged the authority of the Director of Aeronautical Inspection Division over airworthiness requirements. Presumably this gave him unstated power to consider noise in the standards. However, it was not until after the adoption by ICAO of Annex 16 in 1971 that significant government response to aircraft noise problems became evident.

Late in 1971 amendments to the Aviation Act gave a firm legal basis to the ordinances, decrees and regulations. First, Ch. 1, Art. 2 received a new paragraph (e) specifying that noise certification was a part of the airworthiness certification procedure. Second, the Minister of Transport could by an ordinance, issue regulations pertaining to the limiting of aircraft noise, or the Minister could delegate this duty to the Director General of Civil Aviation.

In March 1972, an ordinance on the supervision of aviation was amended giving the Director General of the Civil Aviation Department authority to intervene if noise increased on existing aircraft. And, responding to the complaints of the airport neighbors concerning noise emissions of engines running on the ground, the ordinance gave the Minister of Transport and Public Works the authority to publish regulations covering the ground operation of engines.

2.1 Supersonic Flights: In April 1972, an amendment to the
ordinance on air traffic rules prohibited supersonic flight over Netherlands territory, subject to exceptions to be granted by the Minister of Transport and Public Works.

At the same time as supersonic flights were banned, the Minister of Transport and Public Works was given the authority to make specific rules on civil aircraft noise emissions and to ban civil aircraft which exceed specified limits from landing or taking off.

2.2 Annex 16 Adoption: In May 1972, by a decree of the Director of Aeronautical Inspection, the Netherlands adopted the original Annex 16 Ch. 2 dealing with future designed aircraft. Following ICAO's Amendments 1 and 2 to the noise standards in the Annex, the Director, by decree, made the standards applicable to all civil jet aircraft to be entered on the Netherlands register beginning April 1, 1974.

By another decree in late 1977, the noise requirements were amended to adopt Annex 16 "Noise Standards for Newly Designed Jet Aeroplanes and For Derived Versions of Existing Aeroplanes," as proposed by CAN 5.32/ It will be recalled that these lower limits were required for aircraft for which certification was requested on or after Oct. 6, 1977. Although much publicity was made of these lower limits required, in fact, since future production of current models was not included, the real noise benefits (assuming the normal design, certification and production time required for new aircraft)

32/ See charts 8, 9, and 10 in Chapter 3.
would not be felt until some years in the future. Exceptions at the discretion of the Director of Aeronautical Inspection could further delay the benefits. For example, exemptions could be authorized (1) for temporarily leased planes, (2) for replacing a plane lost due to an accident, or (3) on a finding that an equivalent noise certified plane did not exist.

Since the results of the Dutch investigations concerning the desirability of retrofit were congruent with those made by ECAC, namely, that retrofitting with SAM would be of very limited benefit, the Dutch felt no need for a phase-out date for non-certified aircraft. Accordingly, nothing like the 91-136 phase-out rule in the U.S. has been proposed. Recently the feeling has been expressed that the rapidly rising cost of fuel will drive out the noisy aircraft at least as fast as would a rule. However, if that does not happen, the Dutch favor the suggestion of ECAC and the EEC for a date of 1988. The advanced date, they argue, will give the airlines ample opportunity and incentive to purchase new quieter Chapter 3 (Stage 3) aircraft.

3. Curfews

A curfew was introduced at Schiphol in 1972 and has continued with some changes ever since. At present there is a partial curfew for inbound traffic in which all runways except 06 and 24 are closed from 2330 to 0600 local time. Thus, three of the four major runways are closed. Special provisions are made for accepting noise certificated airplanes. Additionally, there are limitations on runways used
CHART 3

AMSTERDAM NOISE MAP - KOSTEN INDEX
for departures depending upon whether the aircraft is noise certified or not and upon how many engines the aircraft has. Partly as a result of these limitations the incidence of night movements within the curfew time is low, averaging about 30 per night. Chart 3, page 176, indicates the location of housing giving rise to those rules. Pilots operating in and out of Schiphol must consult some 20 different SID's and STAR's 33/ to determine their proper course of action.

4. Operational Rules

As early as 1967 "social complaints" concerning aircraft noise around Schiphol led to the establishment of a Noise Office by the government whose function was to develop noise mitigating procedures. Its initial effort was to increase the glide slope angle to 3 degrees (from 2 1/2) and raise the glide slope intercept to 2,000 feet. In 1973 the elimination of night training flights between 10 pm and 7 am and their total elimination on "Christian Holidays" began. Also in this year, possibly the peak of violent demonstrations against aircraft noise took place when cars were set afire and approach lights destroyed. However, this is not to say that noise complaints decreased at that time. Quite the reverse is true.

Noise abatement take-off procedures in the form of power, flap, and airspeed control were issued with the objective of reducing noise

-33/Standard Instrument Departure (SID) and Standard Instrument Arrival (STAR)
CHART 14
NOISE ABATEMENT PROCEDURES
AMSTERDAM, NETHERLANDS

GENERAL INSTRUCTIONS: Below FL 100 - maximum climb speed 250 KT IAS. Intercept radials in principle at an angle of 30°. Instructions containing deviations from SIDs may be added to take-off or enroute clearance, such as opposite turn after, take-off, intercept of different radials, maintaining a specified heading or temporary altitude restriction.

Noise Monitoring Point

LEK DEPARTURE (ALL RWY’S)

NOTE: Lek 2 Dep (RWY 01L) applies during nighttime for non-noise-certified jet aircraft.

TAKING-OFF

RWY 01L: At Schiphol 4 DME arc turn RIGHT, intercept Spikerboer R-190 to Lek Int. Thence RWY 09: At 500 turn RIGHT, intercept Spikerboer R-190 to Lek Int. Thence RWY 18L: At 01R ILS NM turn LEFT, intercept Spikerboer R-190 to Lek Int. Thence RWY 24: At Schiphol 2.5 DME arc turn LEFT, intercept Spikerboer R-190 to Lek Int. Thence DEPARTURE

Cross Lek at FL 60. Request level change at FL 60. Aircraft departing to UA-8 and cleared to level above FL 150 “standard climb”, proceed as follows: cross Lek above FL 70, Woody above FL 150. Nicky 10 DME fix at or above FL 200.

LEK 2 DEPARTURE (RWY 01L)
(NIGHTTIME FOR NON-NOISE-CERTIFIED JET AIRCRAFT)

TAKE-OFF/DEPARTURE

AT 500’ turn LEFT, intercept Schiphol R-246 at Schiphol 10 DME fix/Spikerboer R-235 turn RIGHT, intercept Spikerboer R-190 to Lek Int. Cross Lek at FL 60. “request level change at FL 60. Aircraft departing to UA-4 and cleared to level above FL 150 “standard climb”, proceed as follows: cross Lek above FL 70, Woody above FL 150. Nicky 10 DME fix at or above FL 200.

TRANS LEVEL: BY ATC
TRANS ALT: 3000’
(particularly on the DC-9) to 105dB. Later, power cut-backs were ordered, the effect of which was to reduce emissions by 4dB which decreased noise at the point of initial cut-back but spread its effect over a greater distance because of the reduced rate of climb. When the citizens complained about the turns being made over Amsterdam, minimum noise routes were introduced as prescribed in a series of SIDs and STARs.

Further restrictions on the freedom of operation were instituted in 1971 with two actions. One, a general prohibition was placed on the ground running of engines between 2300 hours and 0700 with some exemptions allowed during the first and last hour of the period. Second, a preferential runway system was instituted favoring runway 06 for landing and 01L for take-off. Chart 3, page 176, shows these flight paths to be over the least congested areas. As was pointed out in section 4 of this chapter, in 1972 a further constraining step was taken with the introduction of a curfew (sometimes called the "half curfew") which closed all but one runway, namely 06-24.

Over the succeeding years there has been a proliferation of noise routes and procedures with the result that a pilot using the airport is confronted with 20 STAR and SID charts plus the usual complement of instrument approach charts, airport layout charts, special noise pages and an area navigation chart. Some charts, such as the ones on Chart 14, depict the location of the noise monitoring microphones thus giving the pilot a hint on whether to "slide
right, "slide left" or where to "play with the throttles" to minimize the recorded sound. A recent Amsterdam noise abatement list of rules is reproduced on Table 11.

5. Noise Monitoring

As noted above, Amsterdam has installed a noise monitoring system consisting of four fixed and one mobile microphone. A 24-hour complaint center for aircraft noise is also maintained so that the public may feel complaints can and will be investigated promptly. According to the Director of the Office of Noise Affairs, while the purpose of the monitoring system is to gather facts for planning purposes and to have a means of evaluating complaints, the system has been used indirectly by others for disciplinary purposes. It is reported that some countries when advised that their pilots have exceeded noise limits have forbidden the offending pilots from flying into Amsterdam for a period of time. As will be recalled, this same type of penalty was reported by the Frankfurt noise authorities.

The Amsterdam system, because of budgetary restrictions, is not as sophisticated as that of Zurich or Frankfurt. For example, Table 12, "Noise Monitoring Report Schiphol," lists the monitoring point, the type of aircraft (arranged in alphabetical order), the name of the airline, the number of flights measured, the noise level in various dB brackets, the mean value of the noise and the excesses above a certain level. The table displayed is one page of the 34-page report covering all the monitoring or "measuring points". Noise
### TABLE 11

**Summer LT - 3 Hours = GMT +3**

**Winter LT - 4 Hours = GMT +4**

**AMSTERDAM, NETHERLANDS**

**SCHIPHOL**

#### GENERAL

The following procedures are designed to avoid excessive aircraft noise in the area adjacent to the airport and in the areas overflown during take-off and landing. Noise levels are monitored in the built-up areas concerned. For take-off a provisional guiding limit has been established at 112 PHdB. The standard instrument Departure routes as shown on Amsterdam SID charts avoid large built-up areas as much as possible and are considered to be minimum noise routes. Special SIDs for nighttime operations of non-noise-certified jet aircraft are in effect as shown on Amsterdam SIDs.

#### PREFERENTIAL RUNWAY SYSTEM

The order of preference in which the main runways are to be used:

**LANDING:** 1) 06  2) 18R  3) 27  4) 01R
2) 24  3) 18L  4) 01L  5) 09

This yields the following combinations of active runways in order of preference, landing runway listed first:

1) 06/24  2) 06/01L  3) 06/09  4) 18R/24  5) 18R/18L  6) 27/04  7) 01R/01L

**NOTE:** The combination 06/24 will only be used from 2200-0700 LT. Delays in departures resulting from this combination are accepted within certain limits.

Wind criteria for runway selection:

- **A.** Wind velocity - not exceeding 5 KT, system as above.
- **B.** Dry runway - system changed with tailwind of more than 5 KT and crosswind of 15 KT (flaps included).
- **C.** Wet runway - system changed with crosswind of 10 KT (flaps included), no tailwind allowable.

In addition to wind criteria, such factors as navigation aids, closed runways, traffic conditions and prevailing weather will also be considered in selecting runway pair.

The runways 05/23 and 14/32 may be available for take-off and landing if wind direction and/or velocity so require for certain types of aircraft. They may also be assigned for light aircraft. Runway 05/23 may only be used by aircraft with a weight of less than 30,000 KGs AOW. Runway 14 may only be used from 06-09.

Deviations from the preferential runway system in order to obtain a shorter taxi route, departure or approach pattern are not permitted. However, if a pilot decides that a different runway should be used for safety reasons, ATC will assign that runway (air traffic and other conditions permitting).

#### ARRIVALS

No instrument or visual approach shall be made at an angle less than the ILS glide-path or less than 3° if an ILS is available. Aircraft executing a visual approach shall intercept the final approach at an altitude of at least 1000' MSL unless flying over populated areas can be avoided. After landing, reverse thrust above idle power setting shall not be used from 2200-0800 LT on runways 01R, 18R and 27, safety permitting.

#### DEPARTURES

Procedures for jet aircraft take-off and initial climb are as follows:

- Take-off to 1500' QNH with normal take-off power, a speed of Vy + 10 (+) and appropriate flap setting.
- From 1500' QNH to 3000' QNH with power reduced to climb thrust, a speed of Vy + 10 (+) maintaining previous flap setting.
- At 3000' QNH retract flaps on schedule, maintain normal en-route climb.
- Between 3000' QNH and FL 100 maximum climb speed is 250 KT IAS, unless otherwise instructed by ATC.

**NOTE:** The formula Vy + 10 (+) recognizes that under certain conditions in which the pitch angle may be the limiting factor, acceleration above Vy + 10 will be allowed. The formula is also intended to cover specific aircraft characteristics.

#### NIGHT RESTRICTIONS

Jet aircraft without noise certification must use:

- 09 LT for landing runway 06 only between 2330-0600 LT.
- 24 LT for take-off runway 24 only between 2330-0700 LT.
- Runway 01L may be used during the above mentioned period when the departing aircraft has less than four engines and if the use of runway 24 is impossible due to safety reasons. Deviations from any of the noise abatement procedures will only be granted for safety reasons.

---

**CHANGES:** Night restrictions.
<table>
<thead>
<tr>
<th>TYPE</th>
<th>COMPANY</th>
<th>AUGUST 1978</th>
<th>SCHIPHOL</th>
<th>TOTAL LESS NUMBER THAN 95 AS-95</th>
<th>90-95</th>
<th>95-100</th>
<th>100-105</th>
<th>105-110</th>
<th>&gt;110</th>
<th>MEAN VALUE EXC ND(%) 110</th>
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<td>3</td>
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<td>0</td>
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<td>0</td>
<td>92.67</td>
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</table>

**TABLE 12**

Noise Monitoring Report Schiphol
values at this number 1 point (located at the town of Zwanenburg - see Chart 3 and 14) are higher than at any of the other four microphones. The Russian Antonov 12, the BAC 111, and the Boeing 707 stand out as the greatest noise-makers. For its size, the BAC 111 is particularly noisy.

Unlike the Swiss and German reports, the Dutch do not specifically identify the time, trip and flight number nor separate the "good guys" (the compliant operators) and the "bad guys" (the non-compliant). Absent this delineation, the Dutch system is not as revealing as it might be. However, the system has political appeal because it gives the appearance of a system of control rather than one with limited information.

6. Noise Related Landing Charges

The Netherlands is one of the three countries in Europe most actively interested in a rational workable noise related landing charge. The other two are France and Switzerland. The Chief of the Office of Noise Affairs at Schiphol has worked closely with the French and plans soon to present a more sophisticated proposal to his government. Although a great deal of work has been expended, no charges are yet in place. The most recent plan involves establishing a standard noise level for each airplane and then developing a deviation from average levels at flyover, approach, and side line sites. The weight of the aircraft and the noise differences of the individual aircraft types are important elements.
As of October 1979 the formula being considered for a noise charge labelled C at Schiphol was \[ C = c \times 10^{-3} \text{EPNdB} - 270 \]

where \( \text{EPNdB} \) = the sum of the certificated noise levels at the three certification points, according to FAR 36, incl. Amendment 7 \[ \text{EPNdB} \]

and 270 is a constant to be subtracted. This value is only introduced, to have a value for: \( c \) is, a monetary value in guilders (as a first estimate, it could be: \( c = 8 \) Dutch guilders).

Admittedly the plan is not without its technical and practical difficulties. First, as indicated, because of lack of other data it is necessary to use FAR 36 data even though technically the country subscribes to and has adopted Annex 16. Additionally, the data in circular AC-36-2A are only estimates. To overcome this difficulty the DC-8, B-707 and VC-10 will have to be given the benefit of the doubt by a certain number of decibels. Third, because there are some

\[ 34/ \text{For information on noise-related landing charges, both in the Netherlands and in France, the author is indebted to A.A. Maurits, Chief of the Office of Noise Affairs at Schiphol.} \]

\[ 35/ \text{Although in the Netherlands ICAO Annex 16 applies, the FAR 36 values are used, because the majority of data available are published in the FAA Advisory Circulars AC-36-2A of 2/6/78 (Estimated levels) and AC-36-1B of 12/5/77 (certificated levels).} \]
18 different noise levels for the B-727 it may be necessary to group such aircraft in 10EPNdB bands for sum. Fourth, the sizes, weights and noise of the various models do not necessarily correlate with the formula so that a relatively quieter plane may fall just over the line into a higher bracket than a smaller plane with undesirable noise characteristics, i.e., a DC-10 paying more than a B-707.

For political reasons it seems that there is little likelihood of the abandonment of the Kösten unit with its progressively high penalties for nighttime operations (as high as an effective penalty of 20 dB(A)). Thus the formula, if adopted, would severely penalize the noisy aircraft. The opinion was expressed by the airport authorities that noise-related landing charges whose objective was to provide incentive for carriers to purchase quieter equipment would never succeed because of the economic burden they would impose. On the other hand, they felt a plan with more modest noise charges for the reimbursement of insulation costs, the acquisition of land, or for the purchase of easements might well be easier to enact.

7. Land-Use Planning

Previous sections of this chapter dealt with noise constraints placed on emissions from the aircraft itself for certification on the Netherlands' register, and with constraints on the operation of the plane (curfews, airport and in-flight restrictions and noise monitoring). All of these constraints were aimed at the manufacturers, owners and operators of the planes. Although it was clear, or should
have been clear, that a portion of the responsibility for noise complaints rests with the public (the government) if it fails to prevent people from moving toward an airport and thus encroaching on an area which if not noisy at the time of construction of the airport will surely be so as operations increase, nevertheless, until 1978 there has been a lack of overall planning and cooperation between the various levels of government.

Land-use planning involving reserving sufficient area around an airport and then zoning it for uses compatible with airport noise has been attractive for years, but its implementation, often because of conflicting interests in different layers of government, has been very slow. The Netherlands' story is no different. In the case of Amsterdam a housing and land shortage with attendant profits for owners of property inhibited the passage of legislation which would take some land from residential purposes for uses more compatible with aircraft noise. Thus, some provinces have been ahead of the city in planning. As previously noted in connection with the planning for Schiphol, in 1961 a Noise Advisory Committee was appointed to suggest solutions for the aircraft noise problem generated by the new transport jets. With the speed of a glacier the committee, six years later, recommended that the Aviation Act be amended to provide land use planning. Another seven years elapsed until, in 1974, actual proposals were introduced into Parliament. In the meantime two communities have been built near Schiphol. Finally, after four more years, in late
1978, an amendment to the Aviation Act providing shared responsibility for mandatory land use planning among various levels and departments of government passed both houses of Parliament.

While no English text is available, officials in the Ministry of Transport and Public Works provided the following information:

1. The law makes airport land designation a part of total urban planning, thereby making a statutory connection between national and urban planning.

2. Two noise zones must be established. The noise levels permitted will be in terms of the Dutch Kosten unit and will probably be in the order of 40 and 60 when converted to the more familiar NNI.

In the loudest (above 60 NNI) zone no housing will be permitted and existing housing, estimated at 16,000 homes, is planned to be demolished and an alternate home provided. However, the homeowner must agree. What happens if he does not is not clear. Must he live in it or can he sell it? Presumably he would not be entitled to insulation payments.

In the lesser noise zone (40-60 NNI) existing buildings must be modified with insulation which is estimated to be 10 percent of the cost of the house. Since the insulation requirements (like the U.K. but unlike western Germany) include a ventilating system, the cost can be quite expensive. The airport authorities would pay a part or all of the cost of this modification. Financing is expected to be by some sort of tax on those responsible for the noise. The proposals for noise-related landing charges attempt to address this point. As many as 10,000 buildings could be involved.

3. Finally, some figure (probably below 40 NNI) would be set as the limit for constructing houses, schools and hospitals where "thinking work has to be done."

4. While in the past there have been few suits for loss in value due to noise, and these were unsuccessful, it has been suggested that under the new law or an extension of it the situation might change.
Indicating some growth of power on the part of non-aviation departments, the amendment provides that proposals for noise zones come from the Minister of Transport and Public Works, or the Minister of Defense (military airports) and the Minister of Housing and Urban Planning. However, the foregoing must be in consultation with the Minister of Public Health and Environmental Hygiene and with various local authorities. Finally, it is the Health Minister who for each airport sets the limit which shall not be exceeded outside of the noise zone. By statute each airport will establish an advisory committee composed of all parties concerned, i.e., the government, local authorities, people living near the airport, the airport authority and airport users.

The foregoing shows that to obtain passage in Parliament a large number of competing interests had to obtain "a piece of the action," and, accordingly, the fruits of the legislation will be a long time in ripening. It is expected that in 1980 a kind of Environmental Impact Statement (EIS) which will include some intermediate noise contours will be issued for each airport. Also, discussions will begin with the Minister of Public Health and Environmental Hygiene about the limiting noise exposure value for the outer boundary. With so many diverse groups and special interest groups involved, there will be many problems. Also, the length of time necessary to condemn homes and decide compensation will be so long that some in the Civil Aviation Department think that for some time to come effectiveness of the new law will be primarily in promoting the insulation of
To conclude, the mandatory land-use planning law related to aircraft noise annoyance at airports is almost one cycle behind schedule. While the concept was first suggested in 1960 when Schiphol was being planned, it was almost twenty years until it became law. By that time studies were being made concerning the need for a second airport at Amsterdam.

8. Summary Comment

The story in the Netherlands of noise annoyance and the development of legislative and administrative attempts to deal with the conflicting interests of national pride, commerce and the public interest in maintaining reasonably quiet living areas on balance is not significantly different from that in other countries. Complaints of airport neighbors grew faster than the progress of technology in reducing noise at the source, so that the progressive adoption of the various amendments to Annex 16 did not satisfy these neighbors. As a result, a number of operational rules limiting the power to be used (noise abatement climbs) designating the manner of aircraft operation (noise abatement departures and arrivals in the form of SID's and STAR's), and, indeed, prohibiting some operations completely (curfews on flights and ground run-ups) were instituted. Finally, to prevent the citizens themselves from contributing to the problem by moving into potential or actual high noise areas, a land-use planning amendment was added to the Aviation Act.
The outlook for noise abatement in the Netherlands is beginning to turn from dark to "light at the end of the tunnel." By its terms, Annex 16 and its various amendments deals primarily with rules for future designed aircraft so that because of the normal design, production and introduction time lag, the result would not really be felt for five to ten years. Similar time lags or longer are applicable to new airport design and construction, as well as for land-use planning in the airport environs.

Some fragmentary bits of information are available which suggest that the peak of noise complaints may already have been reached. For example, a study by the Netherlands Civil Aviation Department showed that in 1970 there were 105,000 aircraft movements a day of which none were by noise certificated aircraft. By 1976 movements had increased to 132,300 of which 26 percent were by noise certificated aircraft. Since, as we have seen, aircraft proclaimed as "noise certificated" can be perceived by persons on the ground to be more noisy than non-certificated aircraft, a more relevant measure of the noise exposure may be the change in the size of a given level noise exposure area. The Civil Aviation Department comparison indicated that from a figure of 135 sq. km. in 1970, the Kosten index for the noisy Ke 40 area was, in 1976, reduced to 106, a reduction of 22 percent.

Dutch authorities estimate that noise levels around Schiphol have now reached a maximum and should remain almost unchanged until 1985 when a noticeable improvement of about 5dB could take place as fleet
renewal programs start bringing in a number of the quieter Chapter 3 aircraft. The airport authorities were particularly pleased when KLM purchased the A-300 and expressed the hope that opportunities would soon develop for carriers to purchase high bypass, fuel-efficient aircraft of the narrow-body type. The outlook has improved enough that plans to restrict Schiphol further for noise reasons and to establish a second Amsterdam airport have been replaced by plans for increasing the capacity of Schiphol. For example, by modifying the heading of runway 19-R by 14 degrees a noise-sensitive area can be avoided. Additionally, such change may satisfy airport capacity needs to about the year 2,000.

Although the advent of Chapter 3 airplanes and the implementation of the Land-Use Planning Amendment presents an improving picture for noise by jet transport, noise by other aircraft is becoming a problem. Noise from general aviation is growing and the rise in helicopter complaints has resulted in the formulation of rules for the latter aircraft. Notwithstanding the generally improving picture, the government personnel consensus is that the curfew rules not only will stay but very likely will become more severe at Schiphol and elsewhere in Europe, as the growing interest in quality of life made itself felt. Finally, if one projects a continuation of the rapid escalation of fuel prices and assumes their reflection in a much higher fare structure, the noise problem may be moderated by a decrease in the demand for travel. However, if we believe those who project a continued increase
in international traffic of about 8 percent per year, then we can side with the Deputy Managing Director of Schiphol who late in 1979 said: "Further reduction of (limits in) noise certification criteria as well as cut-off dates for the production and operation of first generation noise certificated aircraft are still required to counteract the effect of further growth in air traffic during the nineties."\textsuperscript{36/}

\textsuperscript{36/} Letter from Douwes Dekker, Deputy Managing Director, Schiphol Airport.
APPENDICES
APPENDIX A

Summary of People Interviewed on European Noise Regulation

LONDON, U.K.

Theodore Childs, Operations Manager, British Airports Authority
R.H. Chowns, Assistant Manager Operations Engineer, British Airways
Nelson V.F. Court, Manager-Resource Planning, British Airways
Miss J.V.S. Danks, Noise Policy Manager, British Airports Authority
Iver Davies, CAA
John Fennel, British Delegate to Working Group D
Trevor Ingam, Deputy Director, Directorate of Operations Research and Analysis, CAA
John B. Knight, Principal Engineer (Noise), British Airways
Roger Maynard, Assistant Secretary, Air Division, Department of Industry
R.K. Paskins, Civil Air Policy Division, Branch 5, Department of Trade
Norman J. Payne, Chairman, British Airports Authority (interviews in Singapore and New York)
John Purdie, Producer, Aviation Documentary, BBC
M.J.T. Smith, Head, Aeronoise Engineering, Rolls-Royce, Ltd.

PARIS, FRANCE

Jacque Balazard, former coordinator of noise matters for Ministry of Civil Aviation, now with Aerospatiale
M. Chaussonnet, SNIAS
Vital Ferry, Department of Environment
Claude Girard, TWA Staff Vice President, Europe
Michele Lagorce, French Ministry of Civil Aviation
Bernard Lathiere, President and CEO, Airbus Industries
Roger Lorin, Assistant Director, Department of Analysis and Equipment, Paris Airport Authority
Jacque Melene, Air France, Chief of International Organizations, also head of AEA
J. O'Connor, Civil Air Attache, U.S. Embassy
Mark Pianko, with ONERO (comparable to NASA)
Roger Pierre, FAA Representative, U.S. Embassy
Jean-Paul Roche, Director, Paris Airport Authority
Louis Ropars, Deputy Secretary of European Civil Aviation Conference

TOULOUSE, FRANCE

J. Chaussonnet, Itell, Acoustic Department, SNIAS
Andre Fort, Manager, Operations Engineering, Airbus Industrie Flight Directorate
George A. Warde, President, Airbus Industrie, U.S.
APPENDIX A (Continued)

GENEVA, SWITZERLAND

Peter Cunningham, IATA
Raffaele Gerardo, Manager, Geneva Airport Station for TWA
J.P. Jobin, Technical Operations Director, Geneva Airport
Alexander Strahl, Airport Association Coordination Council

ZURICH SWITZERLAND

Dr. Max Berchtold, Member Swissair Board and Professor of Mechanical Engineering, Swiss Federal Institutue of Technology
Neli Degele, Deputy for Director (Eric Schurter) of Zurich Airport Authority, Noise Abatement Department
Peter Gyse', Corporate Planner, Swissair
Peter Hablutzel, Division Manager, Engineering Studies, Swissair
Walter Nussbaumer, Chief Engineer for Noise Abatement on Ground, Swissair
Dr. Bernhard Staehelin, Deputy Secretary General, Swissair
Herbert Zwahlen, Aircraft Production Engineering, Swissair

FRANKFURT, GERMANY

Alfred Berger, Managing Director of Frankfurt Noise Commission (Ministry)
Karl Ernst Hierl, Deputy Director A & E Research, Ministry of Transport (interviewed in Montreal)
Werner Huxhorn, Head of Department of Environment and Community, Frankfurt Airport (Noise Monitoring)
W.G.B. Jurzig, General Manager, Route Operations and Navigation, Lufthansa
Dr. Karwath, recently held Jurzig's position on noise, now part time and a professor
Dr. Ludwig, Mr. Berger's superior in Wiesbaden
Mr. Monch, assistant to Alfred Reichenbacher and W.G.B. Jurzig
Alfred Reichenbacher, Manager-Performance Engineering, Lufthansa

STOCKHOLM, SWEDEN

Ulf Abramson, Manager, Aircraft Analysis, SAS
Ernst Ahlstrom, Aircraft Analysis Engineer, SAS
Gunnar Akvit, Swedish Board of Civil Aviation
Stig Anderson, SAS Dispatch
C. Hagstrom, ATC Supervisor, Arlanda Airport
Birger Holmer, Vice President, Aircraft Research Development, SAS
APPENDIX A (Continued)

COPENHAGEN, DENMARK

K. Christiansen, Engineer, Directorate of Civil Aviation
H. Dahl, Head of Government Directorate of Civil Aviation
Bror Hulthen, Civil Aviation Directorate
Eric Nelson, Head of Noise Monitoring
Captain Niels Voetmann, President, Danish Airline Pilots Association

AMSTERDAM, NETHERLANDS

H.H. Blaauwgeers, R & D Department, Schiphol Airport Authority
F.E. Douwes Dekker, Deputy Managing Director, Schiphol Airport
Authority
A.A. Maurits, Head, Noise Monitoring Department, Schiphol Airport,
Amsterdam, Netherlands

KINGSTON, JAMAICA

Armin Baltensweiler, President, SWISSAIR
V.K.H. Eggers, Director of Civil Aviation, Denmark
Dr. Werner Guildimann, Director, Swiss Federal Air Office
Frederick Sorensen, Head of Division, European Economic Community
Dr. Henrik Winberg, Director General, Swedish Board of Civil Aviation

MONTREAL, CANADA

ICAO:
Herman Gursahaney, Technical Officer, Operations Airworthiness Section
Roderick Heitmeyer, Chief, Economic Section
Keith Shaver, Chief of Operations/Airworthiness
Ken Wilde, Chief AGA Section

IATA:
Guy Goodman, Director of Engineering and Environment
R.R. Shaw, Assistant Director - Technical

UNITED STATES

R.E. Bates, V.P. Advanced Programs, McDonnell Douglas
Vaughn L. Blumenthal, Director Noise and Emission Abatement Programs,
Boeing
James T. Burton, Director, Market Development, McDonnell Douglas
R.H. Hopps, V.P. & General Manager, Engineering, Lockheed-California
A.L. McPike, Director of Industry and Association Activities,
McDonnell Douglas
Noel A. Peart, Community Noise Technology, Boeing
Richard Russell, Noise and Emission Abatement Programs, Boeing
John E. Steiner, Vice President, Boeing
APPENDIX B

LONDON/Heathrow

U.K. "Air Pilot" and "G.A.F.G."
**APPENDIX B**

**Takes-off ATC Clearance Procedure**

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<thead>
<tr>
<th>Route</th>
<th>Clearance</th>
</tr>
</thead>
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<tr>
<td><strong>31R</strong> Via Woodley</td>
<td>Climb straight ahead to intercept LON VOR R263 until LON DME 7 then turn right onto QDM 273 to WOD NDB (LON DME 14).</td>
</tr>
<tr>
<td>Via Chiltern/ Glascote</td>
<td>Climb straight ahead to intercept BUR VOR R124, at LON DME 5 turn right onto QDM 060 to CHT NDB.</td>
</tr>
<tr>
<td>Via Burnham/ Bourne Don</td>
<td>Climb straight ahead to intercept BUR VOR R124, at LON DME 1 turn right onto QDM 232 to BUR NDB.</td>
</tr>
<tr>
<td>Via Fair Oak/ Don</td>
<td>Turn left to intercept LON VOR R143 until LON DME 5 then turn left onto QDM 160 to DUN NDB (LON DME 23).</td>
</tr>
<tr>
<td><strong>22</strong> Via Woodley</td>
<td>Climb straight ahead to intercept LON VOR R263 until LON DME 7 then turn right onto QDM 273 to WOD NDB (LON DME 14).</td>
</tr>
<tr>
<td>Via Chiltern/ Glascote</td>
<td>At 10 R ILS MM turn right to intercept BUR VOR R124, at LON DME 6 turn right onto QDM 060 to CHT NDB.</td>
</tr>
<tr>
<td>Via Burnham/ Bourne Don</td>
<td>At 10 R ILS MM turn right to intercept BUR VOR R143, at LON DME 2 turn right to intercept BUR VOR R160 to intercept R212 to DUN NDB.</td>
</tr>
<tr>
<td>Via Fair Oak/ Don</td>
<td>Climb straight ahead to intercept LON VOR R143 until LON DME 3 then turn left onto QDM 160 to DUN NDB (LON DME 22).</td>
</tr>
<tr>
<td><strong>10R</strong> Via Woodley</td>
<td>Climb straight ahead to intercept LON VOR R143 until LON DME 5 then turn left onto QDM 160 to DUN NDB (LON DME 23).</td>
</tr>
<tr>
<td>Via Epsom</td>
<td>At LON VOR R118/DME 2 turn left onto QDM 143 to EPM NDB.</td>
</tr>
<tr>
<td>Via Dunsford</td>
<td>Turn right to intercept LON VOR R 10 until LON DME 5 then turn right onto OCK VOR R107, at OCK DME 1 turn left to intercept LON VOR R179 to DUN NDB (LON DME 22).</td>
</tr>
<tr>
<td>Via Waltham</td>
<td>Turn right to intercept LON VOR R143 until LON DME 1 turn left onto QDM 160 to AID VOR.</td>
</tr>
</tbody>
</table>

(2) An aircraft using the airport shall maintain as high an altitude as practicable. An aircraft using the ILS in IMC or VMC shall not descend below 2,000 ft (Heathrow VNH) before intercepting the glide path, nor thereafter for below it. An aircraft approaching without assistance from ILS or radar shall follow a descent path which will not result in its being at any time lower than the approach path which would be followed by an aircraft using the ILS glide path.

(3) The minimum noise routing procedures shall apply to all aircraft, except propeller driven aircraft whose maximum total weight authorized does not exceed 7,500 kg, taking off from the runways specified in the first column of the following table in accordance with the ATC clearance as specified or overflying and shall apply in both IMC and VMC.

(4) Before operating on a scheduled journey (as defined in Article 98(1) of the Air Navigation Order, 1978) on which an aircraft type not previously operated at Heathrow by that operator, the operator concerned shall have satisfied the Secretary of State that the type will be flown with a co-pilot and out of the airport in a manner calculated to cause the least disturbance practicable and shall have received written notification from the Secretary of State that operators with that type may be carried out at Heathrow. (See Note 4.)

(5) Before operating any jet aircraft type at night (2300-0500 hours local time) the operator shall have received written notification from the Secretary of State that operators with that type may be carried out at Heathrow at night, in addition to any written notification required under subparagraph (4) above. (See Note 4.)

(6) Every jet aircraft using the airport shall, in addition to complying with any minimum noise routing procedures which are applicable to it under subparagraph (4) of these requirements, be operated after take-off in such a way that it is at a height of not less than 2,500 ft above the runway at which it takes off.
APPENDIX B

AGA 2-23-4

LONDON/Heathrow

U.K. "Air Pilot" and "C.A.F.G." 3 of 3

Local flying restrictions and remarks (continued):

(a) in the case of an aircraft which is not required to comply
with any minimum noise training procedure, at the point
nearest to the noise monitoring point relevant to the runway
used by the aircraft as shown on Chart CAA C106 & of
Drg. No. 7211(M). (See Note (1)).

(b) in the case of an aircraft which is required to comply
with a minimum noise training procedure, at the point nearest to the
noise monitoring point relevant to the departure clearance
given, as shown on the said Chart.

(7) Every aircraft using the airport except Concorde shall, after
takeoff, be operated on such a way as to avoid
posing a noise hazard for the period of time
as indicated on the said Chart.

(8) Every aircraft using the airport shall, after takeoff, maintain
that the attired, relevant monitoring point, a radius of 3 nautical miles
which will ensure progressively decreasing noise levels as points on the ground
and the flight path beyond the monitoring point.

(9) Without prejudice to the provisions of sub-paragraphs (2) to (8)
above, and subject to the provisions of sub-paragraph (1) every
operating day or day on which aircraft operated by him
are at all times, is the responsibility of the operator to
cause the least disturbance practicable in areas surrounding the airport.

Gavin Darby.

As Under Secretary,
Department of Trade.

27th April, 1977

Notes

(These Notes are not part of the Notice)

(1) Noise from ground running of aircraft engines is controlled in
accordance with instructions issued by the British Airports
Authority.

(2) In the interests of noise abatement, certain restrictions are
imposed on the operation of training flights at Heathrow Airport—
London: operators concerned are advised to obtain details from
the British Airports Authority.

(3) The minimum noise training procedures specified in the above
notices are in accordance with normal ATC requirements. The
operation of any aircraft, however, drawn in to paragraph 4, sub-
paragraph (1), of the notice, will be on a request by the operators
concerned and will be in accordance with the directions
from the British Airports Authority.

(4) Operators wishing to have a noise abatement notice issued from
the Secretary of State as provided for in paragraph 4, sub-paragraphs
(4) and (5), of the notice, should apply to the Department of
Trade CAA. The Adelphi, John Adam Street, London, WC2N 6BQ.

(5) Copies of the chart referred to in paragraph 4, sub-paragraph (6),
of the notice, may be obtained from the Department of Trade,
CAA, The Adelphi, John Adam Street, London, WC2N 6BQ.

(6) To minimum disturbance in areas adjacent to this Airport. Operators
are requested to avoid the use of reverse thrust after landing, consistent
with the safety operations of the aircraft, between 2230 and 0600 hours
local time.

(7) Runways 10L, 10R, 18L, 18R and 26, subject to the availability of
the required facilities, are suitable for Category III operations by
operators whose minima have been approved by the Civil Aviation
Authority.

See also RAC and COM Sections.

Use of Runways. The use of runways will be as published in RAC
2-2 except in the circumstances shown below, when the use will be
as follows:

(a) When the runway is used is temporarily occupied by other traffic
landing clearance will be issued to an arriving aircraft provided
that the time the aircraft crosses the threshold of the runway
in use will be the same as that of the preceding aircraft.

(b) Landing following landing—The preceding landing aircraft
will be clear of the runway in use or will be at least 1,500
m. from the threshold of the runway in use.

(c) Landing following departure—The preceding departure aircraft
will be airborne and will be at least 2,000 m. from the threshold
or runway in use. If the aircraft is not airborne, will be at least 2,000
m. from the threshold of the runway in use.

(ii) Reduced separation distances as follows will be used where
both the preceding and succeeding landing aircraft or both
landing and departing aircraft are propeller driven and have a
maximum authorised take-off weight not exceeding 2,000 kg.

(a) Landing following landing—The preceding landing aircraft
will be clear of the runway in use will be at least 1,500
m. from the threshold of the runway in use.

(b) Landing following departure—The preceding departure aircraft
will be airborne or will be at least 1,500 m. from the threshold
of the runway in use.

(iii) Conditions of use: The procedures will be used by DAY only
under the following conditions:

(a) When the reported meteorological conditions are equal to
or better than a visibility of 6 nautical miles and a cloud ceiling
of 1,000 ft.

(b) When both the preceding and succeeding aircraft are propeller
driven and are operating in the normal manner. (Dispatch is responsibility for
notifying ATC if they are operating their aircraft in other than the normal manner.)

(c) When the runway is dry and free of all precipitants.

(c) Noise Restrictions

Full details concerning the maximum number of occasions on which
aircraft may be permitted to take off or land at night during
specified periods at the airport are promulgated in No. 3 Class Tens.

(a) A helicopter strip has been provided for the Heathrow-Carling
air link service. It comprises an approach lighting point and take-off
strip which is located on the grass area 210 m. South of threshold
Runway 03. It is aligned E-W and has both the marking and
night lighting. The strip is not a landing area and will only be used
as such in an emergency.

Helicopters will take-off and from the strip to lights on the
threshold of Runway 03 and thereafter ground-take off across Runway
28L/16R to end and from the grass area used.

This strip is provided for the air link helicopter only. and other
helicopters will continue to operate at directed by ATC.
Ortliche Flugbeschränkungen und Rücksichten:

1. Flugzeuge sind verboten während der Nacht (Sperroffnung).

1.1 Allgemeines:
Nach Art. 93 der Verordnung über die Luftfahrta (LFY) ist die Bewegung von Abflügen und Landungen in der Nacht zwischen 2100 und 0500 GMT grundsätzlich zu uben. Luftverkehrspflichten dürfen deshalb nicht durchgeführt, dass Bewegungen aufgrund von Nachtflugbe- wickungen des Luftverkehrs und der jeweiligen Ausbausverkehr für die Zeit von 2100 bis 0500 GMT in jedem Fall erstellt werden (siehe auch AOA 0-10, Ziffer 7).

1.1.1 Allgemeine Flüge均可
Der Kommodore kann nur mit Ermessen der Ab- fluggesellschaften, wenn er spätestens um 2200 GMT entweder sofort oder nach dem Abflugplanen der Reisenden, um 11100 GMT oder nach dem Abflugplanen der Abflüge, um 11100 GMT die Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

1.1.1.1 Allgemeine Flüge
Der Kommodore kann nur mit Ermessen der Ab- fluggesellschaften, wenn er spätestens um 2200 GMT entweder sofort oder nach dem Abflugplanen der Reisenden, um 11100 GMT oder nach dem Abflugplanen der Abflüge, um 11100 GMT die Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

1.1.1.2 Allgemeine Flüge
Der Kommodore kann nur mit Ermessen der Ab- fluggesellschaften, wenn er spätestens um 2200 GMT entweder sofort oder nach dem Abflugplanen der Reisenden, um 11100 GMT oder nach dem Abflugplanen der Abflüge, um 11100 GMT die Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

1.2 Linienflüge (übergeordnete Flugzeuge):
1.2.1 Flugplanmäßige Abflüge und Landungen werden nur bis 2200 GMT zugelasen, verbotene Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

1.2.2 Am Morgen werden Landungen erst ab 0400 GMT, Abflüge ab 0500 GMT wieder zugelasen.

1.3 Gewerblicher Abflug (übergeordnete Gewerbliche):
1.4 Flüge können von Gewerbliche Flugplanen von Linienunternehmungen zur Verfügung serienweise angeboten.

Weitere Einzelheiten siehe AOA 0-10, Ziffer 7.1.2.4.

1.3.1 Abflüge und Landungen sind nur bis 2200 GMT gestattet, verbotene Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

1.3.1.1 Abflug
Der Kommodore kann nur mit Ermessen der Ab- fluggesellschaften, wenn er spätestens um 2200 GMT entweder sofort oder nach dem Abflugplanen der Reisenden, um 11100 GMT oder nach dem Abflugplanen der Abflüge, um 11100 GMT die Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

1.3.2 Flüge können von Gewerbliche Flugplanen von Linienunternehmungen zur Verfügung serienweise angeboten.

1.4.1 Die Abflüge und Landungen werden nur bis 2200 GMT zugelasen.

1.4.1.1 Abflug
Der Kommodore kann nur mit Ermessen der Ab- fluggesellschaften, wenn er spätestens um 2200 GMT entweder sofort oder nach dem Abflugplanen der Reisenden, um 11100 GMT oder nach dem Abflugplanen der Abflüge, um 11100 GMT die Abflüge und Landungen bis 2200 GMT ohne besondere Bewegungen, ab 2200 GMT nur noch beim Vorliegen wichtiger Gründe durch Ausnahmewerbung des Luftverkehrs (vorbehalten Ziffer 1.3.4).

Local Flying Restrictions and Remarks:

1.1 Regulation on Traffic Restrictions at Night (Night Flight Prohibition)

1.1.1 General:
According to Art. 93 of the Air Navigation Or- dinance, it is prohibited to fly at night from 2100 to 0500 GMT. Air traffic may only operate at night if special authorisations for take-offs and landings at night have been granted. Under this general prohibition, night flights are prohibited subject to the following:

1.2 Scheduled air traffic (supplementary flights included)

1.2.1 Take-offs and landings according to the schedule are allowed only until 2200 GMT, if delayed they are allowed until 2230 GMT without special authorisation; from 2231 GMT they are allowed only with special authorisation of the Airport Authority for important justified reasons (subject to para. 1.3.4).

1.2.1.1 Departure
A Pilot-in-command can only expect to receive a departure clearance if he intends to start the turbo- jet or turbo-prop engines (AI P RAC 1-2-1, para. 2) at 2200 GMT at the latest.

1.2.1.2 Approach
A Pilot-in-command can only expect to receive a clearance for approach if he is over or at a distance of 5 miles (8 km) when radar vectored reporting point SHA NDB or ECHO INT at 2200 GMT at the latest.

1.3 Non-scheduled commercial air traffic (including non- scheduled flights of scheduled airlines):

Further details see AOA 0-9, para. 7.1.2.

1.3.1 The take-offs and landings are allowed only till 2200 GMT; if delayed, they are allowed till 2230 GMT without special authorisation; from 2231 GMT they are allowed only with special authorisation from the + AIP for Luftverkehr x for important justified reasons (subject to para. 1.3.4).

1.3.1.1 Departure
A Pilot-in-command can only expect to receive a departure clearance if he is ready to start the turbo- jet or turbo-prop engines (AI P RAC 1-2-1, para. 2) at 2200 GMT at the latest.

1.3.1.2 Approach
A Pilot-in-command can only expect to receive a clearance for approach if he is over or at a distance of 5 miles (8 km) when radar vectored reporting point SHA NDB or ECHO INT at 2200 GMT at the latest.

1.3.2 In the morning the take-offs and landings are allowed only from 0500 GMT.

1.3.3 Private traffic

1.4 Private traffic

1.4.1 The take-offs and landings are allowed only till 2100 GMT.
APPENDIX C

2 of 2

AIP
SCHWEITZ
AGA 2-LSZH 3
ZURICH

26

\textbf{2. Verkehrsbeschränkungen während des Tages}

\textbf{2.1 Gewerbemäßiger Nichtlieferverkehr}

\textbf{2.1.1} Flüge (Auskunft, Bedarf und Absprache) müssen vorher von der Flughafendirektion zugestimmt werden. Flüge von mehr als 15 000 KG wurden abgeschätzt zu Einflügen, die in der Zeit von 1000 bis 1130 GMT fallen, behalten. Anfragen müssen daher erforderlich sein.

\textbf{2.2 Meldungen und Gesuche sind über die Abteilungsorgan (Bagavat AG, Jet Aviation AG) bei Aktion der Flughafendirektion richten.}

\textbf{2.3 Für Flüge, die nicht gemeldet sind oder die sich nicht an die gemeldeten oder bewilligten Zeiten halten, ist mit erheblichen Wartezeiten zu rechnen.}

\textbf{2.4 Private Flüge}

Für Flüge mit Fluggastzahlen von mehr als 15 000 KG müssen Meldungen und Gesuche an die zuständigen Abteilungsorgan (Ag Aviation AG, Last AG) richten.

\textbf{2.5 VIP-Flüge}

In der Zeit von 1000 bis 1230 und 1630 bis 1800 GMT sind An- und Abflüge nach schriftlicher (VIP) zu unterlassen, da mit betrieblichen Unstetigkeiten zu rechnen ist.

\textbf{2. Regulations on Traffic Restrictions in Daytime}

\textbf{2.1 Normalized commercial air traffic}

\textbf{2.1.1 Due to limited parting position capacity, the arrival times for passenger aircraft with more than 15,000 KG M. W. must be notified to the Airport Operator as early as possible. An authorization from the Airport Operator is required for flights operated between 1000 and 1130 GMT.}

\textbf{2.1.2 Notifications and formal requests must be submitted to the Airport Operator in the name of the ground service agent (Bagavat, Jet Aviation AG).}

\textbf{2.1.3 For the submission of formal requests the following closing dates apply:}

\textbf{2.1.3.1 For flights between 1 NOV and 31 MAR: 15 JUN}

\textbf{2.1.3.2 For flights between 1 APR and 31 OCT: 15 NOV}

\textbf{2.1.3.3 Overall decision on formal requests submitted in due time will be made until 15 JUL and 15 DEC. If not all requests can be complied with, allocation of the parking positions will be made after hearing of the applicants, preference being given to aeronauts of high priority.}

\textbf{2.1.4 For flights which have not been notified or for which are not operated according to the notified or authorized times, considerable waiting periods must be expected.}

\textbf{2.2 Private Traffic}

For flights with capacities over 15 000 KG M. W. a minimum of 24 hours' notice is mandatory. Notifications and formal requests must be submitted to the Airport Operator in the name of the ground service agent (Jet Aviation AG, Last AG).
ZÜRICH
LÄRMKAMPFUNGSVORSCHRIFTEN UND -VERFAHREN

1

1.1

Die nachstehenden Vorschriften bezwecken die Verminderung von Fluglärm in den bezeichneten Gebieten der Umgebung des Flughafens Zürich.

1.2

Die technischen Einzelheiten sind im Luftfahrthandbuch der Schweiz (AIP Schweiz) enthalten.

1.3

Von den publizierten Routen und Verfahren darf nur abgewichen werden, wenn es die Sicherheit des Luftfahrzeugs verlangt (vorbehalten bleibt LFV Art. 34, Abs. 4).

1.4

Luftfahrzeugen, deren Luftfahrzeuge nachgewiesenermassen nicht in der Lage sind, diese Vorschriften und Verfahren zu befolgen, haben andere Genehmigungen zu beantragen. Gesuche sind der Flughafendirektion einzureichen.

2

ANFLUG

2.1

ILS-Anflug

Der Sinkflug ist so einzustellen, dass die Reiseflugkonfiguration unter Berücksichtigung der Flughöhe und der Anforderungen der Fluggesetze möglichst lange eingehalten werden kann. Der Abflug der Geschwindigkeit und das Ausfärben der Wanderstände haben so zu erfolgen, dass sich das Flugzeug kurz vor oder über dem Aussemmarker in der Landekonfiguration befindet und die korrekte Anfluggeschwindigkeit erreicht hat.

2.2

Übige Anflüge

2.2.1

Ziffer 2.1 ist sinngemäss anzuwenden.

Im Endflug ist ein Winkel von nicht weniger als 3 Grad einzuhalten.

2.2.2


3

LANDEPLÄTZE

Landungen sind normalerweise auf den Pisten 14 und 16 durchzuführen. Auf anderen Pisten ist eine Landung nur zulässig, wenn die Pisten 14 und 16 aus technischen oder meteorologischen Gründen nicht benützbar sind. Vorbehalten bleibt Ziffer 9.3.3.

4

SCHLUSSWORTE

Die Leerkraft ( Idle reverse) darf nur erhöht werden, wenn dies aus operationellen oder Sicherheitsgründen erforderlich ist.

ZÜRICH AIRPORT

NOISE ABATEMENT:
PRESCRIPTIONS AND PROCEDURES

GENERAL

The following regulations are designed to avoid excessive aircraft noise in the populated areas in the vicinity of Zurich Airport.

Technical details are published in AIP.

Deviation from the published routes and procedures is only permitted if the safety of the aircraft so demands (subject to Art. 34, para 4 of the Air Navigation Ordinance).

Aircraft operators provable unable to comply with these prescriptions and procedures have to submit alternative procedures to the airport authority for approval.

APPROACH

ILS-Approach

The descent is to be arranged so as to maintain en-route configuration as long as possible considering safety and Air Traffic control requirements. Speed reduction and extension of landing gear and high-lift devices are to be planned in such a way that landing configuration is established and correct approach speed reached shortly prior to or when over the Outer Marker.

Other approaches

Paragraph 2.1 is to be applied accordingly. An approach angle of not less than 3° shall be maintained on final.

Visual circuits shall be flown at 3000 ft QNH or higher whenever visibility and cloud base permit. Overflying of densely populated areas is to be avoided as far as possible. Reserved is paragraph 9.3.2.

LANDING-RUNWAYS

Normally, all landings are to be made on runways 14 and 16. Other runways may only be used if landing on runways 14 and 16 is impracticable due to technical or meteorological reasons. Reserved is paragraph 9.3.3.

REVERSE THRUST

More than idle reverse should not be used except when necessitated for operational or safety reasons.
APPENDIX D

BORDEIGENE HILFSAGGREGATE
Bei Verwendung für Unterhaltstzwecke ist die Betriebsdauer auf ein Minimum zu beschränken.

ABFLUG

6.1 Abflugwege

Von den im Luftfahrt handbuch der Schweiz (AIP Schweiz) veröffentlichten Standard-Instrumentenabflugstrecken (SID) darf nur in Höhen über 5000 ft QNH (zwischen 2201 und 0600 Uhr Lokalzeit für Abflüge in Richtung ALFA: FL 80) mit Bewilligung der Flugverkehrsleitung abgewichen werden. Die SID im Anfangssteilflug sowie der wegen Lärm zu meidende Luftraum sind auf beiliegender Karte dargestellt.

6.2 Abflugverfahren

6.2.1 Der Start hat nach Möglichkeit rollend zu erfolgen. Die Triebwerksleistung darf erst nach dem Eindrehen in die Startspitze erhöht werden.

6.2.2 Nach dem Abheben ist unter Berücksichtigung der Flugsicherheit der höchstmögliche Steiggradient einzuhalten.

6.2.3 Für Staffelflugzeuge ist der Steigflug gemäß nachstehenden beschriebenen Verfahren durchzuführen:

a. Flugzeuge mit Maschinenstromtriebwerken:
   1. Start bis 2900 ft QNH mit
      - Startleistung
      - Auftriebshilfen in Startstellung
      - Geschwindigkeit V₁ + 10 kt (oder wie durch den Steigflugwinkel begrenzt)
   2. Bei Erreichen von 2900 ft QNH
      - Triebwerksleistung auf nicht weniger als Steigflugleistung reduziert.
   3. Von 2900 ft QNH bis 4500 ft QNH
      - Geschwindigkeit V₁ + 10 kt.
   4. Bei Erreichen von 4500 ft QNH
      Übergang zum normalen Streckensteigflug (Aufholen von Geschwindigkeit und Fahrten der Auftriebshilfen).

b. Flugzeuge mit Einstromtriebwerken: Die Reduktion der Triebwerksleistung muss auf 2100 ft QNH erfolgen, im übrigen findet das unter lit. a beschriebene Verfahren Anwendung.

c. Die Überwachung der Einhaltung von Ziffer 6.2.3 erfolgt durch die automatische Lärmessanlage (monitorig).

AUXILIARY POWER UNITS (APU)

On the apron no auxiliary power unit (APU) shall be run longer than
- 60 minutes prior to scheduled departure time
- 20 minutes after arrival (in special cases the Operation Department may permit longer use).

If required for maintenance purposes, the running of the APU is to be kept at a minimum.

DEPARTURE

Departure Routes

Deviation from the Standard Departure Routes (SID) published in AIP is only possible at altitudes above 5000 ft (between 2101 and 0600 HR QNH for departures in direction of ALFA: FL 80) with permission of Air Traffic Control.

The SID for initial climb as well as the airspace to be avoided for noise abatement reasons are shown on the attached chart.

Departure Procedure

As far as possible a rolling take-off is to be executed. The engine power is to be increased only after entering the take-off runway.

After lift-off the maximum climb gradient considering flight safety is to be maintained.

For jet aircraft the climb is to be carried out as follows:

a. FAN jet equipped aircraft:
   1. Take-off up to 2900 FT QNH
      - take-off power;
      - lift increasing devices in take-off setting;
      - speed V₁ + 10 KT (or according climb angle limitation);
   2. When at 2900 FT QNH
      - thrust reduction to not less than climb power;
   3. 2900 FT QNH to 4500 FT QNH:
      - speed V₁ + 10 KT (or limited by body angle);
   4. At 4500 FT QNH:
      - normal speed and high-lift devices retraction schedules to en-route climb;

b. Simple jet equipped aircraft: Thrust reduction at 2100 FT QNH. Otherwise, the procedure under a. above applies.

c. Automatic measuring equipment is used to monitor adherence to para. 6.2.3.
APPENDIX D

3 of 5

RAC 4-3-7

6.3 Ablaufpläne

6.3.1 Zwischen 0701 und 2100 Uhr Lokalzeit sind normalerweise alle Abflüge auf Piste 28/10 durchzuführen. Ist ein Abflug auf Piste 28/10 aus operationalen Gründen nicht möglich, so steht die Piste 34/16 zur Verfügung.

6.3.2 Die Abflüge nicht lärmcertifizierter Luftfahrzeuge sind bei Langstreckenflügen über 4000 km Flugdistanz auf Piste 34 durchzuführen.

6.3.3 Zwischen 2101 und 0700 Uhr Lokalzeit sind normalerweise alle Abflüge von Strahlflugzeugen auf Piste 34 durchzuführen.

6.3.4 Abweichungen von den Ziffern 6.3.1, 6.3.2 und 6.3.3 sind aus Sicherheitsgründen (besondere Wetterbedingungen, Pistezustand) zulässig.

6.3.5 Der Start auf Piste 34 muss zwischen 2101 und 0700 Uhr Lokalzeit bei der Kreuzung von Rollweg K erfolgen, sofern nicht aus Gründen der Flugsicherheit die volle Pistenlänge erforderlich ist.

6.3.6 Luftfahrzeuge, die beim Wegflug von Piste 34 an der Messstelle Oberglatt in der Regel mehr als 95 dBA Lärm erzeugen, werden zwischen 2201 und 0600 Uhr Lokalzeit nicht zugelassen.

7 SCHUL- UND KONTROLLFLÜGE

Die Lärmbekämpfungsverschreibungen und -verfahren gelten auch für Schul- und Kontrollflüge. Abweichungen sind im Rahmen eines vom Eidgenössischen Luftamt genehmigten Flugprogrammes zulässig.

8 STANDLÄUFE

8.1 Als Standläufe gelten Prüfungen von in Flugzeugen eingebauten Triebwerken, bei welchen die Leerlaufdrehzahlen überschritten werden.


8.4 Ausnahmen

Der Verkehrsdiensst kann Standläufe von Strahltriebwerken ohne Schalldämpfer im Werftareal bewilligen:
- wenn die Schalldämpfungsanlagen aus unvorhergesehenen technischen oder meteorologischen Gründen nicht verwendbar sind,
- wenn die Schalldämpfungsanlagen für das betreffende Flugzeugmuster nicht geeignet sind.

Take-off runways

Between 0601 and 2000 HR GMT normally all take-offs are to be made on runway 28/10. When take-off on runway 28/10 is not possible due to operational reasons, runway 34/16 is available.

For long distance flights (more than 4000 km) of non noise-certifizierter aircraft, runway 34 is to be used for take-off.

Deviations from paragraphs 6.3.1, 6.3.2 and 6.3.3 are permitted for safety reasons (special weather conditions, state of runway).

Between 2001 and 0500 HR GMT normally all take-offs of jet aircraft are to be made on runway 34.

Exceptions

The Operation Department may permit run-ups of jet engines without silencers on the maintenance base:
- when the silencers cannot be used for unforeseen technical or meteorological reasons;
- if the silencers are not compatible with the type of aircraft in question.

INSTRUCTIONS AND CHECK FLIGHTS

Noise abatement prescriptions and procedures are applicable also to instruction and check flights. Deviations are admissible within a flight program approved by the Federal Air Office.

RUN-UP

Run-ups are tests of engines installed in the aircraft, at power settings above idle r.p.m.

On the apron, on taxiways and runways, run-ups require permission from the Operation Department. No run-ups are permitted between 2101 and 0500 HR GMT. Outside these hours both duration and power setting for such run-ups are to be kept at a minimum.

On the aprons of the maintenance base run-ups of jet engines may only be performed when using silencers. Run-ups of propeller engines are not permitted between 2101 and 0500 HR GMT.
APPENDIX D

8.5 Die Swissair, Schweizerische Luftverkehrs AG, erlässt für den Betrieb der Schalldämpfungsanlagen besondere Vorschriften. Diese sind der Flughafendirektion zur Genehmigung vorzulegen.

9 SICHTFLUG

9.1 Die Lärmbekämpfungsverschriften und -verfahren gelten für den Sichtflug sinngemäß.

9.2 Die im Luftfahrtbuch der Schweiz (AIP Schweiz) veröffentlichten VFR-An- und Abflugrouten gelten für ein- und mehrmotorige Propellerflugzeuge bis 5700 kg maximalem Abluggewicht sowie für Helikopter.

9.3 Ausnahmen

9.3.1 In Ausnahmefällen kann die Flughafendirektion andere Flugwege festlegen.

9.3.2 Platzrunden sind, sofern Sicht- und Wolkenhöhe dies erlauben, auf einer Höhe von 2100 ft QNH (bei mehrmotorigen Propellerflugzeugen: 3000 ft QNH) zu liegen.

9.3.3 Landungen sind normalerweise auf Piste 28/16 durchzuführen.

SWISSAIR, Swiss Air Transport Co. Ltd., issues special regulations for the operation of silencers. They are subject to the approval of the Airport authority.

VFR FLIGHT

Noise abatement prescriptions and procedures are applicable to VFR flight accordingly.

VFR Approach and Departure Routes published in AIP are applicable to single and multi-engined propeller aeroplanes of up to 5700 KG take-off weight as well as to helicopters.

Exceptions

In exceptional cases the Airport authority can establish other flight routes.

Aerodrome circuits are to be flown at an altitude of 2100 FT (for multi-engined aeroplanes: 3000 FT), if visibility and cloud base permit

Landing is normally to be made on runway 28/10.
## ZURICH NOISE ABATEMENT PROCEDURES

### RUNWAY 10 DEPARTURES

**ALFA 01 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept Kloten R-256 to Whiskey INT. Cross Kloten R-360 at 4000 QNH or above, FL55 at latest at Kloten 11 DME fix [Trasadingen R-204]. Leave Whiskey on Hochwald R-113 to intercept Trasadingen R-171 over Alpha Int at FL 100 or above.

**ALFA 02 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] proceed heading 360° to intercept Trasadingen R-171 over Alpha Int at FL 100 or above.

**ALFA 03 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] to climb through 2000' QNH or above, Whiskey INT. Kloten R-113 to Whiskey INT. Cross Kloten R-360 at 4000 QNH or above, Whiskey at FL 65 or above. Leave Whiskey on Hochwald R-113 to intercept Trasadingen R-171 over Alpha Int at FL 100 or above.

**ALFA 05 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept and follow Williassau R-037 until intercepting Hochwald R-113 to Whiskey INT. Cross Kloten R-360 at 4000 QNH or above, Whiskey at FL 65 or above. Leave Whiskey on Hochwald R-113 to intercept Trasadingen R-171 over Alpha Int at FL 100 or above.

**ALFA 07 (HIGH PERFORMANCE GLIDER ACTIVITY)**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept and follow Kloten R-256 to Whiskey INT. Cross Kloten R-360 at 4000 QNH or above, FL65 at latest at 13 DME fix [Trasadingen R-209]. Leave Whiskey on Hochwald R-113 to intercept Trasadingen R-171 over Alpha Int at FL 100 or above.

**HOCHWALD 01 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept Kloten R-273 to Hochwald VOR. Cross Kloten R-360 at 4000 QNH or above, FL 55 at latest at Kloten 11 DME fix [Trasadingen R-209].

**HOCHWALD 05 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept and follow Williassau R-037 toward Williassau VOR until passing FL 65, thendirecttoHochwald VOR. Cross Kloten R-360 at 4000 QNH or above.

**HOCHWALD 07 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept Kloten R-273 to Hochwald VOR. Cross Kloten R-360 at 4000 QNH or above, FL 65 at latest at Kloten 13 DME fix [Trasadingen R-215].

**WILLISAU 01 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] intercept Williassau R-037 to Williassau VOR. Cross Kloten R-360 at 4000 QNH or above.

**ZURICH EAST 01 DEPARTURE**  
Climb straight ahead, at Kloten 2 DME fix [Trasadingen R-157] or 2500 QNH whichever is later, turn LEFT [IAS 210 KT or less during turn] proceed on heading 360° to intercept Zurich East R-237 to Zurich East VOR.

### NOISE ABATEMENT PROCEDURES ALL AIRCRAFT

**B-707 NON-FAN USE**  
Reduce thrust to climb thrust when reaching 2900 QNH. Maintain maximum climb gradient $V_2$ to $V_2 + 10$ to 4500 QNH. B-707 NON-FAN reduce thrust to 2.0

**EPR as soon as practicable upon reaching 2100 QNH.**
SIDs are also minimum noise routings. Strict adherence within the limits of aircraft performance is mandatory.
APPENDIX E

ZURICH NOISE ABATEMENT PROCEDURES

RUNWAY 28 DEPARTURES

<table>
<thead>
<tr>
<th>RUNWAY 28</th>
<th>ALL SIDS USE NOISE ABATEMENT PROCEDURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-707 NON FAN USE THRUST REDUCTION REQUIRED ALL SIDS.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ALFA 81 DEPARTURE</th>
<th>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix), turn LEFT, intercept and follow Kloten R-256 to Whiskey Int. Cross FL 55 at 1000 feet above Kloten 11 DME fix (Trasadingen R-204). Leave Whiskey Int on Hochwald R-113 to intercept Trasadingen R-171 over All Int at FL 100 or above.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALFA 85 DEPARTURE (FLY AROUND GLIDER AREA)</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix), turn LEFT, intercept and follow Willisau R-057 until intercepting Hochwald R-113 to Whiskey Int. Cross Whiskey at FL 65 or above. Leave Whiskey on Hochwald R-113 to intercept Trasadingen R-171 over All Int at FL 100 or above.</td>
</tr>
<tr>
<td>ALFA 87 DEPARTURE (HIGH PERFORMANCE GLIDER ACTIVITY)</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix) proceed on Kloten R-273 to Hochwald VOR. Cross FL 55 at latest at Kloten 11 DME fix (Trasadingen R-209).</td>
</tr>
<tr>
<td>HOCHWALD 81 DEPARTURE</td>
<td>(USE ONLY IN WEATHER CONDITIONS WHEN SURROUNDING HILLS ARE CLEAR AND TERRAIN CLEARANCE CAN BE MAINTAINED VISUALLY) Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix) proceed on Kloten R-273 to Hochwald VOR. Cross FL 55 at latest at Kloten 11 DME fix (Trasadingen R-209).</td>
</tr>
<tr>
<td>HOCHWALD 83 DEPARTURE</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix), turn LEFT, intercept Kloten R-256 and proceed via Whiskey Int to Hochwald VOR. Cross FL 55 at latest at Kloten 11 DME fix (Trasadingen R-204).</td>
</tr>
<tr>
<td>HOCHWALD 85 DEPARTURE (FLY AROUND GLIDER AREA)</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix), turn LEFT, intercept Kloten R-256 and proceed via Whiskey Int to Hochwald VOR. Cross FL 55 at latest at Kloten 11 DME fix (Trasadingen R-204).</td>
</tr>
<tr>
<td>HOCHWALD 87 DEPARTURE (HIGH PERFORMANCE GLIDER ACTIVITY REPORTED AND ONLY IN WEATHER CONDITIONS WHEN SURROUNDING HILLS ARE CLEAR AND TERRAIN CLEARANCE CAN BE MAINTAINED VISUALLY)</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix) proceed on Kloten R-273 direct to Hochwald VOR. When passing 4500’ QNH continue with optimum climb gradient to cross FL 65 at latest at Kloten 13 DME fix (Trasadingen R-215).</td>
</tr>
<tr>
<td>HOCHWALD 89 DEPARTURE (HIGH PERFORMANCE GLIDER ACTIVITY)</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix) turn LEFT, intercept Kloten R-256, and proceed via Whiskey Int to Hochwald VOR. When passing 4500’ QNH continue with optimum climb gradient to cross FL 65 at latest at Kloten 13 DME fix (Trasadingen R-209). Cross Whiskey at FL 75 or above.</td>
</tr>
<tr>
<td>WILLISAU 81 DEPARTURE</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix), turn LEFT, intercept Willisau R-057 to Willisau VOR.</td>
</tr>
<tr>
<td>ZURICH EAST 81 DEPARTURE</td>
<td>Climb straight ahead, at Runlang FM (Kloten 2.5 DME fix), turn LEFT, intercept Willisau R-057 to Willisau VOR.</td>
</tr>
</tbody>
</table>

NOISE ABATEMENT PROCEDURES ALL AIRCRAFT

B-707, B-707 FAN use standard noise abatement climb-out procedure. Reduce thrust to climb thrust when reaching 2900’ QNH, maintain maximum climb gradient V2 + 10' to 4500’ QNH. B-707 NON FAN reduce thrust to 2.0 EPR as soon as practicable upon reaching 2900’ QNH.
APPENDIX E
ZURICH NOISE ABATEMENT PROCEDURES

RUNWAY 28 DEPARTURES (Contd.)

ZURICH NOISE ABATEMENT PROCEDURES

APPENDIX E