REPORT FROM
THE HOUSE OF REPRESENTATIVES
SELECT COMMITTEE
ON
AIRCRAFT NOISE

OCTOBER 1970

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA
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27th Parliament

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Contents

1 Recommendations

The Committee recommends that:

1. the noise exposure forecast system of the United States of America Federal Aviation Agency be adopted by Australia but used as a guide to noise exposure only. Cautious restraint is necessary when town planning authorities apply the accompanying land use categories to Australian conditions. [4.4.4]

2. the wearing of protective equipment by workers exposed to aircraft noise on tarmac and maintenance areas be rigidly enforced where necessary. [6.2.3]

3. the building of hospitals and rest homes beneath flight paths be avoided and that sound proofing should be installed in such buildings in adjacent areas. [6.5.1]

4. architects and builders concerned with the design and construction of buildings near airports utilise available noise reduction techniques. [6.3.3]

5. the Department of Air and the Department of Civil Aviation institute an extensive investigation of complaints into the effects of overflying aircraft on structures so as to establish the cause of damage. [6.4.2]

6. education authorities pay greater regard to the interference caused to class room instruction when planning buildings in noise sensitive areas. [6.5.2]

7. airline operators investigate the feasibility of minimising disturbance of church services by a re-arrangement of flight schedules on Sunday. [6.5.3]

8. there is a need for a social survey in Australia to obtain factual data on the magnitude of unrest and disturbance attributable to aircraft noise. It is recommended that this should be conducted in the areas surrounding Sydney Airport as being the area of greatest exposure. [6.6]

9. the Department of Air and the Department of Civil Aviation introduce a standard method of recording complaint information as outlined in the text. [7.3.2]

10. the Department of Civil Aviation and, where appropriate, the Department of Air pay continuing attention to the administrative arrangements as set out in the text. [7.3.3]

11. at Sydney during the hours of curfew (11.00 p.m. to 6.00 a.m.) movements be confined to operations over Botany Bay except in cases of emergency. [8.2.2]

12. criteria authorising jet movements in curfew hours be applied more stringently to ensure the preservation of the original intention of the regulation. [8.2.2]

13. the Department of Civil Aviation thoroughly examine flight patterns within a 5 mile radius of airports in order to avoid residential districts by directing aircraft over water, open spaces or industrial areas, whenever possible. [8.2.2]

14. the Air Co-ordinating Committee examine the feasibility of re-allocating air space to facilitate the re-routing of flight paths to minimise noise over residential areas. [8.2.2]

15. pilots of heavy aircraft on visual landing approaches be required to conform to a glide slope no less than the T-VASIS for the particular runway. [8.2.3]

16. as a noise abatement measure the glide slope at Australian airports should be standardised at 3.0° wherever possible. [8.2.3]

17. there is a need for research into—
    (a) the effect of meteorological conditions on the propagation of sound near major airports. [4.5.2]
    (b) the potential physiological effects of typical exposure to aircraft noise. [6.2]
    (c) the effect of aircraft noise on sleep and rest. [6.2.1]
    (d) whether exposure to aircraft noise is a major factor in reducing work efficiency. [6.3.2]

18. for the evaluation of community exposure to aircraft noise the concept of EPNL seems most appropriate. [5.2]

19. monitoring of aircraft noise should be introduced in Australia with Sydney Airport as first priority. [5.4]

20. the responsibility for operating monitoring installations must rest with the Department of Civil Aviation. [5.4]

21. consideration be given to a variable airport charge related to the noise level performance of each aircraft, the specific time of operation and individual runways at each airport separately. [5.4]

22. Australia should be represented on the ICAO body being established to formulate future developments in aircraft noise certification. [9.2]

23. the Department of Civil Aviation should press for the reduction of aircraft noise certification limits and pursue a relentless course of imposing restrictions on any airline whose aircraft repeatedly exceed acceptable noise standards. [9.2]

24. an appropriate land use policy is the most likely prospect for reducing noise nuisance. [10.2]

25. each planning authority in Australia will need to develop its own land use classification. [10.2]

26. land use zoning should have the statutory basis of State Government enactment and not be subject to unco-ordinated change by local authorities. [10.2]

27. Local Government Councils in airport neighbourhoods should issue warnings to persons seeking permission to build and include suitable noise insulation techniques in building codes. [10.3]

28. proceedings of Airport Noise Abatement Committees should not be on a confidential basis, and the Committees should remain relatively small in composition. On matters concerning airport development the Committees can serve in a useful consultative capacity. [10.4]

29. accurate and regular records of monitoring, where carried out, should be supplied to the relevant Airport Noise Abatement Committees for information and comment. [10.4]

2 Summary

The Interim Reports

In the latter part of 1969 the then Committee, realising the impending dissolution of the 26th Parliament, resolved to present an Interim Report outlining its activities and place before Parliament preliminary conclusions on some problems of aircraft noise. That Committee also recommended the appointment of a new Committee to complete the Inquiry.

The present Committee, appointed by the 27th Parliament, had sufficient evidence to make suitable recommendations on certain aspects of its Inquiry. It was therefore considered desirable to present a second Interim Report recommending various measures for implementation as soon as possible.

Final Report

The Committee now reports finally having considered those areas of the Inquiry not completed when presenting the June 1970 Interim Report. Matter contained in the June 1970 Interim Report has been incorporated in this Final Report though somewhat re-arranged and, in minor respects, updated.

In this Report the Committee deals with the following areas of the Inquiry:

Term of reference (a) and part (h) — Section 4 defines noise, identifies the sources of aircraft noise, its critical aspects and its propagation.

Term of reference (e) — Section 5 refers to aircraft noise measurement for various purposes.

Term of reference (c) — Section 6 the effects of noise on persons, property, institutions and community amenity.

Term of reference (b) and (d) — Section 7 reactions to aircraft noise, setting out the manner in which reactions are expressed and administrative arrangements for recording complaints and effecting attention to them.

Term of reference (f) and (g) — Section 8 procedures designed to lessen aircraft noise. A resume of regulations and procedures is followed by consideration of their effectiveness and of the effect of glide slopes on exposure to noise.

Term of reference (h) and (i) — Section 9 technological programmes to lessen aircraft noise including quiet engine programmes and engine retrofit.

Term of reference (g) — Section 10 land use, building and public relations programmes in use and considered for the future.

Term of reference (j) — Section 11 constitutional rights and responsibilities of Commonwealth, State and Local Governments and instrumentalities.

3 Introduction

3.1 General

Complaints about the nuisance inflicted on communities by the intrusion of aircraft noise date from 1957. The problem has intensified following the rapid growth in the number of aircraft movements combined with the change over to jet engined aircraft.

3.2 The Committee

On 26 November 1968 the then Minister for Civil Aviation (Hon. R. W. C. Swartz, M.P.) moved for the appointment of a Select Committee on Aircraft Noise, the motion being agreed to unanimously by the House.

The Committee ceased to exist on 29 September 1969 with the dissolution of the 26th Parliament on that day. It was reconstituted with some change of personnel on the first day of the 27th Parliament, ceased to exist again when the 1st Session of the 27th Parliament was prorogued on 23 February 1970, and was reconstituted on 11 March 1970.

On 1 May 1969 the procedural sections of the resolution of appointment were altered slightly to insert a provision for the appointment from time to time of a Deputy Chairman. Apart from this change the original resolution of appointment has remained unaltered.

The resolution of appointment required the Committee to inquire into and report on:

(a) the definition of the major forms of noise associated with aircraft which cause complaint;
(b) problems which emerge from the incidence of the various forms of aircraft noise;
(c) the effects of aircraft noise on persons, property, institutions and communities;
(d) the sources of and extent of complaint arising from aircraft noise;
(e) the units used for the measurement of aircraft noise and any special factors peculiar to Australia which should be considered in the application of acceptable levels of noise for various sections of the community, having regard to the international consideration of these matters;
(f) administrative procedures and regulations in the course of operation, designed to lessen aircraft noise, and their effectiveness for that purpose;
(g) administrative procedures and regulations required to be formulated and initiated to lessen aircraft noise nuisance now and in the future;

(h) technological developments and programmes in course of operation to lessen aircraft noise and their effectiveness for this purpose;

(i) technological developments and programmes required to be formulated and initiated to motivate and expedite further progress in lessening aircraft noise having regard to overseas activities including those of the International Civil Aviation Organisation and similar bodies; and

(j) the constitutional powers of the Commonwealth, State and Local Governments to legislate for the adequate control of aircraft noise and the necessity for legislation for this purpose, having regard to the fact that aerodromes may be owned or operated by the Commonwealth, State and Local Governments as well as private persons and organisations.

3.3 Meetings of the Committee

The Committee has taken evidence in all States, the Northern Territory and the Territory of Papua and New Guinea. It met on 92 occasions comprising 42 Public Hearings, 4 *in camera* hearings and 46 deliberative sessions. There are 4,444 pages of transcript of evidence. The Committee took evidence from 209 witnesses [Appendix N] and received 118 submissions.

3.4 Research Material

The Committee found it necessary to supplement evidence from witnesses with information gathered from a wide variety of sources. This 'briefing material' consisted of more than 250 items. Much of this material will be of great value to others who, in the future, may be concerned with investigating the problem of noise generally and aircraft noise specifically. Therefore, the Committee has arranged for this material, which is listed at Appendix A, to be available in the Commonwealth Parliamentary Library.

3.5 Inspections

The Committee has carried out thirty-three inspections of Regular Public Transport (R P T) airports, and twenty-five inspections of military and/or light aircraft airports. These included observations of the recording of noise levels, inspections of Control Towers and Area Approach Control Centres where first hand knowledge of the application of noise abatement procedures was gained.

On many of the inspections, especially of the major airports, the Committee gained additional insight into the effects of aircraft noise on the community by observations and discussion near the particular airport being inspected while aircraft operations were in progress overhead. This, together with airborne inspections of several of the worst affected airports and their environs brought into sharp focus the very real nuisance inflicted on a significant number of Australian citizens.

In early October a regular B747 (the 'Jumbo Jet') service was inaugurated in Australia at Sydney (Kingsford-Smith) Airport. (Hereafter referred to as Sydney Airport). The Committee, mindful of community fears that this new aircraft might emit an intolerable level of

noise, arranged for noise measurements of the arrival and departure of the B747 as well as other aircraft types.

3.6 Evidence

A procedure has been instituted whereby evidence taken at public hearings of a Committee of the House of Representatives may be published. The large volume of evidence taken at this Inquiry precludes the printing of evidence and arrangements have been made for the transcript to be held at Parliament House for inspection by those with a genuine need. To facilitate this procedure an index of this evidence is published at Appendix B of this report. Following inspection, relevant portions of this transcript may be released on written request.

3.7 Aims of the Committee

To facilitate consideration of the problem the Committee, whilst alluding to particular places in order to exemplify a matter, wishes to make *general* recommendations about the incidence, effect and alleviation of exposure to aircraft noise which should be applicable throughout Australia and the Territory of Papua and New Guinea.

As extensive work is likely to be carried out in future on the application of noise reduction to aircraft engine design, the Committee has not sought to extend the scope of its inquiry into these technical aspects beyond 1980. Nevertheless, the Committee has accepted, as one of its aims, a responsibility to make such recommendations as are necessary for the long term if the community is to avoid harmful effects of exposure to aircraft noise.

4 Nature of Aircraft Noise

4.1 Definition of noise

Noise is defined as unwanted sound. Sound, for the purposes of this report, may be regarded as the minute fluctuations in ambient air pressure which can be sensed by the human ear and becomes noise only when a person finds it to be undesirable. Individual attitudes towards annoyance vary greatly and what is sound to one may be noise to another.

Such judgments vary for each individual from time to time depending on the inter-relationship of many factors, and become significant only when a large number of people are in agreement. This condition applies to communities in the vicinity of airports where most people regard the sound from aircraft as noise.

Noise generated by aircraft has special features related to the directional characteristics of the sound from each source and the way in which the source moves.

While for airport workers aircraft noise may be regarded as just another form of intermittent industrial noise, for communities living beneath aircraft flight paths, the noise is quite different from that emanating from other sources, because of its intensity, tonal characteristics, frequency of repetition, lack of warning and the implications of danger involved, and all these contribute to its nuisance value.

Aircraft noise is of a complex nature consisting of a mixture of two or more of the following:

(a) Broad-band noise which is sound energy spread over a wide range of frequencies.

(b) Narrow-band noise which is sound energy restricted in frequency range.

(c) Tonal noise consisting of energy restricted to a single frequency or separate frequencies some of which may be harmonically related.

4.2 Sources of aircraft noise

The sources of aircraft noise are associated with particular features of aircraft propulsion systems such as jet exhausts, propellers, fans, compressors, turbines and to a lesser extent gearboxes, generators and other auxiliary equipment.

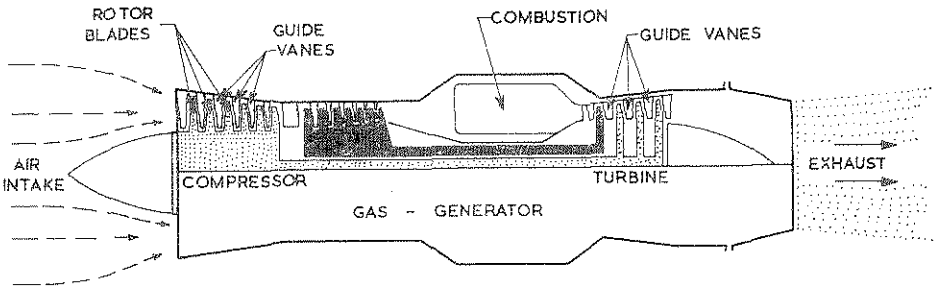
There are many sources of noise within aircraft engines. The strength and directional characteristics of each source depend on the basic engine design and acoustical treatment incorporated within the engine or its nacelle. As each source is recognised, research and development concentrates on design changes to minimise it.

The noise characteristics are therefore undergoing progressive alteration but some generalisation is possible for engines used now and in the near future.

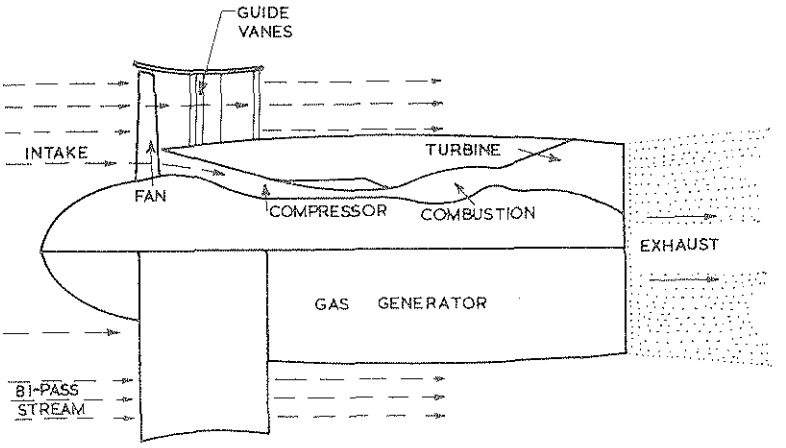
4.2.1. AIRCRAFT ENGINE TYPES

The main types of engine are turbo-jet, turbo-fan, turbo-prop and reciprocating (piston). The first three types have a gas-generator section which sucks in air, compresses it for combustion, and then extracts mechanical energy from the expanding gases by means of the thrust of its jet efflux. Turbo-fan engines apply most of their power by means of the fan. The ratio between the fan and jet (bi-pass ratio) describes the main characteristic of these engines. Turbo-prop engines apply the major proportion of their power by means of the propeller.

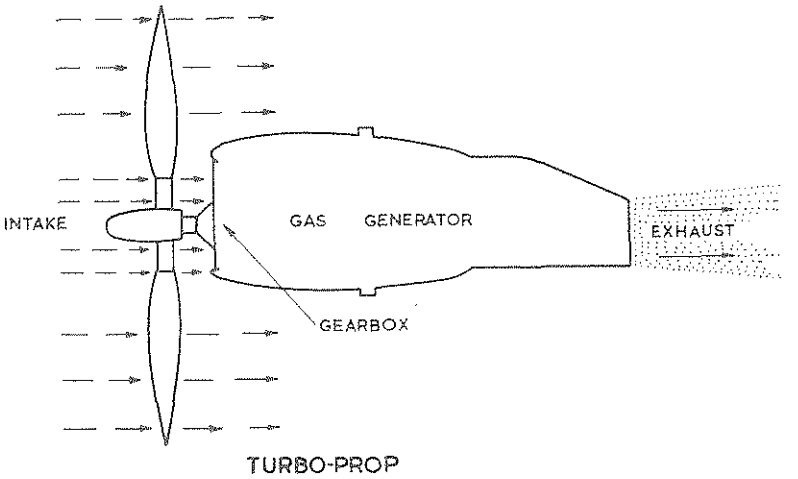
Below is a schematic diagram showing the main features of these engines.



TURBO-JET



TURBO-FAN



TURBO-PROP

Schematic diagrams of common types of aircraft jet engines

Reciprocating engines which use the basic internal combustion cycle represent a declining source of noise. By far the most complaints arise from aircraft using jet type engines.

The mechanisms responsible for the generation of aircraft noise are dealt with in the following sections not necessarily in order of importance.

4.2.2. JET NOISE is applied by many people to all forms of noise from turbo-jet and turbo-fan engined aircraft, but specifically it is the noise caused when a high-speed stream of gas is discharged into the atmosphere.

The acoustic power generated by the jet varies as a multiple of the relative velocity between the jet and the surrounding air. The multiple depends on many factors and in practice ranges from the cube to the eighth power of jet velocity.

Silencers may be used effectively to lower the relative velocity between the gas-generator stream and the surrounding air, or for inducing rapid mixing of the streams, or both, but are accompanied by a loss of available power. The turbo-fan engine provides a second stream of low velocity air surrounding the high velocity exhaust of the gas-generator to obtain substantial noise reduction.

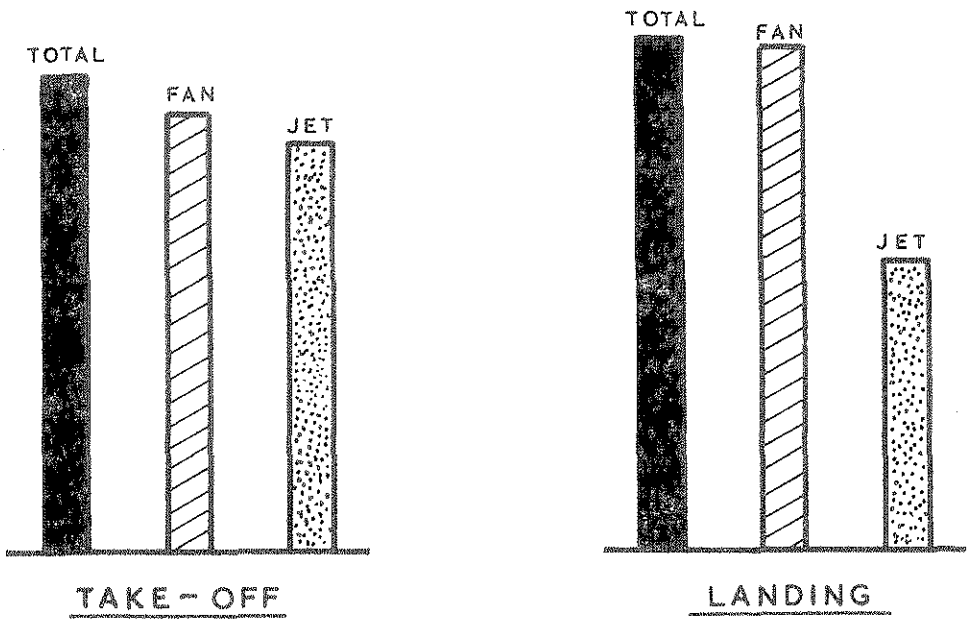
4.2.3. On present engines COMPRESSOR and FAN NOISE dominates during landing approach but on later engines using high bi-pass ratios, fan noise dominates for all aspects of flight including take-off. Compressors and fans produce tonal noise by interaction between rotor blades and guide vanes. At blade tip speeds which exceed the speed of sound, further noise is produced by the combination of pressure pulses caused by each blade. The modifications made to reduce these sources are an increase in the spacing between blades and guide vanes, the elimination of inlet guide vanes and the selective fitting of sound absorbent linings.

4.2.4. TURBINE NOISE. Since the turbines are within the exhaust nozzle they radiate noise from the rear of the engine but this noise is usually masked by jet or fan noise. On engines featuring low fan and jet noise, turbine noise could become significant but may be minimised by acoustical treatment of the exhaust duct.

4.2.5. COMBUSTION NOISE originating from the periodic expulsion of exhaust gases is a major contributor to the noise from reciprocating engines but is a declining problem for communities living near airports.

4.2.6. PROPELLER NOISE is of little significance near major airports but will be a factor for some years in more remote areas and for night freight movements. The most important noise from propellers consists of tones generated by the pressure field which surrounds each propeller blade as it moves through the air on the rotating hub. The sound power generated by a propeller rises rapidly as the blade tip speed increases.

As well, the dominant frequency generated by the passing blades also rises, so that major improvements can be made in the perceived noise level of propellers by reducing propeller tip speed.



Relative contribution to effective perceived noise level for contemporary 4 turbo-fan engined aircraft

The above diagram illustrates, in very simple terms, the major sources of engine noise produced by aircraft using present day turbo-fan engines and their relative contributions to the overall noise for take-off and landing.

4.3 Flyover noise

As an aircraft passes overhead the sound heard by an observer varies both in level and frequency content. The contribution of the sources identified above can be estimated and the significance of each for a particular aircraft operation can be assessed. The diagrams on page 12 demonstrate the various elements in flyover noise generated by a Boeing 707 of the type currently in operation engaged in two manoeuvres:

(a) Take-off
(b) Approach

4.4 Critical Characteristics of Aircraft Noise

Aircraft noise is significant because communities react adversely to it and also because of possible hearing impairment to airport workers.

These effects are caused by combinations of the following critical characteristics:

4.4.1. NOISE LEVEL

All investigations relating noise exposure to either hearing impairment or annoyance indicate that noise intensity is a critical factor. Though

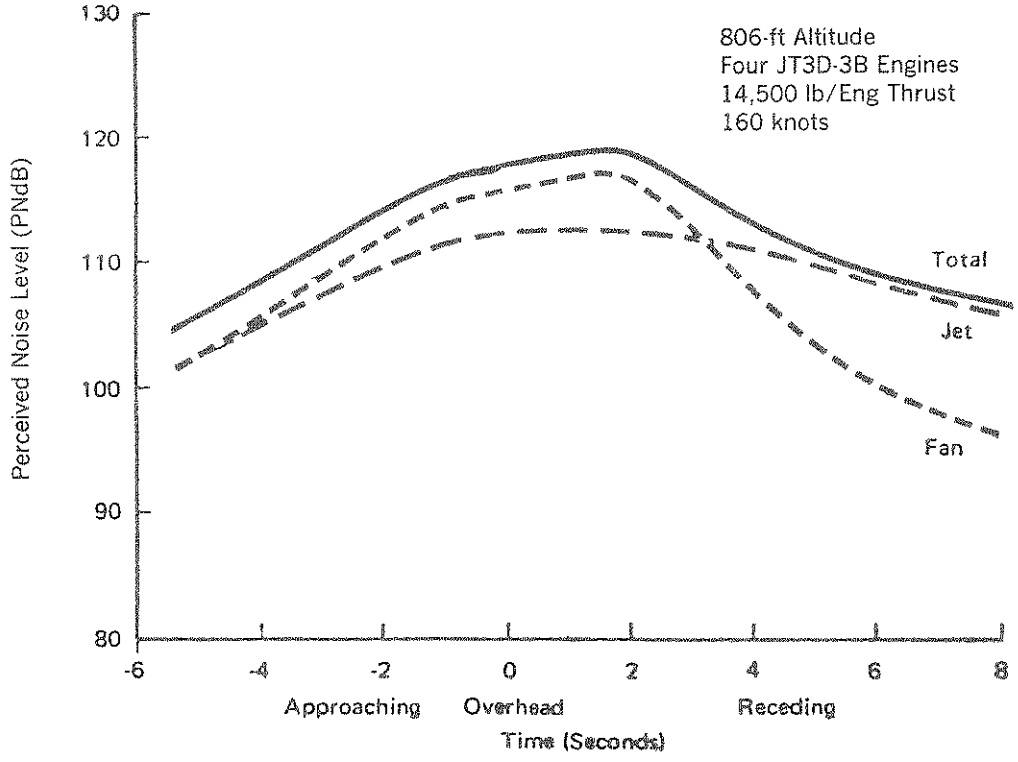


Fig. 4.3.a *Perceived Noise Level–707-320C (Takeoff Power)*

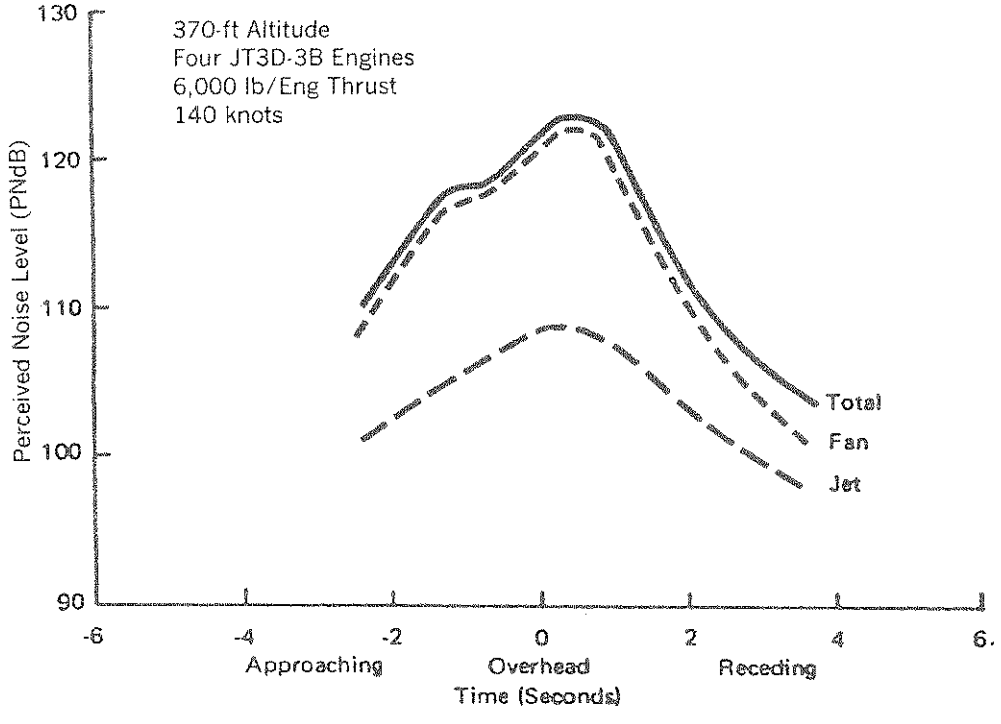


Fig. 4.3.b *Perceived Noise Level–707-320C (Approach Power)*

[The Committee is indebted to Qantas Airways Ltd for these diagrams]

people are unable to detect small variations in intensity, reductions of even a few decibels should be pursued to lessen the cumulative effect of successive exposures to aircraft noise.

4.4.2. FREQUENCY SPECTRUM

This term refers to the way in which noise energy is distributed over the audible range of frequencies.

The manner of distribution is very important since there are wide variations in the tolerable levels for different portions of the spectrum and in the toleration of spectrum irregularities such as tones.

The most accurate available system for rating 'noisiness' of aircraft and for indicating community response to aircraft noise is the Effective Perceived Noise Level (EPNL) system. This system, adopted at the December 1969 meeting of the International Civil Aviation Organisation (I C A O), uses very complex methods for determining the frequency spectrum characteristics.

For hearing conservation however simple methods are adequate to allow for these variations.

4.4.3. DURATION

The length of time during which people are exposed to aircraft noise contributes to the effect on them. Annoyance depends on the time over which the noise disturbs activities or is noticeable and the EPNL system has a method of correcting for duration. For hearing conservation simpler methods (described later in 5.3) suffice.

4.4.4. REPETITION

There is no doubt that the number of aircraft flyovers of any particular area in a given period is a significant factor in determining the complaints arising from aircraft noise. Communities are particularly sensitive to this factor and all proposals for calculating the total effect of aircraft noise include a means of summing the noise events which occur as a result of a succession of aircraft flyovers.

The Committee considers that abatement measures in the areas around present airports must proceed with urgency. It therefore recommends that Australia adopt the Noise Exposure Forecast (NEF) system of the Federal Aviation Agency of U S A as a means of noise forecasting only. However, the Committee urges cautious restraint in local application by planning authorities of land use zoning categories employed overseas pending a critical examination of the requirements in Australia.

4.4.5. TIME OF DAY

The existence of 'curfews' at some Australian airports is an indication that the community is sensitive to noise produced by aircraft at night. This applies not only to the noise from aircraft flying operations but also to the ground running of engines for maintenance at night or in the early hours of the morning.

Restrictions aimed at alleviating community exposure handicap the airlines and are a measure of the importance people place on the time of day factor.

The position has been met in some countries by setting limits for both permissible noise levels and numbers of operations differing between day and night. As well, formulae are used for calculating total noise exposure using different weightings for operations which are often divided into three periods; day, evening and night.

Planning in Australia could proceed using the weightings developed overseas for daytime and evening operation. Owing to the differences in climatic conditions the Committee does not see any reason to adopt seasonal weightings used overseas.

4.5 Propagation of Aircraft Noise

The propagation of aircraft noise is determined by three factors:

(a) the directivity of the noise source, determined in this case by the type of engine used, and

(b) the attenuating and refracting properties of the atmosphere and ground, and

(c) the presence of structures which change the flow of sound from source to receiver.

Each of these factors is of importance in assessing the noise exposure of people both from aircraft in flight and when operating on the ground.

4.5.1. DIRECTIONAL CHARACTERISTICS

The directional characteristics of aircraft engine noise alter according to the power settings and operational modes. It is not possible to generalise but a series of sketches is included in Appendix C to illustrate in a qualitative way the relative importance and directional characteristics of various noise sources associated with general types of aircraft engines. A sketch showing the directional characteristics of sound from an aircraft engine when operating on the ground is also included as Appendix D.

These diagrams indicate that it would be very misleading to consider hearing conservation programmes for workers or the application of noise control procedures without also considering the directional characteristics of the source.

4.5.2. METEOROLOGICAL EFFECTS

The meteorological conditions which have most effect on the propagation of aircraft noise are wind and temperature gradients. Evidence placed before the committee of the typical conditions which apply when aircraft cause most annoyance, and reference to the locations from which complaints arise, lead to the conclusion that these conditions, when combined with effects of terrain surrounding major Australian airports, are significant in causing annoyance, particularly when aircraft are operating on or close to the ground.

Diagrams are included in Appendix E to illustrate in a qualitative way the manner in which wind gradients and temperature gradients affect the spread of sound.

Considerable research is needed to obtain a quantitative evaluation of these effects, but is justified as it would indicate to planning authorities the areas likely to be critical for aircraft noise exposure, particularly at night, and enable them to avoid the mistakes of the past by proper zoning of land use.

4.5.3. SHIELDING EFFECTS

Large buildings and earth banks are sometimes used to change the directivity pattern of noise from aircraft on the ground, so as to shield a noise sensitive area and direct the sound in some less critical direction.

The effectiveness of such treatment is doubtful and evidence given to the Committee with reference to the height of engines above ground level for future aircraft types shows that such devices would need to be of most substantial dimensions to achieve a worthwhile result.

It would seem therefore that these are not cost effective structures and should be used only if they are available for some reason other than noise control.

5 Evaluation of Aircraft Noise

5.1 General

Aircraft noise is of widespread concern to the community and is so little understood that its characteristics must be carefully evalued to relate noise exposure to the possible effects on people.

Evaluation of noise covers the complete process of measurement, analysis and assessment. The purpose for which the noise is to be evalued, i.e. prediction of community annoyance or damage to hearing, determines the type of equipment together with the criteria for assessment of effects.

Generally, aircraft noise measurements are undertaken to arrive at numerical ratings for the possible effect on persons and communities. There are two approaches to the derivation of such ratings, the first involving highly complex equipment while the second uses quite simple instruments and assessment methods. Both approaches have their place, the complex approach is needed for research, while the simple systems are adequate for the majority of other purposes.

The Committee understands that there are widely different individual susceptibilities to hearing damage and in reaction to each kind of noise. The results of measurements can therefore only be applied to people on a statistical basis. Reasonable criteria set up to predict reaction cannot ensure absolute freedom from complaint, nor can the establishment of hearing conservation criteria guarantee complete freedom from hearing damage to the more highly susceptible airport workers.

In each case there is an element of risk involved which is similar to that which the community as a whole accepts for all forms of daily life. For hearing conservation the risk may be virtually eliminated if the Committee's recommendation for the use of ear protection is strictly observed but for annoyance there is no simple solution and ultimately the community must strike the balance between the economic and environmental factors involved.

The characteristics of a noise measuring system should simulate, as closely as possible, the known responses of people to noise.

The use of very complex systems is not warranted for relatively simple tasks but research should continue on the effects of aircraft noise on people, ultimately to derive simplified systems which can be used for the benefit of communities living in the neighbourhood of airports.

Included in Appendix F is some of the technical evidence concerning units and standards used in this field.

5.2 Effective Perceived Noise Level (EPNL)

Of the various systems available for the evaluation of community exposure to aircraft noise the concept of effective perceived noise level (EPNL) seems most appropriate.

Although this system is not ideal, is subject to change and requires complex equipment for its accurate evaluation, it is the best available and capable of being approximated from simple measurement systems.

With its history of including new factors as they are found to be important, e.g. tonal corrections after the introduction of turbo-fan engined aircraft, and time corrections to allow for the duration of over-flight, the system seems likely to be adaptable also to further new factors as they appear.

The Committee finds that confusion has occurred due to these changes and that some evidence did not differentiate between the concepts involved:

- Perceived Noise Level (PNL) is the measurement of the noisiness of broad band aircraft noise expressed in the unit PNdB;
- Tone-corrected Perceived Noise Level (TPNL) takes into account the tonal components of aircraft noise expressed in the unit TPNdB; and
- Effective Perceived Noise Level (EPNL) includes the effect of both tonal and duration components and is expressed in the unit EPNdB.

Similarly the units in which these levels were expressed, i.e. PNdB, TPNdB and EPNdB were not always clearly differentiated.

It is misleading to regard these terms as interchangeable and care must be exercised when using simple numerical correction factors for situations other than those for which they were evolved.

The EPNL system, as detailed in Appendix 1A of the I C A O Report (Doc. 8857), is very complex.

The frequency spectrum is divided into 28 one-third octave bands and the sound level is measured for each of the bands. The levels are then combined in a manner which allows for subjective 'noisiness' of various portions of the spectrum. Differences between the levels of adjacent bands indicate the presence of tones and corrections are applied to allow for the increased response these cause. The results are now in the form of Tone-corrected Perceived Noise Level (TPNL).

The measurements are repeated for each half second of the aircraft flyover and from the series of results it is possible to derive a duration correction based on both the time interval over which the TPNL is within certain limits and the levels during this interval. (See Appendix G).

The final result is Effective Perceived Noise Level (EPNL).

It is apparent that such a complex system requiring so many calculations for each noise event is of limited usefulness unless high speed methods are available for processing the data. Special real-time

analysers have been designed to perform the spectrum analysis and level measurements. When coupled to a computer the rapid determination of EPNL is possible.

For maximum accuracy it is necessary to match the precision of the processing equipment with a noise data gathering system of similar refinement. This involves correct selection and orientation of microphones in locations free from substantial reflecting surfaces, great attention to calibration and testing of equipment, as well as the restriction of measurements to times when the meteorological conditions are most suitable for sound propagation.

Since these critical requirements are unlikely to be found in residential areas near major airports under normal conditions of terrain, weather and background noise, measurements made in these situations are of little use for scientific purposes or for comparison with the results of aircraft noise certification tests.

The ICAO meeting stated that such accuracy was needed only for:

> scientific study of human response to aircraft noise; engineering research and development; establishment of an aircraft noise certification system; also, as necessary, for such purposes as the establishment and evaluation of optimum operating noise procedures and accurate assessment of the relative effectiveness of various noise abatement devices.

For valid comparisons to be made between the noise performance of different aircraft under different circumstances it is necessary to apply corrections for aircraft weights, engine power settings, climb and descent characteristics, attenuation of sound in the atmosphere and distance of the aircraft from the measurement location.

It is apparent that many witnesses did not appreciate the extent to which weather conditions affect not only aircraft performance but also the propagation of sound. Measurements made over a limited period under conditions which are not ideal are of little worth for evaluation of community noise exposure.

To be useful, measurements of aircraft noise at specific airports must be continued for sufficient time to sample the range of aircraft types and operational performance as well as the range of weather conditions which normally apply at that airport.

Because of its complexity and the possibility of modifications in the overall system with consequent equipment changes, the Committee does not advocate the adoption of the EPNL system within Australia for any purpose other than research. For tasks, such as monitoring aircraft noise, simplified systems using either the 'A' or 'D' standard sound level meter weighting networks (see Australian Standards ASZ37 and ASZ38) provide sufficient information to permit valid decisions to be made from the results of such measurements. It is anticipated that procedures for inter-relating the various systems will be further refined in the future.

5.3 Measurements for Hearing Conservation

In Australia research has been directed more towards the preservation of hearing than to assessment of annoyance.

Measurements made at work positions with the simple sound level meter, using the 'A' weighting network, are adequate for the prediction of possible hearing damage from broadband aircraft noise.

Evidence shows that an acceptable compromise between the costs of protection and minimal risk to workers' hearing is obtained at a basic level of 90 dBA for regular exposure over the full working day. Since exposure to aircraft noise is typically of an intermittent nature, it is reasonable to allow an increase in levels to compensate for exposures of less than the full working day.

In these circumstances the more conservative approach would permit increased levels of 3 dBA for each halving of exposure time remembering that the criterion of 90 dBA is set for the normal hours of work.

Equipment such as tape recorders and statistical analysers enable a more accurate determination of exposure rates.

If the aircraft noise contains audible tones, an allowance can be made for the greater potential damage of such noise by decreasing the permissible levels by 5 dBA, i.e. the criterion of 90 dBA for full-time broadband noise becomes 85 dBA for noise with audible tones.

Suitable instruments are available to permit evaluation of noise exposure for those directly engaged in the operation and maintenance of both service and civil aircraft. There is, therefore, every reason for proceeding with the implementation of hearing conservation programmes. Management and trade unions have a joint responsibility for ensuring that such programmes are effective.

The RAAF has been active in this field for many years, with other organisations following as the importance of this work was realised.

5.4 Aircraft Noise Monitoring

Aircraft noise monitoring systems are in use at overseas airports with many more being planned for the near future.

Most use measurements in dBA with some, mainly in the USA, using the 'D' weighting network which is said to give a closer approximation to PNL than dBA when the appropriate corrections are applied. The 'D' network was also favoured by the ICAO meeting.

It is apparent that there is no uniformity in this field with each installation having unique features. This lack of uniformity stems in part from particular requirements determined by the airport site, the available communication facilities, the location of nearby communities with respect to flight paths, the type of terrain and the range of weather conditions in which the equipment will be expected to operate. Differences are due also to the variation in concept and aims between individual authorities.

The aim of aircraft noise monitoring, as outlined in the ICAO report (Doc. 8857), is:

> monitoring compliance with and checking the effectivenes of such noise abatement requirements as may have been established for aircraft in flight or on the ground.

The noise abatement requirements usually call for the maintenance of noise levels below specified limits at locations where microphones are placed to sense the aircraft noise. Limits are set as a compromise between the noise created by normal aircraft when flown on correct paths in a reasonable and prudent manner and the desire of each community to suffer as little as possible from exposure to aircraft noise. In order to meet the required limit it may be necessary to call for reduced take-off weights or engine power reductions as the critical communities are overflown.

Where possible, noise abatement procedures call for aircraft to fly along paths which avoid the most sensitive communities and the monitoring microphones are placed near the edge of the community closest to the flight path. When the airport is surrounded by communities of relatively even population density, microphones are placed under the flight paths.

Mobile monitoring equipment is also needed to investigate conditions in complaint areas and to check the effectiveness of changes in noise abatement operating procedures.

Since landing noise and take-off noise are of equal importance both should be monitored. Limiting values could then be set separately for each location for landing and take-off and for each aircraft type (or general categories of aircraft) by a series of controlled flights suitably corrected to allow for the variables previously listed in 5.2 or after an extensive period of trial (say one year) in which the full range of variables was encountered.

Monitoring should be introduced within Australia but its widespread installation is not yet warranted. It is suggested that priority be given according to the severity of the exposure commencing with Sydney Airport.

The aim should be to reduce noise exposure particularly at times which cause most distress to communities. A system which provides incentives to aircraft operators to reduce noise by the fitting of extra engine noise reduction equipment, by weight reductions or by operational techniques is most likely to be effective. The Committee recommends consideration of a variable airport charge related to the noise level performance of each aircraft, the specific time of operation and individual runways at each airport separately.

To be effective noise monitoring must be co-ordinated with air-traffic control to ensure that noise factors receive adequate consideration during planning of operations. Because of this, the responsibility for operating monitoring installations must rest with the Department of Civil Aviation.

The use of automatic systems is indicated since the procedure, to be effective, must be of a routine nature.

The co-ordination of noise monitoring with complaint analysis may also be of advantage in the formulation of improved operational procedures.

As more aircraft noise monitoring installations are planned the need for further standardisation in the areas of data processing and reporting must grow and it would be wise for Australia to encourage this process through ICAO and the International Standards Organisation.

5.5 Prediction of Aircraft Noise Exposure

To avoid the mistakes of the past it is necessary to predict future noise environments near airports so that correct planning decisions can be made.

The system which offers the best promise for satisfying Australian conditions and requirements is, at present, the Noise Exposure Forecast (NEF) system developed in the USA. The reasons for this are:

(a) It is based on EPNL.

(b) Australia uses similar aircraft types.

(c) Allowance is made for the number of aircraft per day.

(d) The time of day for each operation is also considered.

(e) Actual or projected flight paths are used.

The information is presented as a series of tables and graphs which enable the determination of EPNL patterns for each aircraft under its particular operating conditions. To simplify the procedure aircraft are divided into ten general categories and take-off profiles are determined within five classes according to the proposed trip length.

A graph for the aircraft category then is used to derive the EPNL at various slant distances from the flight path for both take-off and landing operations. This information is also available in tabular form which is more convenient for calculations by computer.

If night operations are to be considered a weighting factor may be introduced to allow for the greater sensitivity of communities to aircraft noise at night.

The total effect for each flight track is assessed by the addition of all categories and operations using a formula which, in effect, combines the noise energy from all flights, i.e. two flights are the equivalent of one flight which is 3 EPNdB higher in level; ten flights are equivalent to an increase of 10 EPNdB and so on.

The system uses many approximations and must in time be refined to allow for more detailed information on the noise output of particular aircraft types, individual take-off profiles, the effect of engine power reductions and more accurate determination of flight paths. Further refinements should include a system for summing the individual events and for weighting the time-of-day factor based on local sociological and experimental evidence.

The greater precision thus obtained will enable a better correlation between NEF and the expected reaction of communities than can be achieved with the system in its present state of development.

The most useful guide for prediction of reaction would be one which allows for the wide range of reactions to aircraft noise between individuals and between communities. This can be expressed on a sliding scale adjustable for the community motivation toward the airport.

The arbitrary land use categories specified in the appendix to the published Noise Exposure Forecasts are not based on local building structures or sociological factors. The Committee repeats its earlier warning that this aspect of the NEF system should be treated with caution until a more precise NEF is available and there is more evidence of what land usages are compatible with the various levels of aircraft noise within Australia.

6 Effects of Aircraft Noise

6.1 General

Aircraft noise influences many aspects of daily life and also the value which the community places on living in areas adjacent to airports. The effects are all those things which happen to people or objects as a consequence of exposure to aircraft noise.

During the Committee's hearings it became evident that aircraft noise does constitute a nuisance to those living close to airports particularly under flight paths. The Committee attempted to evaluate the likelihood of permanent harmful effects.

6.2 Physiological Effects on Persons

At the November 1969 meeting of ICAO the results of which were reported to the Committee, it was stated that hazards to health are a highly emotive subject and the meeting urged the highest degree of objectivity in considering these questions. The Committee concurs with these views and finds that the available knowledge on this subject is incomplete. The Committee accepts the further view of the ICAO meeting that there is a need for long range research on the potential effects of typical exposure to aircraft noise.

6.2.1. EFFECTS ON HEALTHY PERSONS

The Committee concludes that at the exposure rates and noise levels commonly experienced by communities living beneath flight paths near major Australian airports any effects on the physical state of persons in good general health are negligible and it has not been given any medical evidence to the contrary.

Reference was made to two authoritative studies, that of the Wilson Committee (*Noise, Final Report,* HMSO, London, UK) and of Dr A. Bell (*Noise, and Occupational Hazard and Public Nuisance*, World Health Organisation, Geneva), neither of which supported the view that the health of people living near airports is likely to be affected.

One aspect on which the Committee would have expected to receive more submissions was the effect of noise on sleep and rest. In Australia, the opportunity to carry out studies of this factor and its influence on people is limited. The Committee agrees with the view expressed in the Wilson report that 'repeated interference with sleep is least to be tolerated because prolonged loss of sleep is known to be injurious to health'.

The Committee commends further research on these aspects as it would have wider application to the general community with particular reference to shiftworkers and those living near major highways.

It is fortunate that aircraft noise exposure conditions in Australia lag behind those experienced by communities near some major airports

in other countries and it is expected that if harmful physiological effects do occur, they will appear in overseas populations before our conditions become critical, thereby giving time to avoid a similar situation in Australia.

6.2.2. EFFECTS ON PERSONS WITH EXISTING MEDICAL CONDITIONS

People who are ill need conditions which ensure freedom from disturbance of rest and sleep at all times of the day and night. Very little guidance as to what levels of noise would be permissible to achieve this end has been produced but it seems logical to avoid the placement of hospitals or rest homes in the vicinity of flight paths. Although many references were made to the possibility of those who are sick being retarded in recovery due to exposure to aircraft noise, medical evidence is not available which would support this contention.

6.2.3. EFFECTS ON HEARING

Numerous factors other than noise affect a person's ability to hear. The Committee is concerned with those changes in hearing acuity brought about by environmental conditions, specifically exposure to aircraft noise, but understands that it is often difficult to distinguish between the effects of noise and those due to ageing because of the wide range in individual susceptibility to these conditions.

Nevertheless, the relationship between exposure to industrial noise and its effect on hearing are well established and the Committee thinks it reasonable to regard the exposure of tarmac workers and those in maintenance areas on airports as being a normal condition of industrial noise of an intermittent character.

At airports many people exposed to high level aircraft noise for relatively short periods suffer a temporary reduction to their hearing acuity, but this loss is restored to normal over a short period and is not to be confused with the permanent effects which are brought about by habitual exposure to such noise.

It has been of interest to the Committee to note the more widespread provision and use of ear protective equipment at Australian airports since the inception of the Inquiry and it is recommended that the use of this equipment should be enforced where necessary. The responsibility for implementing this recommendation rests equally with the management of operating airlines and the industrial unions.

6.3 Psychological Effects on Persons

As a feeling of annoyance is more of a reaction than an effect, this section refers to mental health, effects on speech communication and efficiency of work.

6.3.1. EFFECTS ON MENTAL HEALTH

As with physical health, persons suffering from a pre-existing mental condition of either a temporary or permanent nature may be more susceptible to further complications or retarded in recovery by exposure to any noise including that made by aircraft.

Those suffering from a subclinical condition of stress could be the first affected by the onset of noise.

In summary, the Committee finds that aircraft noise is a factor which cannot be ignored in the deterioration or recovery of those who are suffering from mental disturbances but research data which substantiates this view is not available.

6.3.2. EFFECTS ON EFFICIENCY OF WORK

On the evidence available no general conclusion can be drawn that aircraft noise has any effect on working efficiency, except in those cases where communication is concerned.

If the efficient performance of a task requires the ability to communicate by voice or telephone and is of such a nature that short interruptions could cause misunderstanding, it is obvious that reduced efficiency must occur.

However the popular supposition that noise is a major factor in reduction of efficiency due to its disturbance of concentration, is not supported by the results of carefully controlled reported experiments.

It seems that this general assumption would not be held unless it had some basis in fact and consequently we commend this field for further study.

6.3.3. EFFECTS ON SPEECH COMMUNICATION

In contrast to the effects referred to in the preceding sections, the effects of noise on speech communication are known with some certainty. There are well established methods for measuring the levels at which communication of information, either by direct speech or by artificial means, becomes critical.

After consideration of the levels of aircraft noise heard under flight paths and the lack of noise protection afforded by normal houses, the Committee finds that complaints concerning interference with speech within the home and of interruptions to telephone usage are valid.

For most indoor activities speech communication is not a vital factor and aircraft noise has the advantage of being of relatively short duration. Nevertheless, such disturbance, as stated, represents a major factor in causing annoyance, particularly during the peak periods of aircraft landing and take-off.

Interruption to radio listening and the aural segment of television programmes also contribute to the annoyance of people affected by aircraft noise.

Since noise reduction techniques are more effective for high frequencies, and most interference with speech is caused by noise in the middle to high frequency range, the adoption of noise reduction techniques should greatly reduce disturbance from aircraft noise and is commended to all those concerned with the design and construction of buildings near airports.

6.4 Effect on Property

6.4.1. EFFECTS ON VALUES

The Committee has sought advice from the Valuer-General in each State about criteria used when appraising land in noise sensitive suburbs close to airports. Without exception these authorities have advised that exposure to aircraft noise is not a criterion in valuations, which are based solely on the precept of market value.

Market value and demand for land are determined by many factors and it has not been possible to isolate aircraft noise as a decisive element in property valuation. Nevertheless it seems certain that values are affected in some areas by aircraft noise. In Perth and Sydney it was alleged that aircraft noise caused changes in values in noise sensitive areas. Confirmation of this would require a detailed and protracted survey beyond the scope of this Committee. The Committee has evidence of new residential and other urban development within a mile of airports despite warnings by airport authorities.

Frequently, complaints about noise come from persons who become disturbed subsequent to occupation of new or established homes.

6.4.2. EFFECT ON BUILDING STRUCTURES

Complaints have been received that buildings and interior fittings in the Newcastle N S W area have been damaged by sonic boom caused by R A A F aircraft.

Complaints have also been received in other areas that overflying aircraft have disturbed roofing or ceiling materials or fractured windows.

The Department of Civil Aviation has investigated many of these complaints and denied liability. Claims for compensation have been rejected. Terminal buildings have been repaired by Department of Civil Aviation personnel but such damage has been attributed to air blast and/or ground vibration caused by movement of heavy aircraft rather than by noise.

Experiments on the effects of vortices caused by air disturbance following aircraft movement indicate that this is the more probable cause of damage to buildings, particularly of roofing. Some affected buildings about which complaints have been lodged are relatively old and/or not constructed to withstand this factor in the hazards to which buildings are exposed.

From the Committee's observation it appears that investigation of complaints has not been as intensive as would clearly establish the actual cause of damage. This has prevented complainants from seeking compensation for alleged damage.

It is recommended that the Department of Air and the Department of Civil Aviation institute an extensive investigation of complaints into the effects of overflying aircraft on structures so as to establish the cause of damage.

6.5 Effect on Institutions

This section considers the effects of aircraft noise on such institutions as hospitals, places of learning and of religious worship.

6.5.1. EFFECT ON MEDICAL INSTITUTIONS

Evidence of the effects of exposure to aircraft noise on hospitals and the like has not come from persons directly affected but are the opinions of authorities responsible for the care and treatment of patients. The Committee acknowledges the assistance of the Rockdale Municipal Council and Rockdale Citizens (Noise) Committee as well as others for gathering together evidence of noise nuisance from many of these sources.

There is evidence of difficulties in hospital administration due to aircraft noise. Problems arise from the inability to hear instructions given by doctors and interruption of conversation between patients and nursing staff. Telephone communication also is interrupted. Conversing with persons handicapped by imperfect command of the English language is made more difficult. There is a loss of time waiting for the passing of noisy aircraft.

The Secretary of the Arncliffe Occupational Centre for Moderately Handicapped Persons wrote:

> Our supervisors find that aircraft noise not only interferes with trainees concentration . . . it is always some time before peaceful working conditions are restored in the workshop.

Letters of complaint about aircraft noise have been addressed to the Rockdale Municipal Council from responsible officers at various hospitals and convalescent homes in the area west of the Sydney Airport. In every case it is claimed that aircraft noise is injurious to patients and staff. Administration is more difficult than in similar institutions not so exposed.

The Department of Civil Aviation has produced diagrams showing the number of hospitals within a radius of 5 and 10 miles of most major Australian airports. In the case of Sydney Airport there are 99 hospitals within the critical 5-mile noise sensitive circle and more than half of these lie in the northern sector with 15 per cent in the western sector. See Appendix H.

It seems desirable that hospitals, including those for the treatment of mental conditions, should not be built in the vicinity of aircraft flight paths, and that in adjacent areas, noise insulation should be introduced to buildings which house patients who may be sensitive to noise disturbance.

6.5.2. EFFECT ON EDUCATIONAL INSTITUTIONS

Evidence has been given of interruptions to classroom instruction at primary and secondary school levels. Reference was also made to disturbance of presentation of educational matter by television and other audio-visual teaching aids, and of adverse effects on out of door school assemblies.

Protracted and repeated daily interferences of this nature create difficulties in communication which give rise to grave cause for complaint.

The Committee has been dismayed to learn of decisions to build new schools in acutely noise sensitive areas despite prior warnings of both the effect of exposure to aircraft noise on learning situations and of the prospect of increasing intensity of such exposure.

A diagram produced by the Department of Civil Aviation gives the number of schools in the area around Sydney Airport (see Appendix I). In the critical 5-mile circle there are 242 schools, few of which are likely to be insulated against noise and many are subject to acute noise exposure. Diagrams prepared for the other major cities in Australia show a similar condition of potential exposure to aircraft noise which should be considered by educational authorities when planning new school buildings. Establishment of schools and other educational buildings under flight paths should be rigorously avoided.

6.5.3. EFFECT ON RELIGIOUS INSTITUTIONS

There is evidence of significant interference with religious worship in churches and similar places.

As with hospitals and schools the Department of Civil Aviation has supplied a diagram (see Appendix J) giving the number of churches as 361 within the critical 5-mile circle around Sydney Airport. The Committee is satisfied that religious worship is seriously disturbed and measures should be taken to minimise such exposure.

6.6 Effect on Community Amenity

Whilst community amenity is not easy to define, nevertheless, it is the context in which most people express their feelings of resentment towards the intrusion of aircraft noise into daily living. The Committee is impressed by the many complaints of disturbance of living conditions and considers these disturbances as part of the general problem.

These complaints have been reinforced by the Committee's own observations of such noise sensitive environments.

Standards of comfort for those living near airports have been eroding gradually under the influence of noise and other forms of pollution. The forecast of an increasing number of aircraft movements suggests progressive deterioration in urban amenity unless more ameliorative measures are instituted. The intrusion of aircraft noise seems to be more unwelcome in the home, in recreation areas and institutions of a medical, educational and religious kind than in work places and industrial environments.

Disturbances associated with aircraft operation are:

(a) Interruption to communication between persons and families, and to telephone conversation.
(b) Interference with television and radio reception.
(c) Distress to the aged and the very young.
(d) Disturbance of rest and sleep.
(e) Disturbance of the quiet of hospitals.
(f) Interruption of school lessons and religious worship.
(g) Damage to building structures.

(h) Interference with commercial transactions and business administration.

(i) Intrusion into open air recreation and other such activities.

If these intrusions continue at a rising rate of intensity some living areas near airports can become intolerable even if only in the minds of the people involved.

The Committee has often been informed that 'people get used to noise' and there is evidence that the essential services and other benefits accruing from the heightened commercial and industrial activity generated by a busy R P T airport may lead to acceptance by many people.

The Committee has not been able to secure from any source an accurate measure of the magnitude of the social unrest attributable to aircraft noise. One witness has given evidence of a partial examination of the problem and it is understood that this study is unique in Australia. A social survey of the noise problem in the U K was undertaken by the Wilson Committee.

There is a need for a similar study in Australia before the full nature and extent of the problem is understood and judgment of the level of community tolerance can be established, but information obtained concerning a later survey at Heathrow Airport (U K) and an American report published by the Tracor Corporation emphasises the need for extreme care in selecting population samples and the necessity for professional supervision at all stages, particularly in interpretation of results.

Where new airports are to be built, the problem of aircraft noise can be avoided if local authorities co-operate to apply proper zoning of land use and the provision of buffer areas. In densely populated suburban communities such as exist around Sydney Airport, it may be appropriate to assist persons who are acutely affected to move to more suitable neighbourhoods. It may be less disruptive to move the airport to a more suitable site. Consultation between Commonwealth and State Ministers may be necessary to determine the best course, but it is stressed that the responsibility for action requires the co-operation of the State authorities concerned.

7 Reactions to Aircraft Noise

7.1 General

In this section the Committee deals with reactions of the public to aircraft noise.

7.2 Means Adopted

7.2.1. COMPLAINTS

The most common avenue of complaint is to the local airport authority in various forms including telephone, letter, personal appearance, or by a local Association, Council, or Member of Parliament acting on behalf of one or more citizens.

7.2.2. CIVIC REACTION

Another reaction manifests itself in protest meetings. In some cases these meetings have resulted in the formation of permanent citizens groups which meet regularly to discuss their grievances and formulate joint action. One example is the Rockdale Citizens (Noise) Committee, Sydney.

7.2.3. LOCAL GOVERNMENT ACTION

Another reaction occurs when local government authorities acting in the interests of their constituents make representations to responsible authorities.

The Committee has received evidence from many local government authorities throughout Australia and its Territories on behalf of local communities.

7.2.4. PARLIAMENTARY ACTION

A significant form of reaction is undoubtedly representation to Members of Federal, State and Territory Legislatures many of whom gave evidence to the Committee arising from these representations.

7.2.5. PRESS AND OTHER MEDIA

Both Press and T V have conducted vigorous campaigns highlighting aircraft noise nuisance.

7.2.6. LEGAL ACTION

Legal action is as yet insignificant in Australia because of the difficulty of establishing liability and of instituting action.

7.3 Analysis of Complaints

The Committee has taken evidence of the manner of recording, investigating and analysing complaints.

7.3.1. PRESENT METHODS

At those airports controlled by the Department of Civil Aviation complaints are recorded either in a log book or on a proforma. Summary diagrams are prepared (see Appendix K).

Department of Civil Aviation officers have advised that complaints are referred to the Airport Manager who has the responsibility of investigating them and, if possible, instituting appropriate remedial action. Where action would result in significant operational changes, the Airport Manager refers the matter to a higher authority for consideration.

At those airports controlled by the Department of Air, complaints are recorded in a log book and referred to the Officer Commanding whose responsibilities concerning complaints about aircraft noise are the same as those of Airport Managers.

7.3.2. SUGGESTED IMPROVEMENTS

The Committee recommends that a Standard Complaint Pro-Forma should be devised which includes information showing:

(a) the complainant's name;
(b) whether the complainant is speaking for himself alone or for another or for a group which can be identified;
(c) the type of complaint, i.e. letter, telephone, etc.;
(d) the severity of the complaint (a numerical scale which rates according to degree of support);
(e) the location of the complaint (as specific as possible);
(f) the type of noise which causes annoyance;
(g) the time of day;
(h) meteorological conditions;
(i) action taken as a result of the complaint.

At regular intervals a map should be prepared showing the location, number and severity of complaints, which would indicate clearly where attention must be focussed.

7.3.3. ADMINISTRATIVE ARRANGEMENTS FOR NOISE ABATEMENT

The Committee commends continuing attention of the Department of Civil Aviation and where appropriate the Department of Air to the following matters:

(a) Supervision of noise abatement procedures and their review.
(b) Investigation and analysis of complaints.
(c) Public relations.
(d) Technical aspects of measuring and reducing aircraft noise.
(e) Hearing conservation programmes.
(f) Liaison with Local, State and Commonwealth authorities on land use and other policies relating to aircraft noise nuisance.

8 Procedures Designed to Lessen Aircraft Noise

8.1 General

This section deals with existing noise abatement procedures and their effectiveness.

8.2 Administrative Procedures and Regulations

8.2.1. RESUME OF PROCEDURES AND REGULATIONS

Regulations to abate or attenuate noise are administered by the Department of Civil Aviation which has the effectiveness of procedures constantly under review.

Measures to attenuate aircraft noise are grouped by ICAO into two sets of regulations, viz.:

(a) those which apply to engine running for test and maintenance purposes on the ground, whether the engine is in the airframe or not, known as 'Ground Run-Up Noise Abatement Procedures'; and

(b) those which apply to engine running whilst the aircraft is in operation either on the airport or engaged in take-off or landing, known as 'Aircraft Noise Abatement Operating Procedures'.

The Department of Civil Aviation instructions applicable at each major airport in Australia are set out in Appendix L although some of these are designed for other than noise abatement purposes.

Instructions differ between major airports, and hours of the day, for example restriction on the operation of jet aircraft (the jet curfew) between the hours of 11.00 p.m. and 6.00 a.m. applies at Sydney but not at Perth.

Aircraft operators and pilots are informed of the regulations and of changes from time to time.

In general the procedures are as follows:

(a) Running of engines in test cells when the engine is out of the airframe and when such test cells are available.

(b) Inframe ground engine running for test purposes is restricted to such times of the day and such places on the airport as will minimise community noise exposure.

(c) Operating instructions provide for curfews on jet aircraft where necessary during normal sleeping hours.

(d) The strict use of preferred runways to minimise exposure to aircraft noise and make a more equitable distribution of such exposure.

(e) Departing aircraft are required to reach regulation height after take-off as early as practicable and within a specified distance of the airport.

(f) Pilots of outbound aircraft are required to establish their aircraft on course for their destination within a radius of 5 nautical miles of the airport.

(g) The courses taken by R P T aircraft in controlled air space Department of Civil Aviation. Specified lanes or corridors for air traffic ensure lateral separation between departing and arriving aircraft on different tracks.

(h) Flying training operations are kept to a minimum at airports which have extensive noise sensitive areas around them.

These operating procedures coupled with the use of approved glide paths for landing aircraft, set the current limit of aircraft noise abatement procedures. The Committee has been told that this limit is governed largely by safety factors, workload capacity of air traffic controllers, availability of aircraft navigational aids, limitations of shared air space and pilot tolerance.

8.2.2 EFFECTIVENESS OF PROCEDURES AND REGULATIONS

(a) *Engine ground running* is necessary for maintenance and the regulations aim at reducing noise exposure for airport workers and those in the immediate neighbourhood. The use of test cells for engine running satisfies these aims where such cells are available.

Engine running in the airframe and on test trucks presents a more difficult abatement problem. Where such a noise problem is likely to exist at an airport, regulations restrict the amount of running during the major sleeping period (nominally 11.00 p.m. to 5.00 a.m.). These regulations ensure that if engine ground running is necessary during the most sensitive periods of the day, it is performed for only a limited time and in locations as remote from noise sensitive areas as possible.

During the day ground running of engines does not present a major noise problem because of the much higher background noise which tends to act as a 'mask'. However, because of operational necessity, much maintenance must be performed at night when aircraft are available. Since many flights are scheduled for departure at an early hour, it is inevitable that some ground running has to be done in the early morning hours. There is thus a conflict of interest between the desire of the public for minimum noise nuisance, and the amount of ground running necessary to satisfy aircraft safety standards.

(b) *Operating procedures* to ensure aircraft noise abatement have been introduced progressively since the late 1950s following the introduction of jet aircraft, first by international and later by domestic operators. Many restrictions have been placed on schedules, landing and take-off techniques and flying routes to give relief from increased exposure to higher levels of aircraft noise.

'Curfew' regulations restrict jet aircraft movements between the hours of 11.00 p.m. and 6.00 a.m. at most major Australian airports. The restriction allows for approval of special jet movements in curfew hours only by the Minister and other essential jet flights by local Airport Managers. The Committee is concerned at the frequency of such approvals and it is recommended that such movements at Sydney be confined to operations over Botany Bay except in cases of emergency.

The Committee further recommends more stringent application of the criteria authorising jet movements in curfew hours to ensure the preservation of the original intention of the regulation.

The Committee has noted that a number of new instructions has been developed following consideration of evidence during the progress of this Inquiry. For example a minor variation in the flight path of aircraft using Avalon Airport has produced marked relief for residents of the nearby township of Lara in Victoria. At Sydney, extension of the north-south runway permitting stricter use of the preferred runway system has resulted in the spreading of the pattern of exposure and given some relief to the residential areas to the west and north.

A numbering system is used in identifying runways and has its origins in the concept of assisting aircraft pilots to avoid error. When a pilot aligns his aircraft with a runway preparatory to landing or take-off, he observes that the number painted on the runway threshold corresponds with the first two figures on the compass which indicate the aircraft heading. Thus an aircraft landing into the north on the north-south runway at Sydney Airport uses runway 34 and the (approximate) bearing of approach is 340 degrees. The opposite end of runway 34, will of course, be the reciprocal, and is identified as runway 16. The urban areas exposed to overflying aircraft as a consequence of using different runways at Sydney Airport are:

(i) landing on runway 07 and taking-off on runway 25 take place over Rockdale, Banksia, Bexley and Hurstville;

(ii) landing on runway 25 and taking-off on runway 07 take place over Botany, Mascot, Daceyville, Kingsford and Coogee;

(iii) landing on runway 16 and taking-off on runway 34 take place over St Peters, Sydenham, Marrickville, Leichhardt and Lewisham; and

(iv) landing on runway 34 and taking-off on runway 16 take place over Botany Bay; such suburbs as Kurnell and Cronulla are affected during turning operations to come on to course.

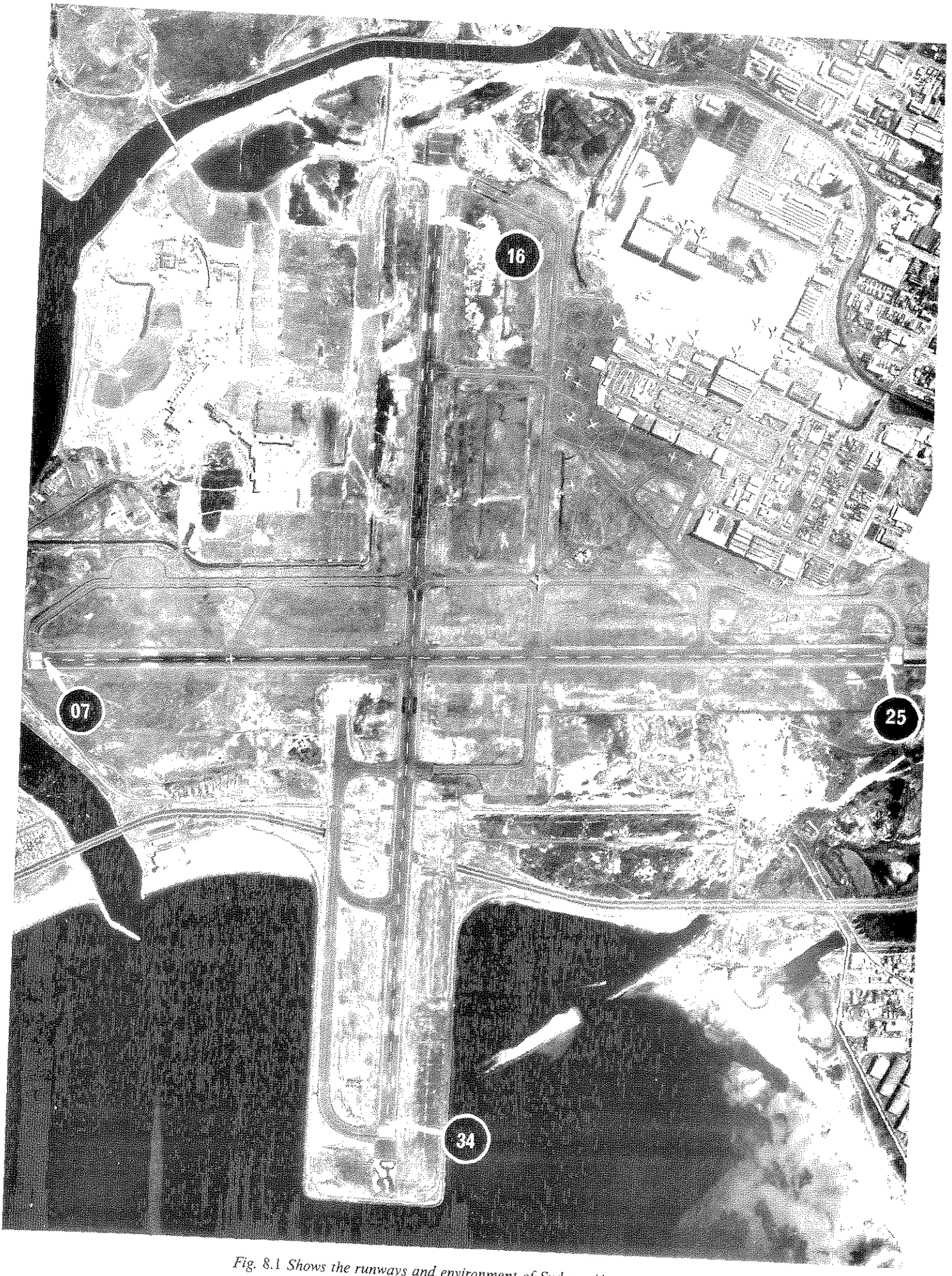


Fig. 8.1 Shows the runways and environment of Sydney Airport

This analysis of aircraft movements at Sydney Airport demonstrates the reason for making the use of runway 34 for landing and 16 for take-off the preferred runways for all movements.

Comparative usage of runways at Sydney (Kingsford-Smith) Airport 1969

	Runways			
	07	*25*	*16*	*34*
Take-off percentages				
Actual 1.7.70 to 7.7.70—				
(a) Day 0645–1900	1.4	19.7	76.6	2.3
(b) Evening 1900–2200	0	0	98.2	1.9
(c) Night 2200–0645	0	0	96.3	3.7
(d) 24 hours	1.2	16.1	80.4	2.3
Actual month of November 1969	19.5	3.9	75.7	0.9
Landing percentages				
Actual 1.7.70 to 7.7.70—				
(a) Day 0645–1900	33.4	22	38.7	5.9
(b) Evening 1900–2200	4.1	59.5	4.6	31.8
(c) Night 2200–0645	3.5	5.2	0	90.7
(d) 24 hours	26.4	27	30.4	16.2
Actual month of November 1969	40.2	9.5	42.8	7.5

In April 1969 after extension of runway 16/34, revised aircraft noise abatement procedures were implemented. A consistent pattern of over 75% usage of runway 16 (over Botany Bay) for aircraft take-offs underlines this change. The effect was to give partial relief to areas east and west of the airport. It is impracticable to use runway 34 for landing aircraft (over Botany Bay) at the same rate as for take-offs. The maximum usage of the preferred runway system generating traffic over Botany Bay is the result of the combination of meteorological conditions, navigational aids, air traffic controller workloads and restraints arising from the sharing of air space for military and civil purposes.

A more thorough examination of the procedures in other places in Australia could further effect relief from aircraft noise. In particular exposure to aircraft noise in the neighbourhoods of Adelaide, Perth and Brisbane airports will increase in the near future and a more critical evaluation of instructions in these places is needed to evolve optimal procedures.

Adoption of principles embodied in procedures specifically developed for one place will provide relief in others.

Distribution of flight patterns within the 5 mile radius of airports needs the closest scrutiny.

Air traffic controllers have to guide arriving and departing aircraft to ensure lateral and vertical separation and at the same time achieve straight-in approaches and take-offs in relation to the runways being used. Because of meteorological conditions or traffic density it is not always possible to direct aircraft to the most desirable runway and turning patterns which unduly cause exposure to residential areas are used. In many cases the overflying of residential areas is unavoidable, if height can be maintained at over 1,500-2,000 ft the impact of noise is tolerable.

Considerable relief may be given to people by establishing turning patterns in areas of least density of population wherever possible. For example at Sydney Airport turning aircraft should avoid residential areas by tracking over Botany Bay headlands and flying along the coastline. At Darwin, aircraft circuiting west of the airport currently fly over the city area when a simple deviation to the west would take them over water and considerably reduce noise exposure.

In many parts of Australia it is necessary to share air space to provide for military and civil usage. For convenience of operation this joint usage sometimes requires civil aircraft to use flight lanes over communities that would not have been exposed had the whole of the air space been available solely for civil use. For example at Brisbane altering southern arrival and departure tracks to the east would mean less exposure to the densely populated suburbs to the south and west of the airport.

Multiple use of air space cannot be avoided but with joint control personnel operating wherever necessary, the result is a satisfactory compromise which permits the optimum in meeting both service and civil requirements.

The joint Committee of Department of Civil Aviation and Service Departments (Air Co-ordinating Committee) should examine the feasibility of re-routing flight paths to minimise noise over residential areas.

8.2.3. CONSIDERATION OF GLIDE SLOPE AND TERRAIN CLEARANCES

A vital factor in exposure to aircraft noise arises from the relationship between glide path, and the nature of the terrain. The Committee has sought to apply *general principles* of glide path useage by taking the *specific* example of aircraft landing at Sydney Airport.

Where an Instrument Landing System (ILS) is installed the procedures to be adopted in an approach to landing are prescribed for aircraft using such an approach. The places where these systems are installed in Australia and the angle of the glide path with respect to the relevant runway are set out in the table below. It should be noted that the glide path of an aircraft landing under ILS conditions is

designed to put it on the runway about 1,300 feet from the approach threshold.

Australian Instrument Landing System (ILS) Glide Slopes for Approaching Aircraft

	Runway	*Glide slopes*
		Degrees
Cairns	15	2.75
Brisbane	22	2.60
Sydney	07	2.67
	16	2.75
Canberra	35	3.00
Tullamarine	16	2.75
	27	2.75
Essendon	26	2.80
Avalon	18	2.75
Launceston	32	3.00
Hobart	12	3.00
Adelaide	23	2.75
Darwin	29	2.75
Perth	24	3.00

N.B. These are all ILS runways only.

In the absence of an ILS, R P T aircraft use the T-shaped Visual Approach Slope Indicator System (T-VASIS). This system is an aid which directs the pilot onto a particular landing glide path by a system of varying colours and visibility of lights which indicate the position of the aircraft in relation to a fixed approach. The glide slope resulting from the T-VASIS is 2.86° though this angle 'may be raised slightly having regard to the approach gradient available' (D C A publication No. 44, 1963 Pilots' Notes on the Visual Approach Slope Indicator System).

Pilots on a visual landing approach normally use the T-VASIS or ILS slope. However this is not always observed and it should be a requirement that pilots of heavy aircraft on visual landing approaches conform to a glide slope of no less than T-VASIS for the particular runway.

These two sets of glide slopes, the ILS and T-VASIS, indicate the range of official glide slopes which are used in Australia.

The effect of these glide slopes on the height of approaching aircraft is demonstrated in the diagram below. The diagram and the accompanying table show the height of aircraft above the runway at varying horizonal distances from touch-down using glide slopes of 2.5°, 2.75° and 3.0°.

The height of approaching aircraft has a considerable bearing on the noise at ground level and the angle of glide path determines the height above any particular spot. The diagram and table below indicate the possibility of noise reduction by keeping glide slopes to the upper range of tolerances promulgated by I C A O (2.5° and 3.0°).

Actual noise levels beneath the landing glide paths depend on the terrain and height of buildings at the point of flyover. Altitudes given in the above table and calculated at varying distances from touchdown

Effect of Glide Slope Angle on Aircraft Height

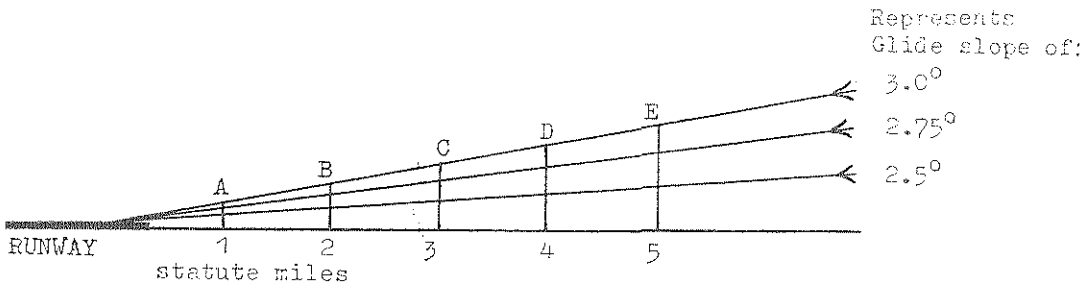


Fig. 8.2

On a glide slope of—	*Height of aircraft in feet at a distance from touch-down*				
	1 mile (*a*)	*2 miles* (*a*)	*3 miles* (*a*)	*4 miles* (*a*)	*5 miles* (*a*)
	feet	feet	feet	feet	feet
2.5°	230	460	690	920	1,150
2.75°	253	506	759	1,012	1,265
3.0°	277	554	831	1,108	1,385

(*a*) Miles are statute miles of 5,280 feet.

do not take into account the uneven topography beneath most approach paths. Any elevated terrain along the extended runway line brings people in such areas closer to overflying aircraft resulting in greater noise exposure.

Areas on the north, east and west of Sydney Airport within five nautical miles of the centres of the runway are as much as 400 feet above the runways. Elsewhere elevations of over 200 feet occur within three miles of the runway centres. Given glide slopes of 2.75° the consequent aircraft height above ground level is about 550 feet (at 3 miles) and high rise buildings plus pilot errors of judgment often reduce this height to less than 500 feet. Even a small increase in glide path will result in worthwhile attenuation of noise and provide welcome relief close to airport boundaries.

It is recommended that as a noise abatement measure the glide slope at Australian airports should be standardised at 3.0° wherever possible.

8.2.4. FREQUENCY OF OPERATIONS

The Committee draws attention to the projected increase in frequency of operations, and the proposed increases in the types of aircraft using engines most likely to generate noise nuisance. No conclusive evidence is available as to the potential of new aircraft types but it is expected that under proposals for certification of aircraft, the total noise factor is unlikely to go beyond present limits.

Evidence of projected aircraft movements at Sydney Airport have been supplied and the relevant statistics are given below:

Actual and projected R.P.T. aircraft movements(a) at Sydney Airport 1968-80

Year	*R.P.T. aircraft movements*(a)		
	Domestic	*International*	*Total*
	Number '000	Number '000	Number '000
1968	66	10	76
1970	70	12	82
1975	82	17	99
1980	97	26	123

(a) Movements includes landings and take-offs and refers to freighter and passenger aircraft.

The figures given in the table above confirm the belief of the Committee that the degree of exposure to aircraft noise at Sydney and elsewhere in Australia will greatly increase in the next decade.

9 Technological Programmes to Lessen Aircraft Noise

9.1 General

The administrative procedures already introduced have been effective to some extent in reducing aircraft noise exposure, though this has been achieved mostly at the expense of the aircraft operators. Engine manufacturers also have taken steps to reduce noise emission in spite of the greater thrust required to lift the heavier aircraft of the future.

9.2 Development of Quieter Aircraft Engines

Evidence was produced of aircraft engines which could be less noisy than those presently in use and the table below shows this possibility.

Comparison of present day aircraft engines with future engines regarding thrust and estimated sideline noise level

	Engine type	*Aircraft type*	*Take-off thrust per engine (lb)*	*Perceived noise level (±5 PNdB)*
Present day engines	P&W JT8D–1	Douglas DC9	14,000	123
	P&W JT8D–7	Boeing 727		
	P&W JT3D–3B	Boeing 707	18,000	127
New engines	P&W JT9D–3	Boeing 747	43,500	124
	G.E. CF6–6	Douglas DC10	45,600	120

The above table demonstrates that, although the new generation of turbo-fan engines will produce approximately three times the take-off thrust of the present day turbo-fans, the noise levels are expected to be quite comparable—in fact slightly less.

Engine manufacturers are undertaking considerable expenditure on the research effort to produce less noisy engines. Noise reduction has now been given a higher rating in the prime design objectives of manufacturers of the new jet engines.

The new attitude to the development of future engine design is commended and should be pursued most vigorously. These matters are extremely technical and the Committee is confident that the expertise so apparant in the aircraft industry will ensure their adoption for our own R P T fleet at the earliest opportunity.

An added impetus to this development has been the introduction of aircraft noise certification to limits set by I C A O. An explanatory graph is included as Appendix M.

Aircraft manufacturing countries, including Britain and the U S A, have passed domestic legislation enabling their aviation authorities to

prescribe noise certification standards (U S A Federal Aviation Regulation No. 36 and United Kingdom Air Navigation (Noise Certification) Order 1970 No. 823).

Though not a manufacturer of large civil turbo-jet aircraft, Australia will, however, need to take local regulatory action to put the I C A O requirements into effect after a new annex has been issued and becomes effective. This is not expected to occur before August 1971.

Australia is obliged to recognise international conventions on this matter but separate certification for Australia is inappropriate at this stage. The Committee considers that Austraila should be represented on the I C A O body being established to formulate future developments in noise certification.

The Department of Civil Aviation should press for the reduction of noise certification limits and pursue a relentless course of imposing restrictions on any airline whose aircraft repeatedly exceed acceptable noise standards.

9.3 Engine Silencing Equipment

The Committee, recognising that existing aircraft will be operational for many years, examined the feasibility, cost and effectiveness of fitting some form of silencing or muffling material to existing jet engines. This is known as 'retrofit' and proposals included exhaust and intake noise suppressors. These devices appear to be only marginally effective, increase the aircraft weight, reduce engine efficiency and are quite costly.

The I C A O special meeting on Aircraft Noise held at Montreal in November 1969 discussed in detail the problems associated with 'retrofitting'. It concluded that such action would involve technical, economic and regulatory problems of great magnitude and that there was not yet sufficient reliable data available to enable soundly based decisions to be made.

In the case of Boeing 707 aircraft, used for international operation by Australia's major overseas airline, evidence given indicated a capital cost of $900,000 to $1,100,000 per aircraft for a quiet nacelle retrofit kit, estimated by I C A O to achieve noise reduction of up to 4 EPNdB on take-off and up to 15 EPNdB on approach. Additional operating costs in the case of the company involved would be up to $7.3m per year which is more than its 1968-69 net operating profit of $7.1m.

The B727 and DC9 aircraft used by Australia's major domestic airlines are also fitted with noisy jet engines, for which actual retrofit cost figures are not available. However from evidence of a recently completed programme of research, carried out by the Rohr Corporation of California, into the economic feasibility of modifying existing aircraft, it was concluded that retrofitting of domestic jet aircraft is not economically feasible.

10 Land Use Planning

10.1 General

Areas adjacent to airports, particularly those immediately within the flight corridors for landing and take-off, will inevitably be subjected to a noise nuisance detrimental to living conditions.

Ideally, airports should be of sufficient size and located in such areas that a natural buffer zone of space insulates the neighbouring residential community from noise exposure.

In seeking the most effective method by which the conflict between the requirements of modern air transport and occupiers of nearby land may be resolved, the Committee invariably came back to appropriate land use zoning as the key to the problem.

10.2 Land Use Planning

It is conceivable that a limited amount of further reduction in engine noise is technically possible at a price in both initial cost and economy of performance, and some attenuation is also feasible by adding to the complexity of operating techniques by pilots, but of course, complete elimination of noise is impracticable. The Committee finds that throughout the world the solution is being sought in land use planning.

The I C A O *Report of the Special Meeting on Aircraft Noise in the Vicinity of Aerodromes* published in December 1969 (I C A O Document 8857 Noise (1969) Montreal, Canada) notes that

> the Meeting did agree on the desirability of the following general recommendation, viz:—
>
> > that States should take action to ensure that, to the extent it is practicable, the uses of land for aerodromes and in the vicinity of aerodromes be optimised through comprehensive planning so as to attain mutual compatibility with regard to aircraft noise exposure, other effects on the local community, and the recognised interests on the development of civil aviation.

The aircraft industry has undertaken considerable expenditure to reduce the noise at its source, as well as accepting a pay load penalty. The operators have accepted considerable increased operational costs together with inconvenience in respect of ground and air procedures aimed at attenuation of noise in the vicinity of airports. Service aircraft do not conform in the same degree to these procedures. The Department of Civil Aviation has undertaken extensive research into appraisal of noise nuisance associated with operating and ground run-up procedures.

In contrast, municipal authorities, who control airport neighbourhoods, have not kept pace over the last decade with developing problems and taken effective steps to reduce noise exposure by appropriate planning.

Fig. 10.1

Fig. 10.2

The Committee finds that an appropriate land use policy is the most likely answer to reducing noise nuisance. However, insufficient attention has been given by municipal, State and Commonwealth authorities to the zoning of areas in the vicinity of airports to ensure compatibility with civil aviation operations.

The initiative in this area lies with those responsible for town planning and supervision of urban development, i.e. with State Governments. These authorities must be supported by Local Government authorities in full consultation with the Department of Civil Aviation.

The two photographs—Fig. 10.1 and Fig. 10.2 (Essendon airport environs 1948 and 1968) demonstrate most clearly the problem confronting the community in airport neighbourhoods. The photo Fig. 10.1, shows development around Essendon in 1948 to be sparse and resembles, in a general way, the situation around Tullamarine Airport at present. Fig. 10.2, shows development twenty years later in 1968 when Essendon Airport has become embedded in intensively developed residential areas so exposed to aircraft noise as to be incompatible with the operation of a major airport.

Similar extremes of development in airport neighbourhoods in Australia today are exemplified by Melbourne (Tullamarine) Airport with its vast areas of surrounding rural properties and Sydney Airport in the midst of an intensive residential land use with high population density.

It is not possible to lay down in simple terms a detailed statement for guiding land use policies which can be applied to all communities. State Planning Authorities have indicated that land use zoning should be put into practice immediately at all existing airports to prevent any intensification of the density of residential development.

The Committee has already recommended that the N E F system of the United States of America Federal Aviation Authority be adopted in Australia. It is once again emphasised that the associated land use classifications are based on an American concept and are meant only as a guide for planning. The classifications only reflect the relative sensitivity to aircraft noise exposure and define, by coarse gradation, stages of compatibility of different land use with airport operation. Each planning authority in Australia will need to develop its own classification.

Zoning should have the statutory basis of State Government enactment and not be subject to unco-ordinated change by local authorities. For example, the present intention enunciated by the Victorian Government in regard to Tullamarine environs needs the backing of legislation to ensure avoidance of later change to incompatible use which would result in the sort of problem that now exists around Essendon, Sydney, and to a lesser extent around Perth, Adelaide, Brisbane and Darwin Airports.

The Committee commends the various State Planning Authorities for the constructive thought given to forward planning. For its particular need the N S W State Planning Authority has appointed a specialist town planner experienced in airport neighbourhood planning.

In its publication *Sydney Region Outline Plan 1970 to 2000 A.D.*, it proposed the expansion of Sydney Airport to include runways at Towra Point so that most aircraft take-offs and approaches would be either over the sea or over Botany Bay, rather than over residential areas. This proposal was intended to avoid building parallel runways on the inadequate area available at the existing site and to reduce the noise nuisance from the increasing number of jet aircraft movements expected in the future.

10.3 Building Structure Adaptions

Very little information is available in Australia regarding insulation of residential buildings against aircraft noise. Experimental work carried out in respect of large commercial buildings indicates that the achievement of a worthwhile reduction would be costly but nevertheless merits serious consideration in areas of acute noise disturbance.

The normal fibrous insulation against temperature change is not effective against the penetration of noise unless sheathed with impervious material.

The following preliminary estimates give some idea of the costs involved in providing double glazing of windows, solid outer doors, blocking off ventilators and solid barrier in roof construction:

(1) New 11 inch brick residence with 6 inch reinforced concrete roof—$1,960.
(2) New 10 inch brick veneer residence with 'Woodtex' insulation over a plaster ceiling under a tiled roof—$1,120.
(3) Existing 11 inch brick or 10 inch brick veneer residence with ¾ inch plasterboard over existing ceiling under a tiled roof—$1,850.
(4) Existing 4 inch timber walled residence similarly treated—$1,850.

The effectiveness of these treatments would vary from a possible reduction of 25 dBA in existing buildings up to 45 dBA in new brick construction and would, to that degree, alleviate noise for indoor living.

To attain a worthwhile result in areas of acute noise it is essential to seal off interiors from outside noise. This in turn calls for mechanical ventilation for which an economic unit could be designed readily at an approximate cost of $150 per room. If full air conditioning, with ducted distribution to living areas, was required to achieve optimum results the cost could be as much as $4,000 for an average 12 square home.

While it is most desirable that local Councils should issue warnings to persons seeking permission to build and include suitable noise insulation techniques in building codes for all areas of acute noise sensitivity, there is some difficulty in modifying existing dwellings owing to the structural types of Australian buildings. Many are too old to warrant the expense and/or are so constructed as to render effective insulation against noise impossible.

The Committee considered the experience of schemes for insulation in other parts of the world but found that they were not applicable to Australia owing to construction of houses and mode of living.

10.4 Consultative Committees on Noise Abatement

In London (Heathrow Airport) where a subsidy scheme was introduced the community response has been poor; only 10-15 per cent of the 4,000 people who qualified for assistance having taken advantage of the offer.

Following the recommendation of this Committee in its Interim Report of August 1969, the Department of Civil Aviation has established Airport Noise Abatement Committees in noise sensitive areas. This has been done at key airports. The Committees, comprising representatives of airline companies, the Department of Civil Aviation, State Planning Authorities, the Federation of Airline Pilots and Municipalities, are now meeting regularly under the chairmanship of senior Department of Civil Aviation officers who also supply secretarial services.

The terms of reference of the Committees include:

- informing the public regarding airport and aircraft operations,
- liaison with airlines and community groups,
- discussing problems involving the community and airport operations,
- acting as a clearing house for complaints,
- recommending additional investigation into local noise problems.

The Committees are already performing a worthwhile public relations role in bringing together around the same table the aviation industry and representatives of airport communities. Noise Information Centres have been set up at major airports to provide complaint centres and to facilitate collecting and processing all inquiries about aircraft noise.

The Committees and the Noise Information Centres have made progress in examining noise abatement programmes and dispelling doubt about the effort being directed towards alleviation. They have ensured a better understanding of the situation and problems confronting the Department of Civil Aviation and the air transport industry.

It is considered that proceedings should not be conducted on a confidential basis, that the composition of Committees should remain relatively small and that they can serve a useful purpose in a consultative capacity on matters concerning airport development.

Elsewhere in this Report mention is made of aircraft noise monitoring and the Committee suggests that accurate and regular records of monitoring, where carried out, should be supplied to the relevant Airport Noise Abatement Committees for information and comment.

11 Constitutional Powers to Legislate for the Control of Aircraft Noise

11.1 General

The Constitution does not give to the Commonwealth an express power over civil aviation. Its interests in the development of the industry are maintained by reason of the power of the National Parliament to make laws with respect to interstate and overseas trade and commerce, external affairs and the Territories of the Commonwealth.

11.2 Control in respect to Places Acquired for Public Purposes

The principal airports in Australia are established on land acquired by the Commonwealth. Section 52 (1) of the Constitution provides—

> 52. The Parliament shall, subject to this Constitution, have exclusive power to make laws for the peace, order, and good government of the Commonwealth with respect to—
>
> (i) The seat of government of the Commonwealth, and all places acquired by the Commonwealth for public purposes.

Consequently it would appear that the Commonwealth can legislate for the control of noise made by aircraft on or over that area.

However such legislation can only be applied to airports owned by the Commonwealth. In another part of this report reference is made to the noise certification requirement of countries manufacturing aircraft which the Commonwealth is obliged to accept because of treaty obligations. There can be no advantage attained in utilising power available under 52 (1) at present.

11.3 Interstate and International Aviation

Under Section 51 (1) the Commonwealth has power to make laws for the regulation of interstate aviation and flights to and from other countries, for providing aviation facilities such as airports and navigational aids.

It should be noted that only the States have the dual legal power to deal with purely intra-state aviation.

The Commonwealth has control over importation of aircraft. Although this might prevent the entry of an aircraft which generated noise above a certain level it would not extend to the later modifications of such an aircraft.

11.4 International obligations

Under Section 51 (XXIX), the Commonwealth has power to make laws in order to carry out any international convention to which Australia is a party. As a party to the Chicago Convention of 1944 Australia is required to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures and organisation in relation to aircraft, personnel, airways and auxiliary services to improve air navigation.

Such amendments as might be adopted by ICAO in regard to rules of the air and air traffic control practices, airworthiness of aircraft, and 'such other matters concerning the safety regularity and efficiency of air navigation as may from time to time appear appropriate' would require supporting legislation. There is no Annex to the Convention as yet on aircraft noise and as a consequence there is no power under this heading by which the Commonwealth may override the sovereign powers of the States in respect of land under their control.

11.5 The Air Navigation Act of 1920

11.5.1. THE AIR NAVIGATION ACT OF 1920 with subsequent amendments, is the main source of regulatory power at the disposal of the Commonwealth. While action residing in the Department of Civil Aviation in respect of operating and other procedures has been used to provide some relief from noise nuisance over built up areas, no Commonwealth power is available to control such nuisanse through land use planning in the neighbourhoods adjacent to airports. Commonwealth legislative power is inadequate to deal with problems of aircraft noise resulting in noise nuisance, personal injury and/or property damage. Responsibility in these matters cannot be identified and separated from that of the States in such a way as to exclude transgressing the powers of State and/or Local Government instrumentalities.

11.5.2. THE POWER TO ISSUE PERMITS under Regulation 320A of the Air Navigation Act is available to regulate activities of aircraft on airports so as to reduce the incidence of noise. After consultation with the airline companies arrangements have been reached for restricting the night time arrival and departure of jet aircraft at certain airports and also the night time ground running of aircraft engines at airports. In the case of Commonwealth airports these conditions could, if found necessary, be formally imposed as conditions for the use of airports so making any breach of these conditions an offence.

Where the person or persons causing a noise that might constitute a nuisance or annoyance is a lessee, the Commonwealth, as lessor, has certain rights within the boundaries of its property.

11.6 Supersonic operations

Air Navigation Regulations prohibit the flying of aircraft in such a manner as is likely to cause avoidable damage to property. If civil supersonic flight with its accompanying significant impact known as 'boom' is sought within Australia, the Commonwealth will be able to regulate supersonic operations by measures directed to the prevention of discomfort and inconvenience of persons on the ground, and to the prevention of damage to surface property.

11.7 Claims for damage

Proceedings by a plaintiff seeking a legal remedy in respect of alleged nuisance in the form of noise made by aircraft have not as yet been litigated. It would appear that nuisance must amount to an inconvenience materially infringing the physical comfort of human existence to become actionable at law and that liability attaches to the person who actively creates it. In certain circumstances the occupier of the land may be held liable. It is however a defence to an action for nuisance that a

statute authorises the particular activity and that this activity inevitably involves the creation of a nuisance.

It is felt that this defence is open to the Commonwealth in respect of airports within its control.

The Civil Aviation Damage by Aircraft Act 1958 (Commonwealth) does not have any application to nuisance by noise not causing direct physical injury or property damage.

The State Acts provide for a right to damages without proof of negligence where loss or damage is caused by an aircraft or articles falling therefrom to persons or property on the surface. However the State Acts first declare that no action lies in respect of trespass or nuisance by reason only of the flight of an aircraft over any property.

In the case of proceedings against the operator of an aircraft in regard to noise produced in flight, an adequate defence appears to be that the noise in question could be demonstrated to be 'an ordinary incident of the flight'. Action could only be taken against the Commonwealth if the aircraft in question was the property of the Commonwealth and then the same defence is applicable.

11.8 Conclusion

Generally it seems unlikely that the problem of aircraft noise may be satisfactorily solved by legislative action on the part of the Commonwealth.

A. A. BUCHANAN, M.P.
Chairman

October 1970

Appendices

Appendix A References and Briefing Material

Curfew

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I C A O

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Draft resolution. (Presented by Australia.) 1 p.

At head of titles:

Agenda item 16: Consideration of any proposals arising from the annual reports or any other reports of the Council to the Assembly.

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Aircraft noise in the vicinity of airports. 3 pp.

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Letter and map.

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[Correspondence on Aircraft Noise.]

Contents: History of proposed Strath Park School Site to the north of Essendon Airport—ILS installation programme for Australian airports as at April 1969—Estimates of number of houses . . . entitled to a subsidy at Sydney (Kingsford-Smith) and Essendon Airports if the London scheme were applied—Information supplied by Dr D. Carr of the Perth, Metropolitan Regional Planning Authority concerning land around Perth Airport—Housing information in respect to Adelaide Airport, being within the 110 PNL of a Boeing 727 . . .

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(Statutory rules: 1966, no. 6.)
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Darwin
Hobart-Cambridge
Melbourne—Essendon and Tullamarine
Perth
Sydney

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AUSTRALIA—*Department of Civil Aviation.*

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Airport concept detailed.
Extract from *American Metal Market.* Tuesday, 28 January 1969.

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Noise at Gatwick Airport. fold. map.

Chairman: Howard Roberts.

Extract from the Report of the Surrey Town and Country Planning Committee presented to the County Council at their meeting on 30 April 1968.

Appendix B Index of Evidence

Where practicable the transcript page numbers of the major evidence relevant to each heading are shown. Evidence relevant to certain headings may occur in many places in the transcript but these are not identified in this index.

VARIOUS AIRPORTS

Evidence on aspects of the Committee's terms of reference was taken in relation to the following airports:

DEPARTMENT OF CIVIL AVIATION

In-flight noise abatement procedures
ground run-up noise abatement procedures.
Relative 'noisiness' of various engine types.
Noise Abatement Committees (the 'Airport Noise Committees').
Flight paths arrangements, e.g. p. 4145.
Technological aspects and problems associated with noise abatement.

DEPARTMENT OF AIR, DEPARTMENT OF THE ARMY, DEPARTMENT OF THE NAVY

Evidence similar to Department of Civil Aviation which comes within their jurisdiction, e.g. p. 92.

AIRLINE OPERATORS

Technological possibilities and limitations for noise abatement, e.g. p. 134.
Economic effects of proposals for noise abatement, e.g. p. 1837.
Measures taken by airline operators for noise abatement, e.g. p. 3704.

COMMONWEALTH ACOUSTIC LABORATORIES

Psycho-acoustical aspects of aircraft noise, e.g. p. 3778.
Physiological effects of aircraft noise nuisance, e.g. p. 3778.
Hearing conservation programmes, e.g. p. 3778.

VARIOUS METROPOLITAN TOWN PLANNERS

Land use compatibility in airport neighbourhoods and related problems, e.g. p. 1687, p. 2764.

VARIOUS MUNICIPAL AUTHORITIES

Nature and extent of complaints received, e.g. p. 4017.
Suggested solutions for noise abatement problems which confront municipalities in the neighbourhood of airports, e.g. p. 4264.
Effect on homes, schools, hospitals and individuals.

VARIOUS LIGHT AIRCRAFT OWNERS AND OPERATORS' ASSOCIATIONS

Problems which aircraft noise abatement procedures cause to their membership.

VARIOUS TRADE UNIONS AND PROFESSIONAL ASSOCIATIONS

Problems that aircraft noise cause to their membership.
Problems which noise abatement requirements cause to their membership.

VARIOUS PROGRESS ASSOCIATIONS

Evidence relating to the extent of nuisance caused by aircraft noise.

BUILDING INSULATION

Evidence relating to the cost, effectiveness and feasibility of insulating residential dwellings in aircraft noise affected areas, e.g. p. 3909, p. 4194.

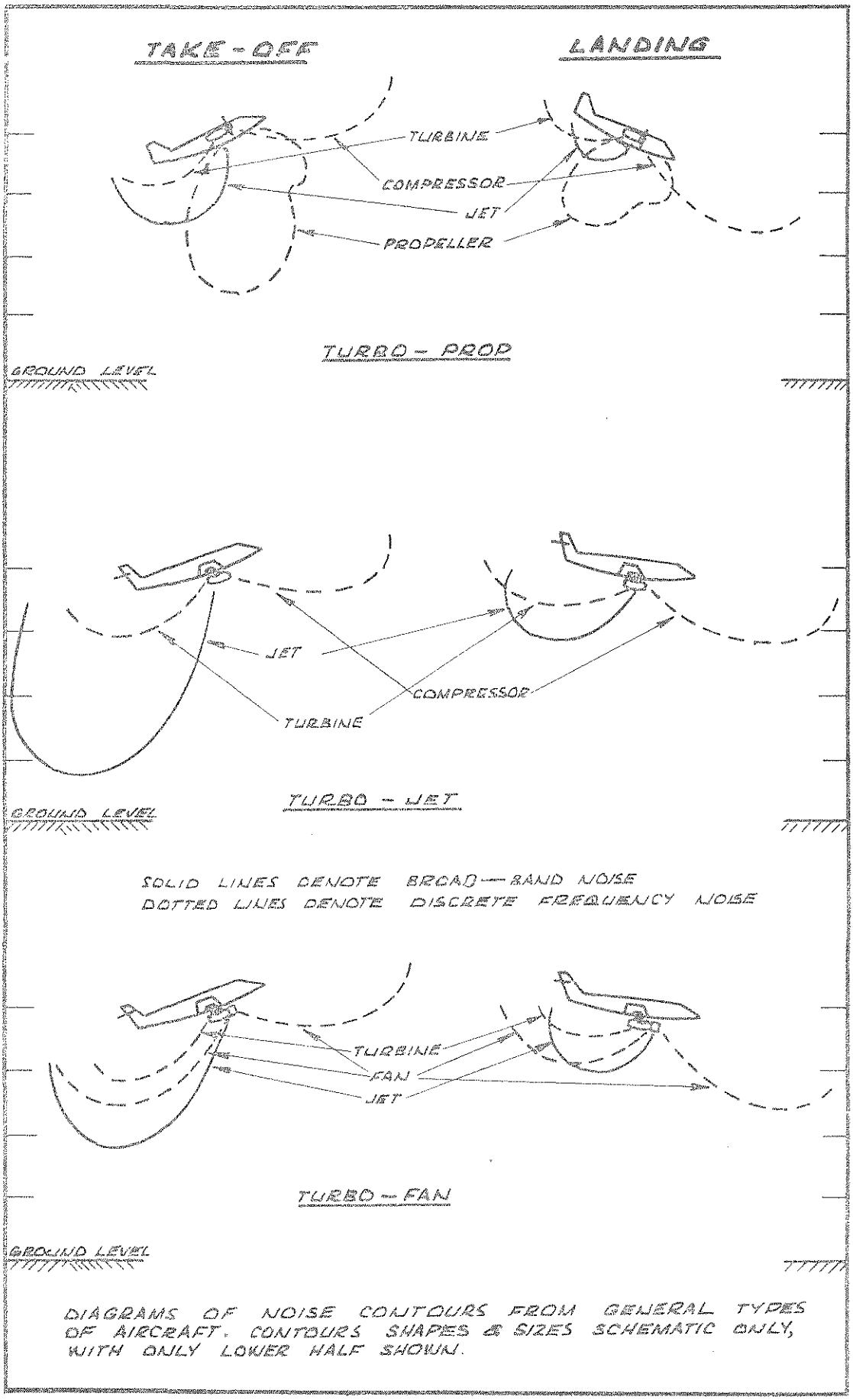
LEGAL

Evidence relating to the relative power of Commonwealth, State and Local Governments to institute noise abatement procedures either by legislation or administrative ararngements, e.g. p. 1000, p. 4400.

VARIOUS MEMBERS OF PARLIAMENT

Extent and nature of complaints lodged by their constituents.

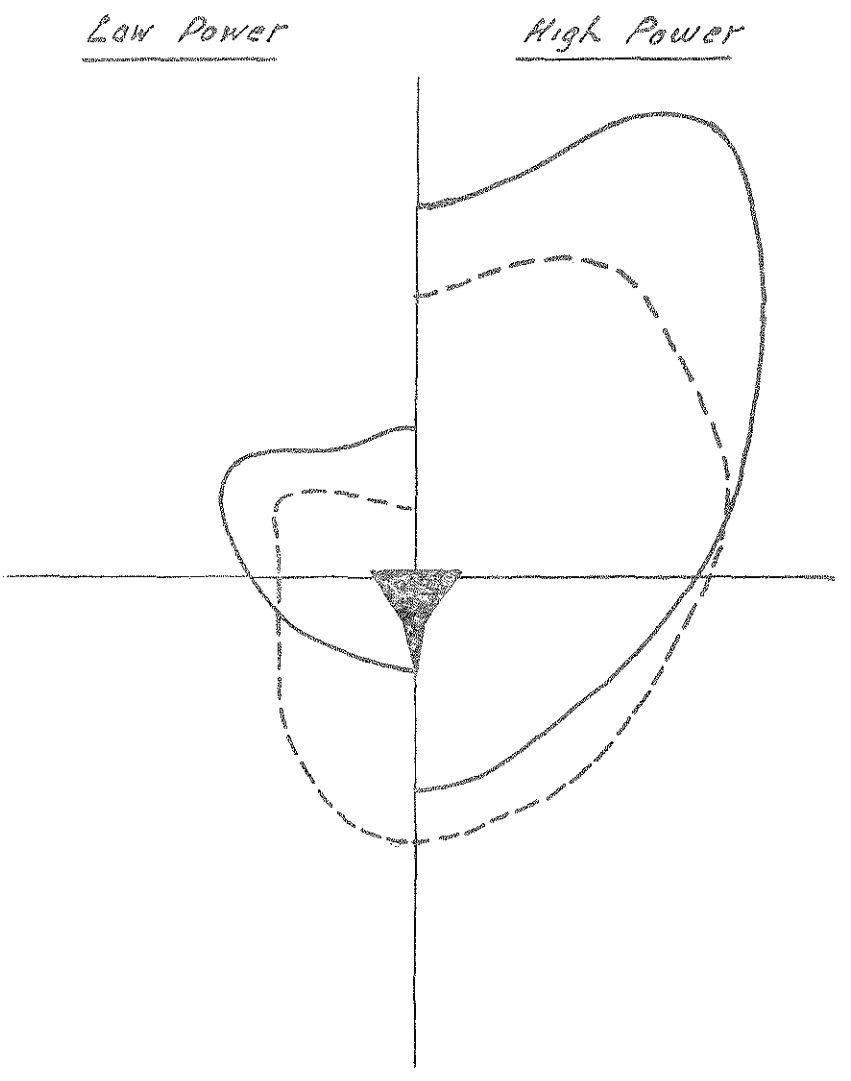
Appendix C



DIAGRAMS OF NOISE CONTOURS FROM GENERAL TYPES OF AIRCRAFT. CONTOURS SHAPES & SIZES SCHEMATIC ONLY, WITH ONLY LOWER HALF SHOWN.

Appendix D

Single Turbo-jet Engine

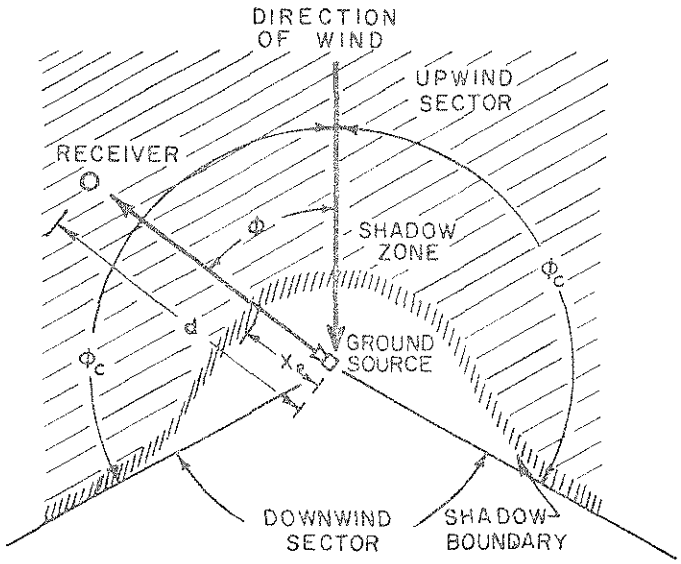


High Frequencies - - - - - - -

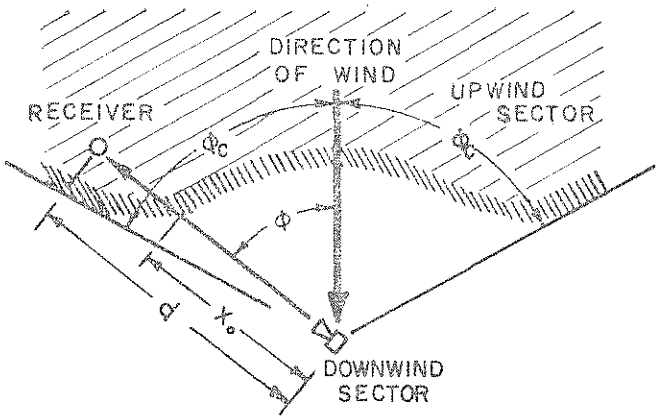
Low Frequencies ————————

Comparative Sound Levels

Appendix E

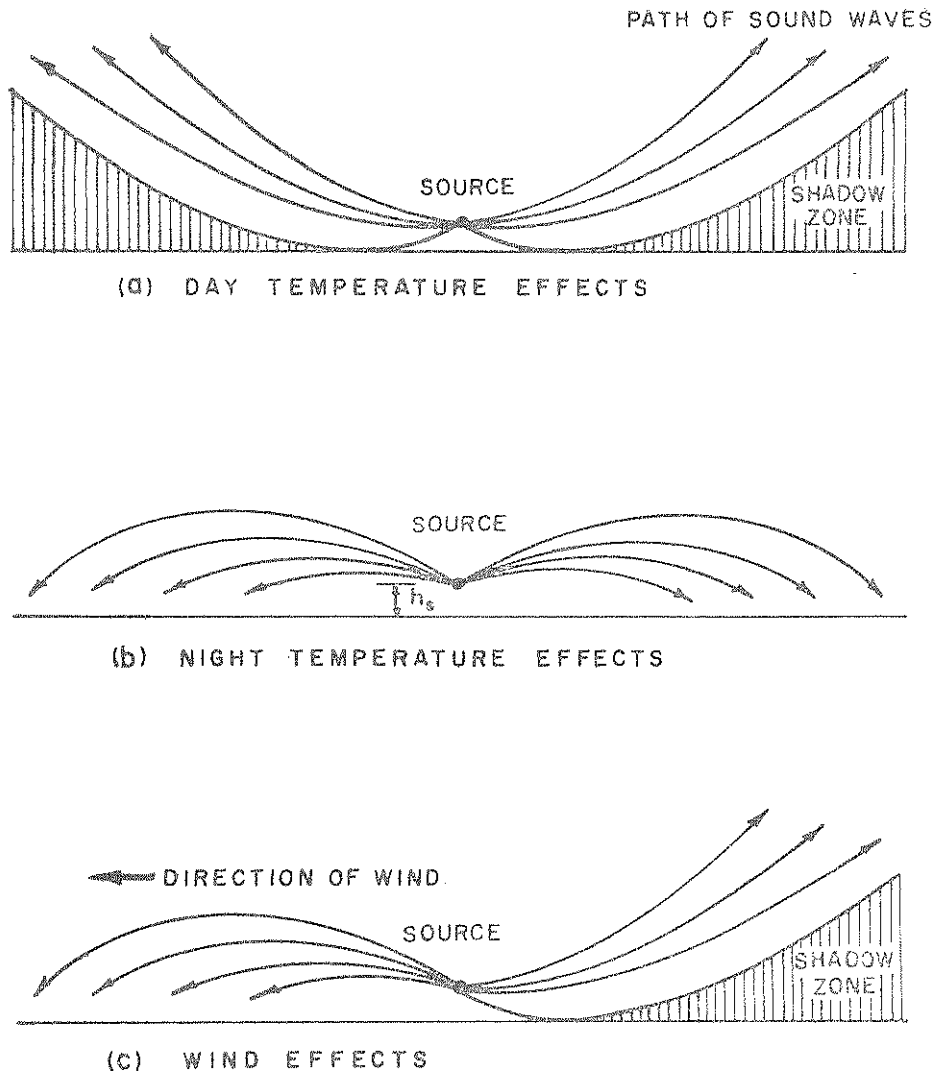


(a)



(b)

Diagrams illustrating the formation of sound shadow zones resulting from typical combinations of (a) daytime, and (b) nighttime, wind and temperature gradients.



Diagrams illustrating the effect of temperature and wind in forming sound shadow zones.

Appendix F Units and Standards used in Sound and Noise Evaluation

Units

Noise measurements can be made for many purposes but are usually related to subjective effects or judgements. The units are chosen to scale these effects and therefore are based on an approximation of human perception, which in this and other fields usually have a logarithmic relationship.

(1) THE DECIBEL

The term decibel is used in many fields when there is a need to express in a logarithmic form the ratio between two values and, strictly speaking, the kind of decibel should be stated whenever this term is used.

Even in the field of acoustics the decibel is used to express the results of measurements for:

(a) Sound Pressure Level (SPL)

(b) Sound Level

(c) Sound Power Level

(d) Sound Intensity Level.

The inclusion of the word 'Level' indicates that an arbitrary zero has been selected and, for each unit, all other levels are related to the respective zero in the manner shown in the following series of formulae:

(a) *Sound Pressure Level*

$$SPL = 20 \log_{10} \frac{p}{p_0}$$

where $p_0 = 2 \times 10^{-5}$ Newtons per square metre (N/m^2) r.m.s. (sometimes referred to as 0.0002 dynes/sq cm or 0.0002 microbar)

and p = r.m.s. pressure of the sound in question in N/m^2

See ISO Recommendation R131 1959 (E) 'Expression of the Physical and Subjective Magnitudes of Sound or Noise'.

(b) *Sound Level*

The term 'Sound Level' is used to describe measurements which allow partly for the variations in the judgement of subjective loudness for sounds of different frequencies. Measurements made using the weighting networks of the standard sound level meter (A, B and C) are referred to as 'sound levels'. The results of such measurements should be quoted in (dBA) (dBB) etc. depending on which weighting network is used.

(c) *Sound Power Level*

$$\text{Sound Power Level} = 10 \log_{10} \frac{P}{P_0} \text{ in decibels}$$

where P = the sound power in question

P_0 (reference Sound Power) = 10^{-12} Watt (1 picowatt).

See ASZ44—1969 'Expression of the Power and Intensity Levels of Sound or Noise'.

(d) *Sound Intensity Level*

$$\text{Sound Intensity Level} = 10 \log_{10} \frac{I}{I_o}$$

where I = sound intensity in question

I_o (reference sound intensity) = 10^{-12}W/m^2 (10^{-16}W/cm^2)

See ASZ44—1969 'Expression of the Power and Intensity Levels of Sound or Noise'.

(2) HERTZ

The frequency of sound (akin to sensation of pitch) is quoted in 'hertz' and this term replaces the formerly used expression 'cycles per second'.

(3) THE PHON

The subjective loudness of sound is determined by its level, frequency spectrum and time characteristics.

When loudness is expressed in logarithmic form the term 'Phon' is used and by international agreement the 'loudness level' of any sound no matter what its frequency spectrum or temporal charactertistics is the sound pressure level (SPL) of a 1,000 hertz pure tone which is judged to be of equal loudness.

Sets of curves are included which illustrate how sound pressure levels (SPL) of sounds of differing frequency are judged by 'average' ears to be equally loud.

The first set shows the equi-loudness curves for pure tones (I S O Recommendation R226—1961. 'Normal Equal-Loudness Contours for Pure Tones).

The second set shows one method for determining the equi-loudness of bands of noise and this can be extended to also include a method for calculating the overall loudness of broad-band noise (I S O Recommendation R532—1966. 'Method for Calculating Loudness Level').

(4) THE SONE (S)

Unfortunately loudness levels do not adequately scale the relative magnitudes which people use to describe the difference in loudness between sounds which differ only in intensity. Over most of the audible range 'average' persons judge an increase of 10dB in intensity to be a doubling of loudness. Similarly a halving of loudness is judged from a decrease of 10dB in intensity of sound.

This relationship extends over a wide range of intensities and for sounds of different frequency characteristics. It can be taken as a linear relationship over the range of 20-120 phon.

To express this relationship the term 'Sone' is used. The sone scale was developed to provide a numerical designation that is proportional to the subjective magnitude as estimated by normal observers for the loudness of sounds or noises. An arbitrary value of 40 phons was chosen for unity in the Sone scale and the expression:

$$S = 2^{(P-40)/10}$$

may be used to calculate the loudness in Sones from the loudness level in phons, see I S O Recommendation ISO/R131—1959 (E).

(5) SPEECH INTERFERENCE LEVEL (SIL)

To rate the difficulty of communicating either by voice or telephone or conversely to express the comfort of background noise conditions for certain activities the Speech Interference Level (SIL) is often used.

Derived initially as a simplification of a more complex method for rating communication conditions, it averages the noise level in the octave bands of the frequency spectrum which are most concerned with speech communication.

Though there is not general agreement on which octave bands are best indicators of difficulties in communication it is usual to average the noise level in the octave bands centred on 500, 1,000 and 2,000 hertz to derive the Speech Interference Level (SIL).

Standards

(1) GENERAL

To permit a logical and uniform study of the physical characteristics or effects of sound or noise it is necessary to have standards which specify basically the term, units and symbols together with the expressions which inter-relate them. For research and application to real life situations it is necessary also to standardise instruments, equipment and the techniques of measurements.

Standardisation makes an essential contribution to solution of the problems of noise by enabling the realistic specification of acoustical requirements, the settlement of legal disputes and the exchange of data on an international basis.

The main standardising organisations whose spheres of activity impinge on the problems of aircraft noise are:

(a) International Standards Organisation (ISO).
(b) International Electro-Technical Commission (IEC).
(c) International Civil Aviation Organisation (ICAO).

The Standards Association of Australia is also interested in this field as part of a general programme of acoustical standardisation.

It is difficult to decide the lines of demarcation between the interests of all these organisations as standardisation, to be effective, relies on a great deal of co-operation, but in general it would seem that ISO is responsible for conceptual matters, facts, scientific data and techniques, IEC for instrumentation performance, ICAO for matters concerning noise of civil aviation where there are international legal or economic implications and SAA to promote Australian interests internationally and to provide standards suitable for local conditions.

These organisations allot projects to committees and working groups which produce documents covering the specific subjects.

In the field of aircraft noise ISO has a particular group—WG2 of TC43/SC1—working on the measurement of aircraft noise and it is understood that ICAO is moving towards permanent arrangements to deal with the problems of aircraft noise.

Current ISO document in aircraft noise are:

- ISO Recommendation R507, Procedure for Describing Aircraft Noise around an Airport.
- ISO Doc. 520E, Draft ISO Recommendation No. 1760 Procedure for Describing Aircraft Noise around an Airport—Revision R507.
- ISO Doc. 521E, Draft ISO Recommendation No. 1761, Monitoring Aircraft Noise around an Airport.
- ISO Doc. 503, D and N-weighted Sound Levels.
- ISO/SC 1 Doc. 8, Draft Proposal for Description and Measurement of Physical Properties of Sonic Bangs.
- ISO/TC 43/SC1 (Sec. 22) 22E, Draft Proposal for Description and Measurement of Physical Properties of Sonic Bangs (Sonic Booms)—rev. of Doc. 8 above.

IEC recommendations used in this field are:

- IEC Publication 123-1961 'Recommendations for Sound Level Meters'.
- IEC Publication 179-1961 'Recommendation for Precision Sound Level Meters'.
- IEC Publication 225-1966 'Octave, Half-octave and Third-octave Band Filters, intended for the Analysis of Sound or Vibrations'.

Australian standards related to this field are:

ASZ33 Preferred Centres for Frequency Bands used in Acoustical Measurements.

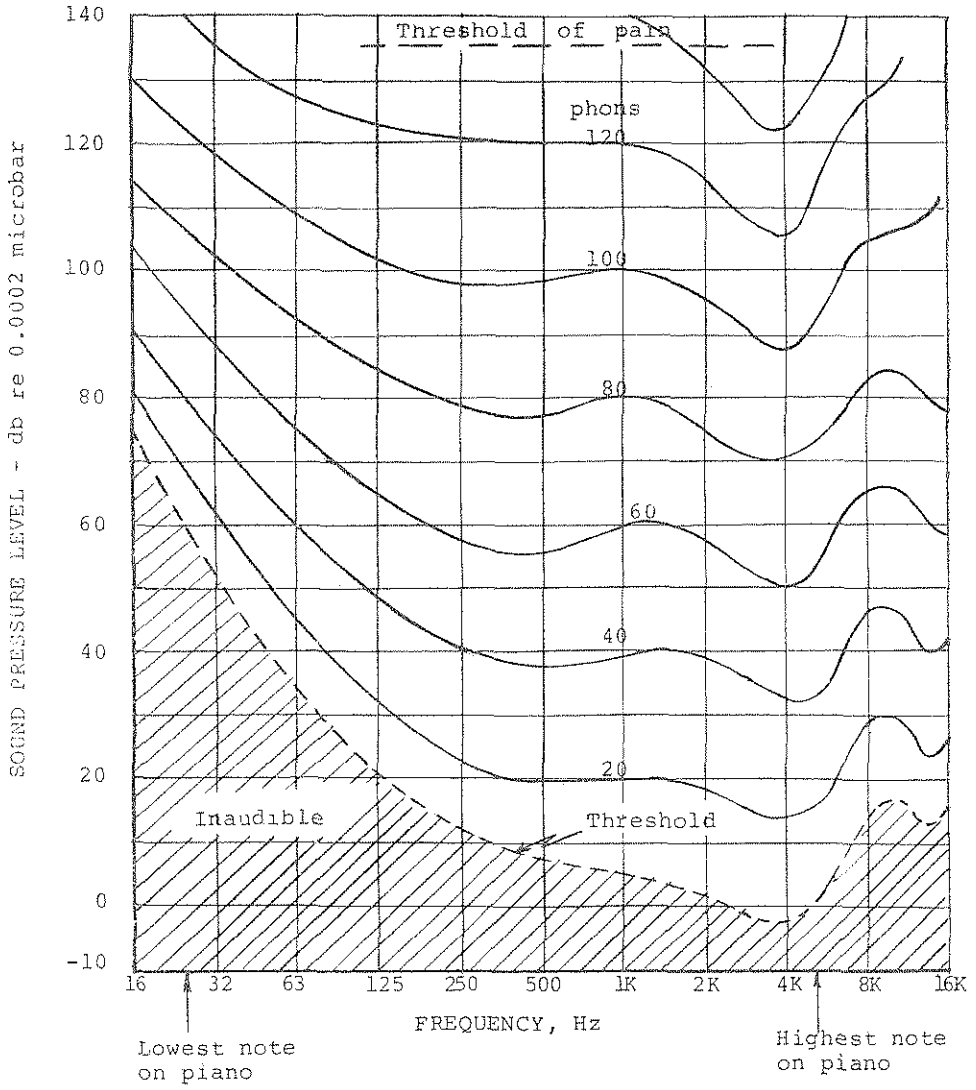
ASZ37 Sound Level Meters, Type 1, General Purpose.

ASZ38 Sound Level Meters, Type 2, Precision.

ASZ41 Octave, Half-octave and One Third-octave Band Pass Filters—Intended for Analysis of Sound and Vibration.

ASZ44 Expression of Power and Intensity Levels of Sound and Noise.

The ICAO Meeting on Aircraft Noise in the Vicinity of Aerodromes held in Montreal late in 1969 called for the standardisation of a complex procedure basically for noise certification of certain categories of aircraft. It also recommended simplified systems for monitoring aircraft noise and for land use planning. Details are available in the report of the meeting, but the systems adopted were based to a great extent on the prior work of other standardising organisations.



Appendix F—Fig. 1. Normal equal-loudness contours for pure tones, free-field listening of young ears (after Robinson and Dadson)

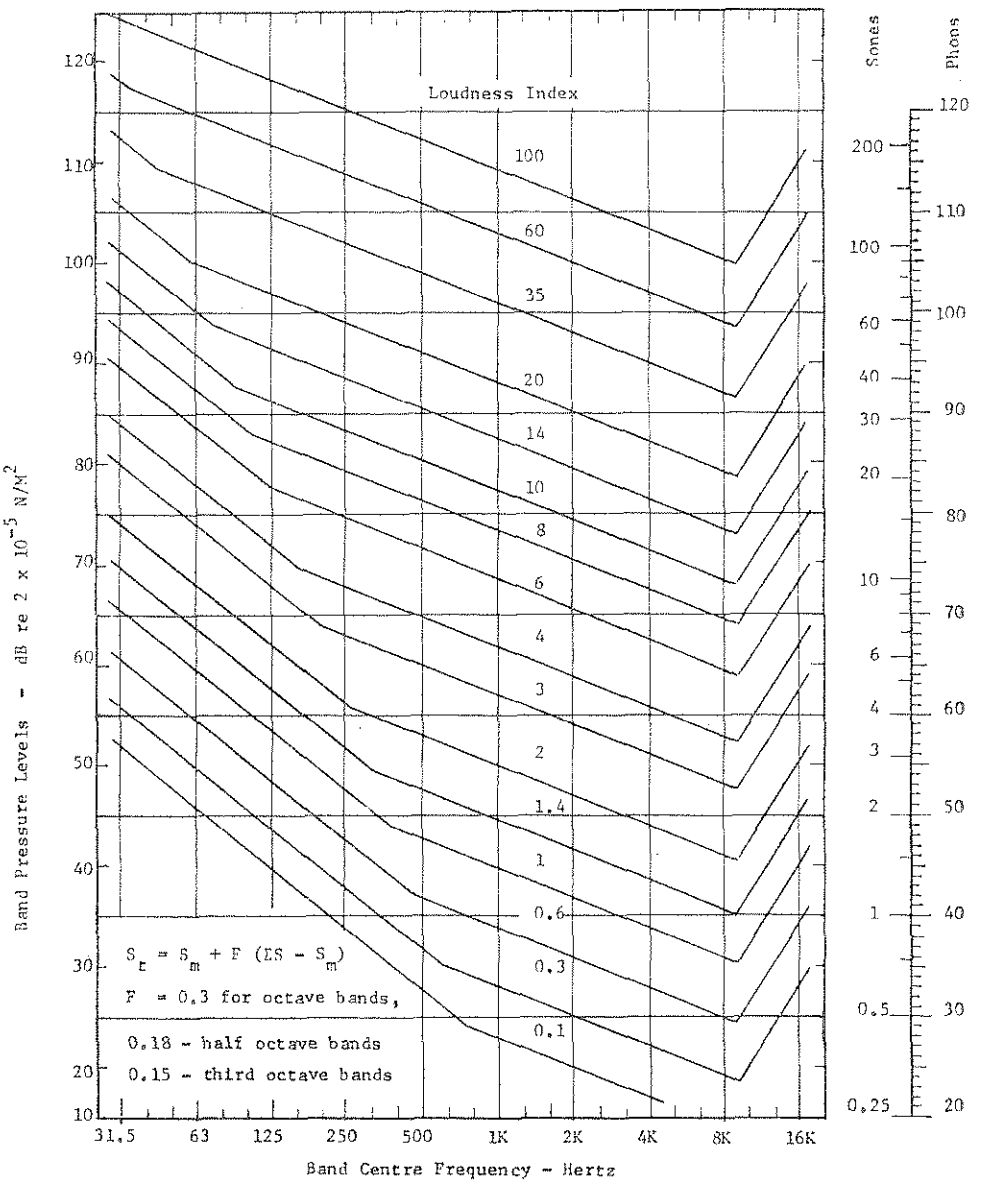
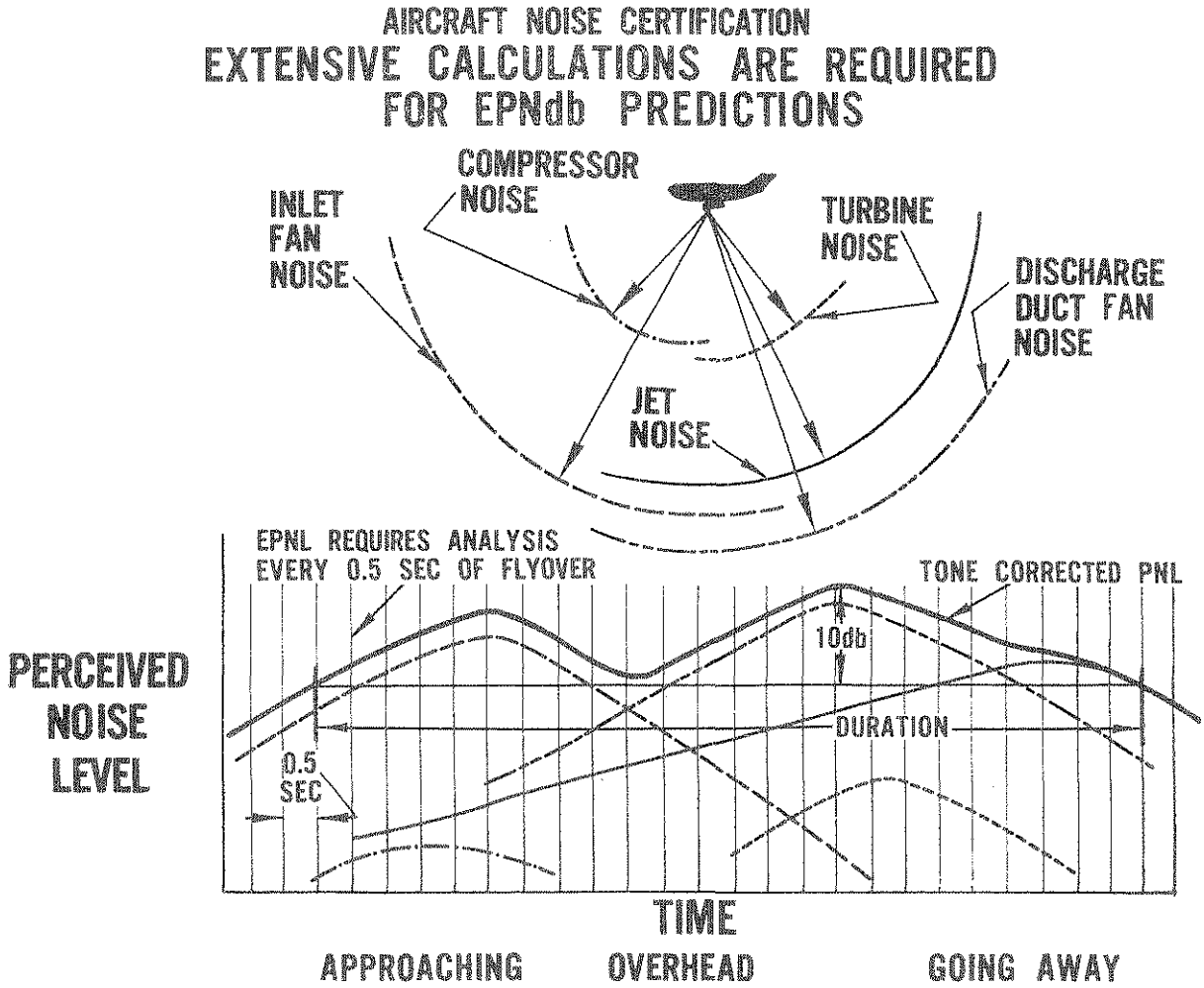


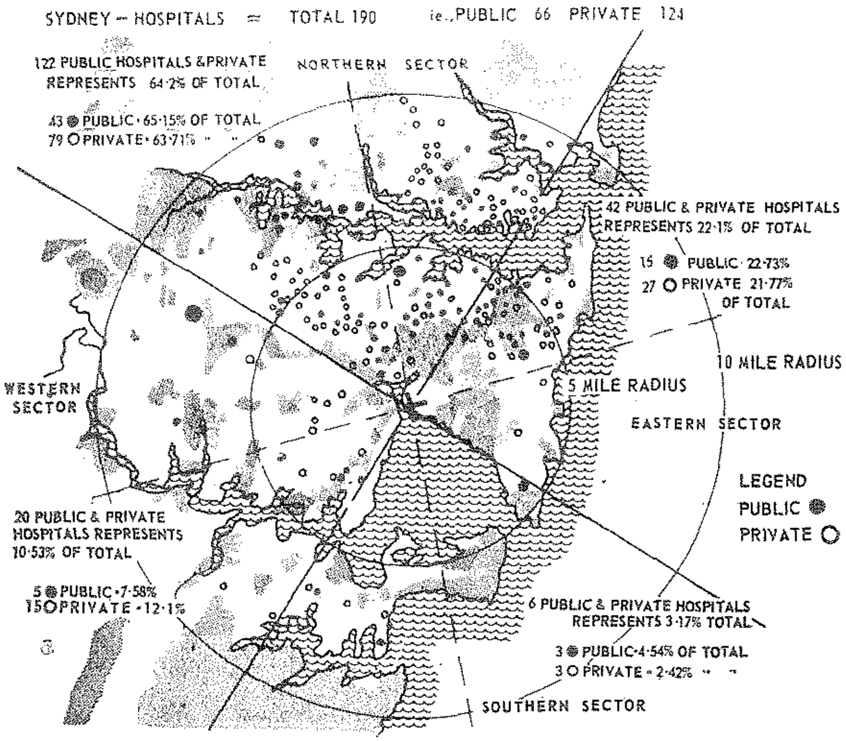
Fig. 2. Loudness level of broadband noise

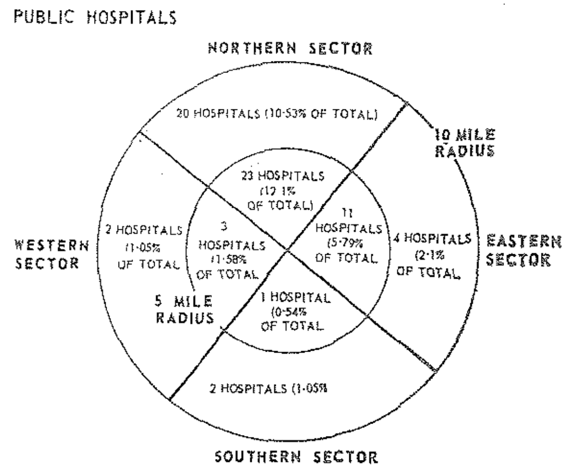
Appendix G

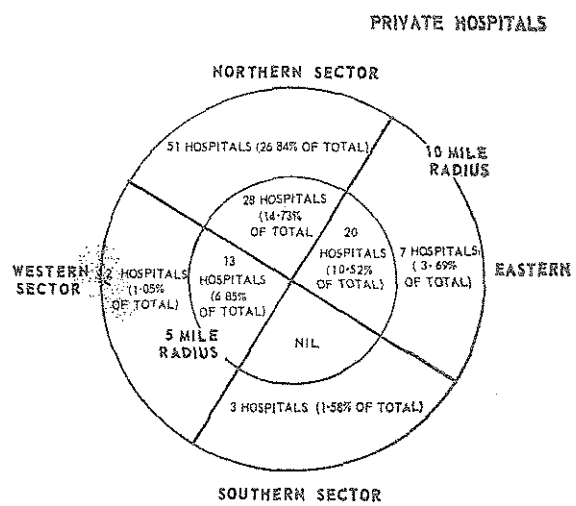

AIRCRAFT NOISE CERTIFICATION
EXTENSIVE CALCULATIONS ARE REQUIRED
FOR EPNdb PREDICTIONS
COMPRESSOR NOISE
INLET FAN NOISE
TURBINE NOISE
DISCHARGE DUCT FAN NOISE
JET NOISE
EPNL REQUIRES ANALYSIS EVERY 0.5 SEC OF FLYOVER
TONE CORRECTED PNL
10db
DURATION
0.5 SEC
PERCEIVED NOISE LEVEL
TIME
APPROACHING
OVERHEAD
GOING AWAY

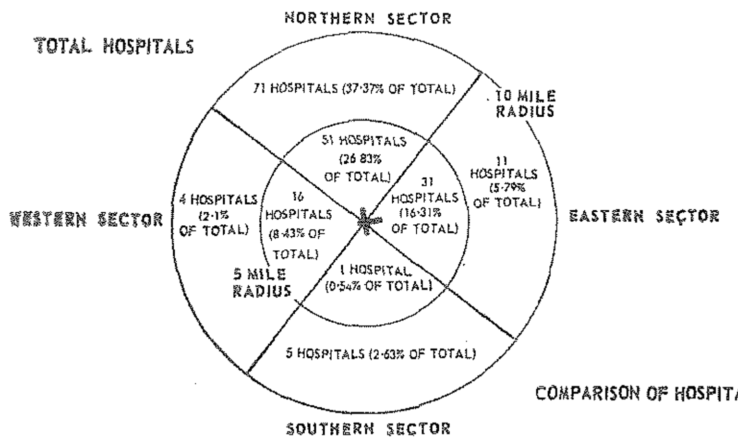
Appendix H

SECTOR ANALYSIS OF HOSPITALS SYDNEY (KINGSFORD-SMITH) AIRPORT









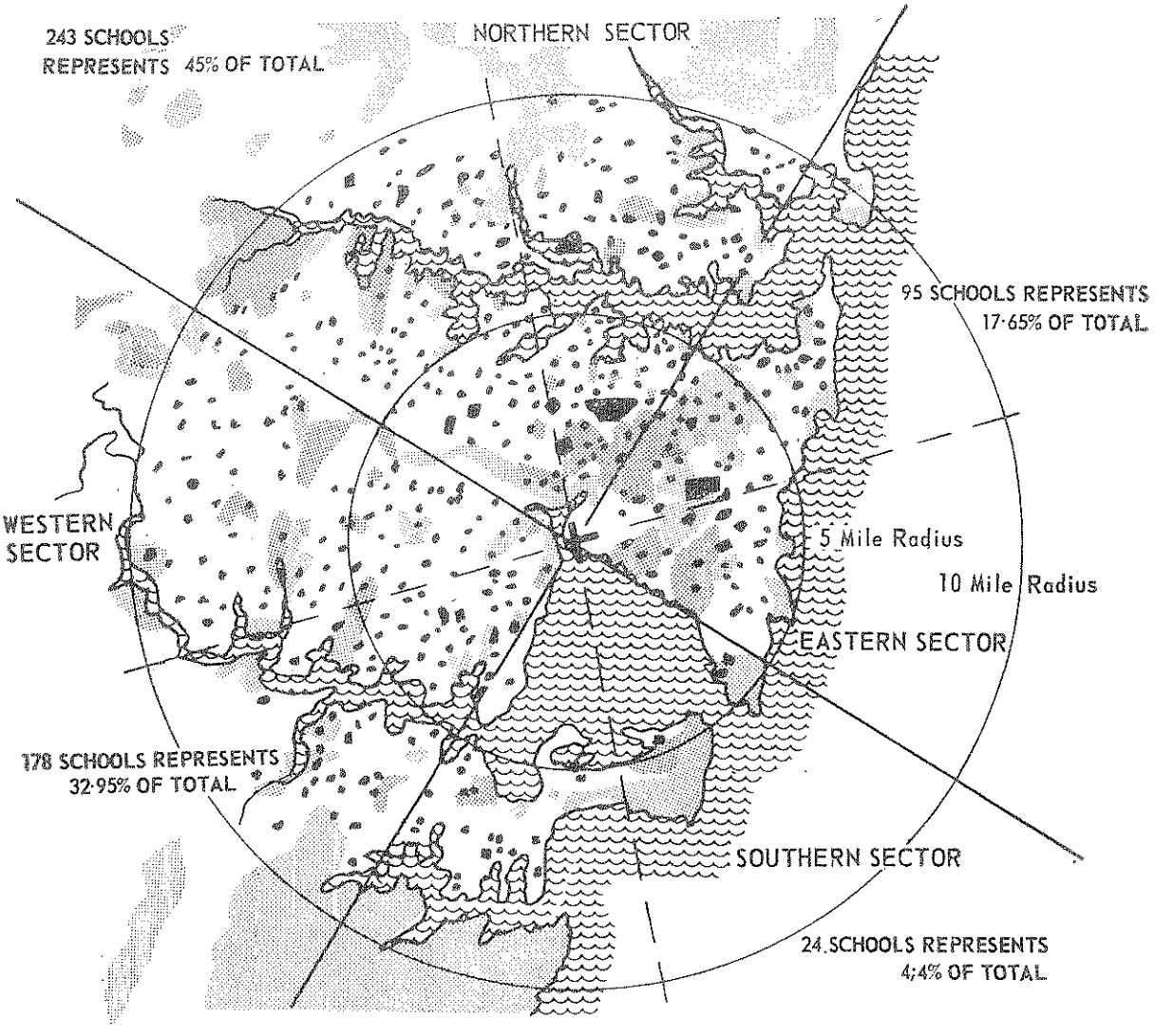
COMPARISON OF HOSPITALS within 5 miles, and within 5 and 10 miles

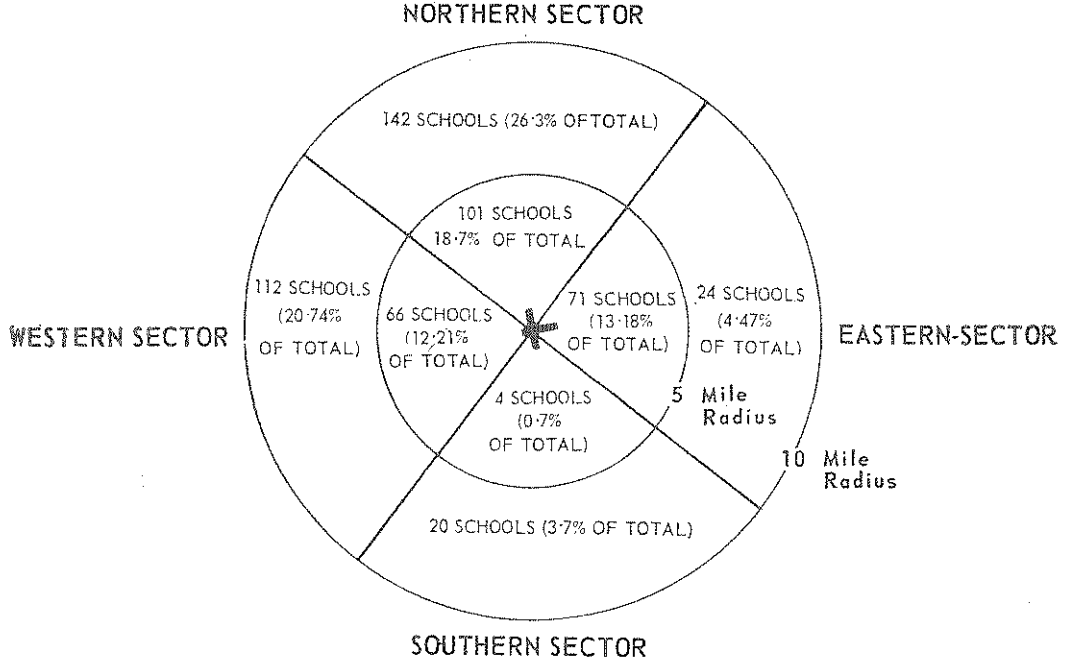
courtesy Department of Civil Aviation

Appendix I

SECTOR ANALYSIS OF SCHOOLS
SYDNEY (KINGSFORD-SMITH) AIRPORT

SYDNEY-SCHOOLS.= No. 540



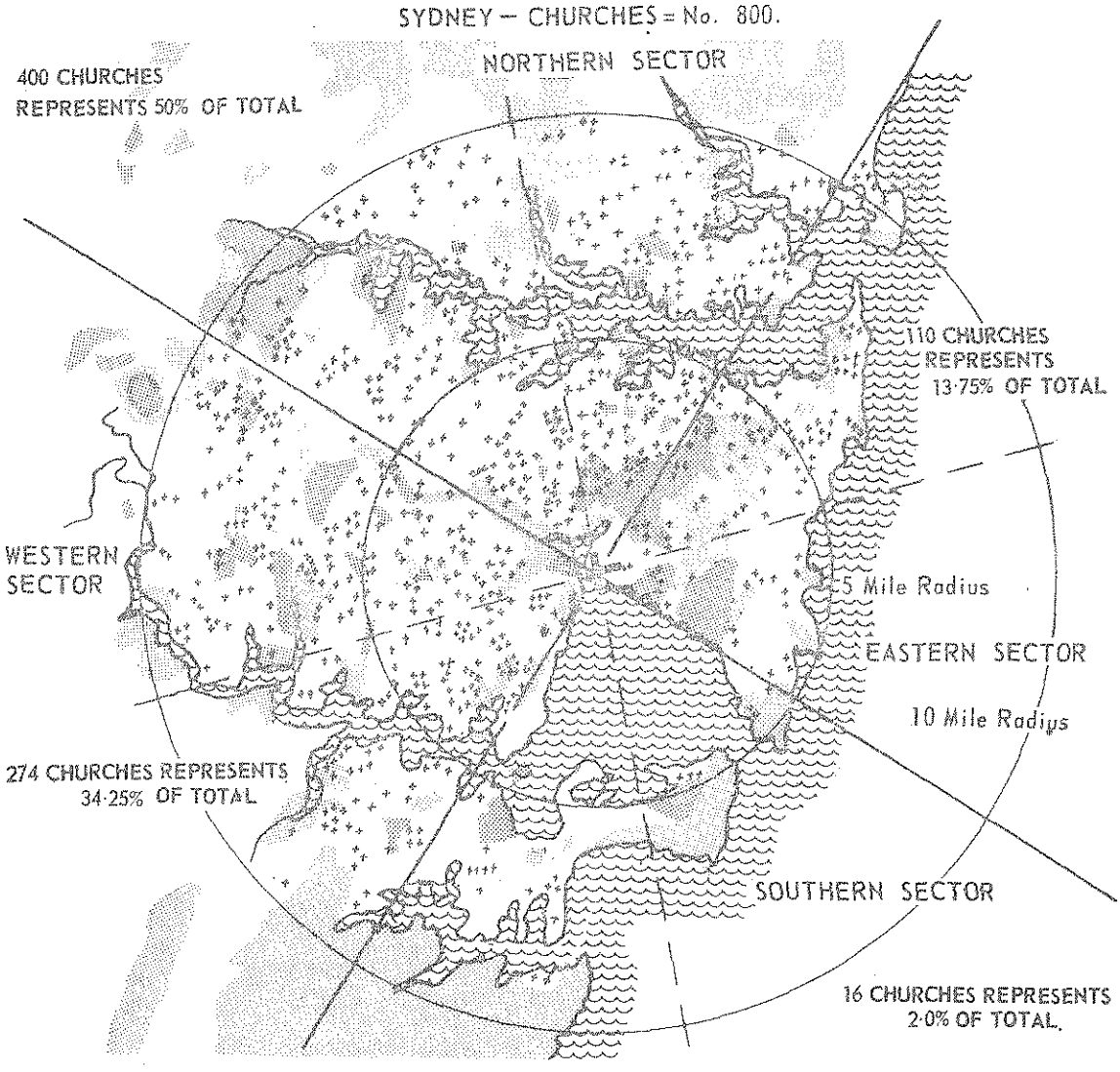


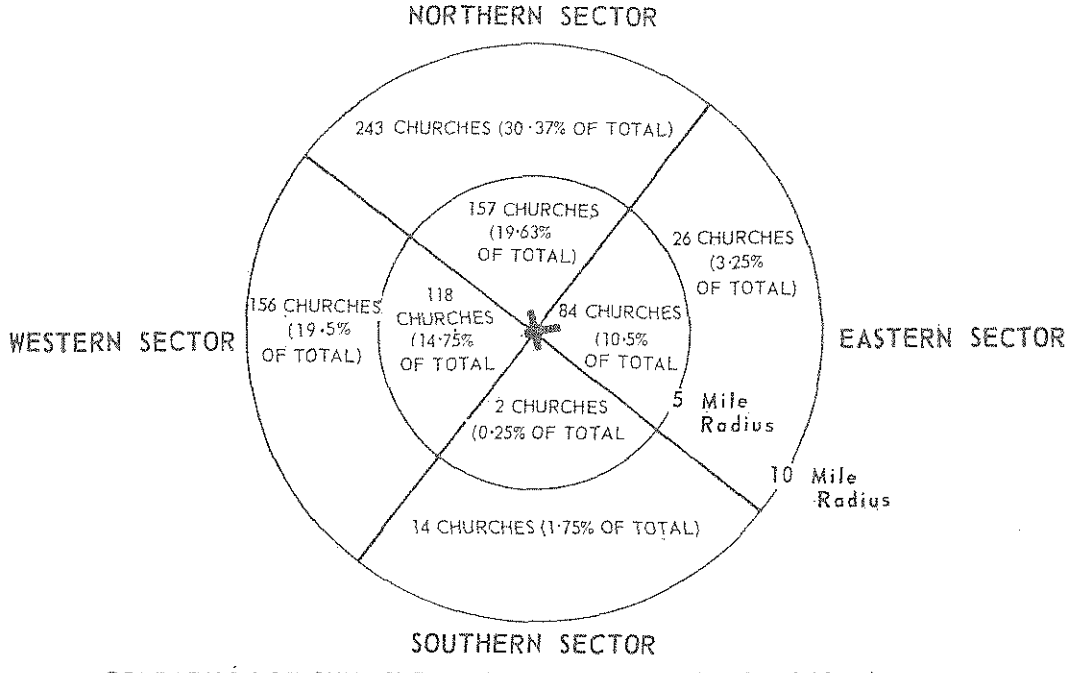
COMPARISON OF SCHOOLS within 5 miles, and within 5 and 10 miles.

courtesy Department of Civil Aviation

Appendix J

SECTOR ANALYSIS OF CHURCHES SYDNEY (KINGSFORD-SMITH) AIRPORT



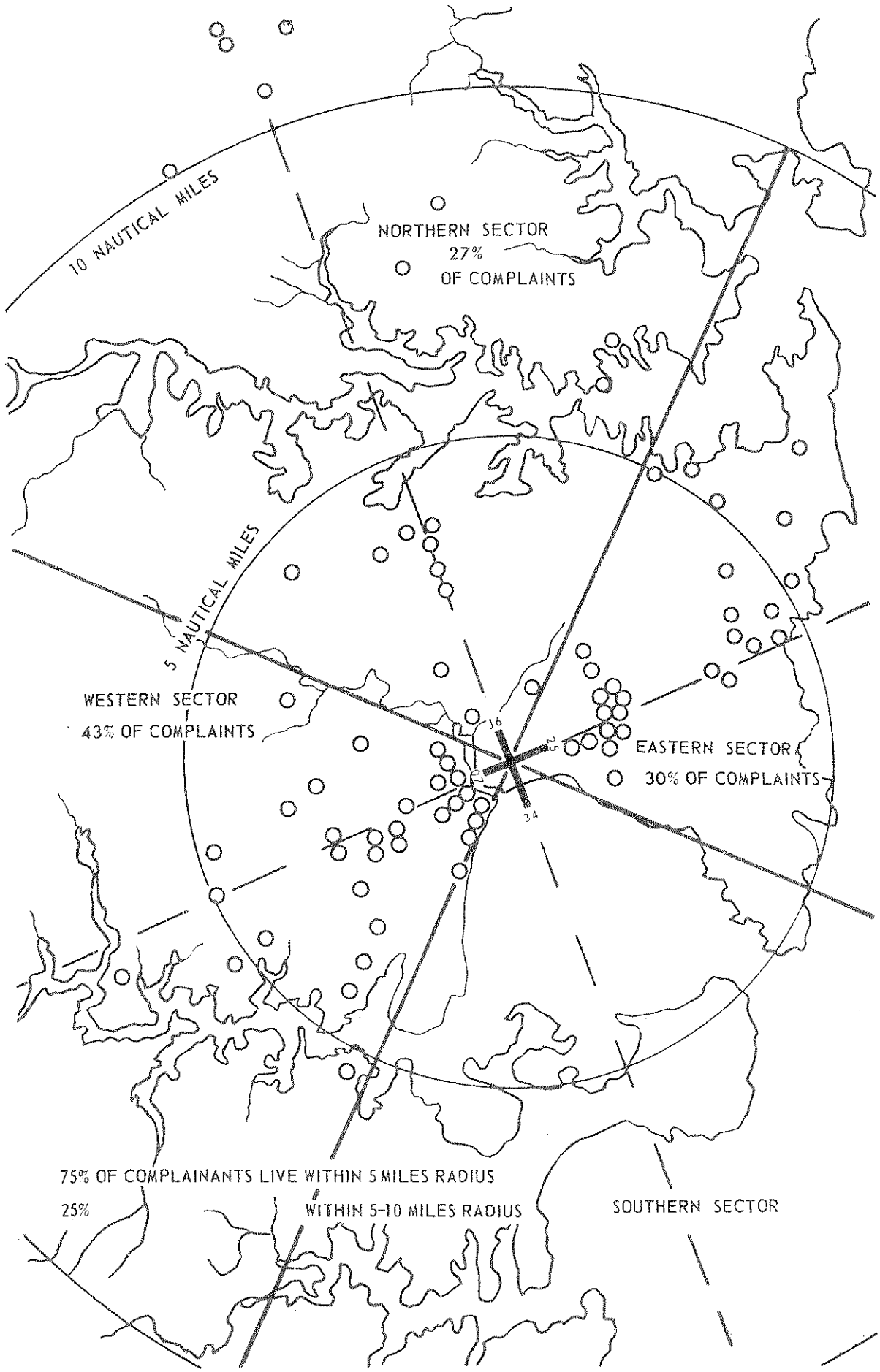


COMPARISON OF CHURCHES within 5 miles, and within 5 and 10 miles.

courtesy Department of Civil Aviation

Appendix K

SECTOR ANALYSIS OF COMPLAINTS
SYDNEY (KINGSFORD-SMITH) AIRPORT



courtesy Department of Civil Aviation

Appendix L Department of Civil Aviation Noise Nuisance Regulations

SYDNEY (KINGSFORD-SMITH) AIRPORT

NOISE NUISANCE/AIRCRAFT GROUND MAINTENANCE

The prolonged high power running of aircraft engines in the maintenance areas adjacent to terminals causes needless public complaint and considerable inconvenience generally to the conduct of the aviation industry on the Airport.

Whilst the Department accepts that it cannot prohibit all ground running for maintenance purposes between the hours of 2300 and 0500, it is satisfied that more can be done to restrict such running to a minimum consistent with safety requirements.

Therefore, as from the date of receipt of this instruction the following requirements are to apply:

(a) Aircraft engine ground running, adjacent to maintenance areas will not be permitted between 2300 and 0500.

(b) When aircraft engine ground running, for unscheduled maintenance purposes, is essential between the hours of 2300 and 0500 such running may only be performed after towing the aircraft to one of the dispersal positions shown below.

(c) To minimise the amount of ground running that may commence at 0500, aircraft scheduled for departure between 0700 and 0900 hours will not be permitted to commence running more than two hours prior to the scheduled departure time.

(d) Aircraft engine ground running, for scheduled maintenance purposes, will be restricted to that period 0500 to 2100 hours delay.

(e) Aircraft engine ground running for any aircraft scheduled for departure after 0900 hours may be done at any time after 0700 hours within the limits of this administrative order.

(f) The prolonged high power running of aircraft engines for any purpose immediately adjacent to the passenger terminals should be avoided at all times. In the case of the international terminal, such running will not be permitted at any time.

(g) Every endeavour is to be made to limit ground running of engines in the period 0500 to 1000 hours on Sunday to an absolute minimum.

The Senior Operations Controller will nominate the dispersed position to be used. As Qantas engine testing during the hours in question is now negligible, however, any such Qantas testing required, whilst being subject to the restrictions outlined herein may be done in the Qantas test bay which is acceptable as a dispersed running position. Otherwise the positions nominated by the Senior Operations Controller will be guided by the following considerations:

(i) For calm or light and variable wind conditions the dispersed running position will be 16 Run Up Bay with the nose of the aircraft pointing North.

(ii) For winds other than in (i) above anywhere from 000° to 135° the dispersed running position will be 16 Run Up Bay with the nose of the aircraft pointing into wind.

(iii) For winds other than in (i) above anywhere from 136° to 359° the dispersed running position will be 34 Run Up Bay with the nose of the aircraft pointing into wind.

As from 2300 hours 1 May 1969 each Airline Operator is to supply the following information to the Airport Manager daily for all ground running during the period 2300 to 0700 hours:

(i) time and date of aircraft ground run,

(ii) type of aircraft,

(iii) reason for run,

(iv) duration and power output used, e.g., low, medium, high,

(v) time aircraft required on schedule,

(vi) location and orientation of aircraft during engine run.

Additionally, a log of all ground maintenance running during the period 2300 to 0600 will be maintained by the Airport Fire Service who will make the information available to the Airport Manager daily.

Whilst the measures outlined above will not eliminate noise nuisance their implementation will materially help to alleviate the problem. The support of all persons in the aviation industry is therefore earnestly sought.

This instruction supersedes Section 5.3, No. 12, dated 18 April 1969.

AIRCRAFT NOISE ABATEMENT OPERATING PROCEDURES

Avoidance of Noise Nuisance (GEN. 10.1)

10.1 GENERAL

10.1.1 A preferred runway and flight path system shall be applied at Sydney (K.S.) Airport.

10.1.2 The preferred runway system shall not apply:

(a) when safety reasons, including inadequate runway lengths, demand;

(b) when the radar and/or approach aids are unserviceable. The Senior Air Approach Controller will be responsible for determining the degree to which these procedures may be varied under these conditions.

10.1.3 The preferred runway system for landing shall not apply when the cloud base is less than 2000 ft and/or the visibility is less than 4 NM.

10.1.4 The preferred runway system for take-off and landing shall not apply:

(a) when a cross wind exceeds 15 knots and/or the down wind component exceeds 5 knots;

(b) to a Department of Civil Aviation aircraft which is testing an approach aid.

10.1.5 During any period of abnormal traffic such as may be experienced in holiday periods the procedures for 0645-2100 may be applied.

10.1.6 The following procedures shall be applied at all times:

10.1.6.1 Turn requirements shall not be given by DEP (R) on his frequency to departing jet Aircraft until such time as the aircraft has passed a point two miles from the upwind end of the runway used.

10.1.6.2 Departing jet aircraft shall not be held below 3000 ft over built up areas.

10.2 **Period 2200-0645**

10.2.1 *Preferred Runway:* During this period the preferred runways are, in order:

	Take-off	Landing
	(i) Runway 16	(i) Runway 34
	(ii) Runway 07	(ii) Runway 25
equal	(iii) Runway 52 and 34 equal	(iii) Runway 07 and 16

10.2.2 Aircraft shall be delayed as necessary to comply with the preferred runway in use.

10.2.3 *Preferred Flight Paths:* Arriving aircraft shall be directed over less sensitive noise areas.

(See Attachment)

Jet Aircraft shall not be permitted to descend below 3000 ft, and other aircraft exceeding 12,500 lbs all-up weight not below 2000 ft, over built-up areas until aligned with the runway centre line at the 'gate' to the various runways.

10.2.4 Departing aircraft shall be directed over less sensitive noise areas.

(See Attachment)

10.2.5 Departing jet aircraft shall climb straight ahead at a speed not exceeding plus 20 knots (or such other speed approved by the Department) or limiting body angle using take-off thrust to a height of 1200 ft (International) or 1000 ft (Domestic).

10.3 **Period 1900-2200**

10.3.1 Whenever possible the procedures for the period 2200-0645 shall be applied for any sequence of traffic offering.

10.3.2 The preferred runway system shall not apply when the average delay to individual aircraft in the sequence would exceed 5 minutes.

10.3.3 The preferred flight path system shall be applied to arriving International Jet Aircraft during this period and to other aircraft as controller work load permits.

10.3.4 The procedures for the period 0645-1900 shall apply in other circumstances.

10.4 **Period 0645-1900**

10.4.1 Preferred Runway—Departing aircraft take precedence over arriving aircraft in the selection of a preferred runway. A runway is not usable for landing aircraft when the opposite direction runway is in use for departing aircraft.

(a) *Departing Aircraft*

(i) Runway 16 shall be used by all aircraft other than piston engine aircraft below 12,500 lb all-up weight whenever this runway is usable having regard to the conditions stated in para. 10.1.2 to 10.1.4.

(ii) During the heavier traffic periods aircraft other than international aircraft may be directed to use another runway as follows:

(a) Runway 25—aircraft bound for western and northern ports.

(b) Runway 07—aircraft bound for eastern, western and northern ports.

(iii) When Runway 16 is not usable for departing aircraft no special procedures apply in respect of other runway preferences. The normal traffic requirements will usually mean that Runways 07, 25 and 34 in that order will be in use.

(b) *Arriving Aircraft*

(i) Control procedures for aircraft other than piston engine aircraft below 12,500 lb all-up weight shall ensure that the runway affording a straight-in approach shall be used having regard to the conditions in paras. 10.1.2 to 10.1.4 and 10.4.1.

(ii) When a straight-in approach is not possible the landing runway shall be selected having regard for the conditions in paras. 10.1.2 and 10.1.4 to 10.4.1 on the basis of the least flight time for the pilot and the minimum traffic confliction as follows:

(a) *Arrivals from the south-west:*
(Runway 07 not usable)
Runway 16, 34 or 25 in that order.

(b) *Arrivals from the north:*
(Runway 16 not usable)
Runway 07, 25 or 34 in that order.

(c) *Arrivals from the east:*
(Runway 25 not usable)
Runway 16, 34 or 07 in that order.

10.4.2 **Preferred Flight Paths**

10.4.2.1 *Departing Aircraft*—At Controller discretion when work load permits, the following procedure shall apply to other than piston engine aircraft below 12,500 lb all-up weight.

(i) *Runway* 16—Turn right heading 170 to 5 NM or until reaching 3000 ft (turbo-jets) or 2000 ft (others) whichever is first reached.

(ii) *Runway* 07—Northern Departures—track 072 until the coastline thence along the coast until reaching 3000 ft—jet aircraft—or 2000 ft for other types.

10.4.2.2 *Arriving Aircraft*—The preferred flight path stated in para. 10.2.3 shall be applied to International jet aircraft.

10.5 **Training Flights**

10.5.1 Conditions governing training at Sydney shall be as follows:

(i) Training is permitted at Sydney only between 0645 and 1900 Monday to Saturday inclusive except that airwork may be conducted at any time provided the training is not over built-up areas. Training on the approach aids shall not continue for more than one hour during any one period.

(ii) No asymmetric training is permitted below 1500 ft over built-up areas except as set out in para. 10.5.1 (iv).

(iii) Practice descents on approach aids shall be confined to Instrument landing system or Localiser training.

(iv) Asymmetric practice descents on ILS or Localiser aids to the minima specified for such aids may be carried out provided that in the simulated failure the engine is not shut down.

(v) At any time arriving RPT (Regular passenger transport) and Charter aircraft may be permitted to carry out a practice ILS or LOC approach at the conclusion of each leg of flights to Sydney provided that:

(a) The Pilot-in-Command has stated that the approach is required for licence renewal purposes, or

(b) The aircraft lands straight ahead and does not use other than the runway currently in use merely for the purpose of carrying out the practice.

(vi) Examiner of Airmen Test and Check Flights on any of the aids in the Sydney Terminal Area. (These flights are subject to appropriate warning and to traffic handling capacity).

(vii) Airline Companies may carry out *aircraft* checking and testing flights, other than under asymmetric conditions, on Runway 16, but these will be limited to two circuits by any one company in one day.

(viii) All training is at the S.A.A.C.'s discretion as traffic and work loads permits.

10.5.2 Military aircraft on practice ILS or LOC approach must intercept the aid at or above 3000 ft.

10.5.3 Visual Flight Rules and Night Visual meteorological conditions category shall not be permitted to make practice ILS or Localiser approaches unless VMC exists from ground level to 3000 ft.

10.5.4 Aircraft not intending to land straight ahead at the conclusion of an approach will carry out the following procedure:

(i) *RUNWAY* 07

(a) Climb straight ahead until reaching 1200 ft,
or

(b) when over the centre of the aerodrome turn right over Botany Bay climbing to a minimum of 1200 ft before crossing the western shore of the Bay.

(ii) *RUNWAY* 16

(a) Climb straight ahead until reaching 1200 ft,
or

(b) turn left over the industrial and open land to the north of the Airport.

10.6 Scheduled Civil Jet Operations

10.6.1 Airline Companies are not permitted to schedule turbo-jet operations at Sydney Airport during the hours 2230-0600 without prior approval of the Regional Director.

10.6.2 Controllers will accept that schedules showing arrivals and/or departures during these hours as having this approval.

10.6.3 Off-schedule civil turbo-jet movements operating to or from Sydney Airport between the hours 2230 to 0600 require the prior approval of the Airport Manager or his deputy.

10.7 Complaints

10.7.1 Details of noise nuisance complaints received from the public, shall be recorded on a pro forma made available in Operations and this shall be forwarded to the Airport Manager. The complainant shall be advised that the matter will be referred to the Airport Manager for subsequent action.

10.7.2 The Airport Manager shall be informed of all turbo-jet operations which land or take off between the hours of 2300 and 0600. (A standard pro forma is available for this purpose).

10.8 Variations to Procedures

10.8.1 The Superintendent of Operations [S.O.] is responsible for the over-all policy in respect of these procedures. Any requests for variation should be handled by the SOC (as representative of the Superintendent of Operations) in respect of all matters other than requests falling into the category specified in para. 10.6.3 above. Any major variation to procedures should be referred to Superintendent of Operations prior to reaching a decision. In his absence, the SOC will make any necessary decisions on his own initiative.

ATTACHMENT 'A'

DEPARTURES—RADAR SERVICEABLE

Runway	Northbound	Southbound	Westbound	Eastbound
16 *See Notes	Turn right heading 170 to 5 nautical miles then left turn onto 090 to 2 nautical miles east of the coast then intercept the 022R at 15 nautical miles	Turn right heading 170 to 7 nautical miles then intercept the 195R or 219R at 10 nautical miles	Turn right heading 170 to 5 nautical miles then left turn onto 090 to climb over water to 3,000 ft (jets) or 2,000 ft (other types) left or right turn to intercept departure track	Turn right heading 170 to 5 nautical miles then turn left onto 090 to 2 nautical miles east of coast, then intercept departure track at 15 nautical miles
34	Maintain runway heading to 5 nautical miles then turn onto track	Maintain runway heading to 5 nautical miles then turn onto track	Maintain runway heading to 5 nautical miles then turn onto track	Maintain runway heading to 5 nautical miles then right turn onto track
07	Track 072 until 2 nautical miles east of coast then intercept the 022R at 15 nautical miles	Track 072 until 2 nautical miles east of coast then track off coast to abeam Kurnell then intercept the 195R or 219R at 20 nautical miles	Track 072 until east of coast then climb over water until reaching 3,000 ft (jets) or 2,000 ft (other types) then turn right onto track	Track 072 until east of coast then turn to intercept departure track by 15 nautical miles
25	Left turn then through Botany Heads to 2 nautical miles east of coast then intercept 022R at 15 nautical miles	Maintain runway heading to 5 nautical miles then left turn to indercept the 219R at 10 nautical miles or 195R at 15 nautical miles	Maintain runway heading until 5 nautical miles then right turn	Left turn then through Botany Heads to 2 nautical miles east of coast then turn to intercept departure track by 15 nautical miles

* NOTES: (i) When an arriving aircraft is awaiting landing on Runway 34, the departing aircraft may be instructed to commence turn at 3 nautical miles.

(ii) Departing aircraft proceeding north, west or east may be turned before 5 nautical miles provided they have reached 2,000 ft or 3,000 ft as applicable.

ATTACHMENT 'B'

DEPARTURES—RADAR UNSERVICEABLE

Runway	Northbound	Southbound	Westbound	Eastbound
16	Left turn to intercept the 039R	Right turn to intercept the 195R ..	Left turn onto 090 and reach 3,000 ft (jets) 2,000 ft (other types) before turning left to intercept departure track	Left turn
34	Maintain runway heading to 5 nautical miles then right turn	Right turn to intercept the 195R	Left turn	Right turn
07	Track 072 to 5 nautical miles then intercept the 039R by 10 nautical miles	Right turn to intercept the 195R	Track 072 and reach 3,000 ft (jets) 2,000 ft (other types) before turning right to intercept departure track	Track 072 to 5 nautical miles then turn to intercept departure track by 15 nautical miles
25	Left turn to intercept the 039R	Maintain runway heading to 5 nautical miles then left turn to intercept the 219R	Maintain runway heading to 5 nautical miles then right turn	Left turn

ATTACHMENT 'C'

ARRIVALS—RADAR SERVICEABLE

Runway	South-West	North	Eeast
16	Vector west of Bankstown and Parramatta	Radio Navigation Chart route ..	Vector east of coast to North Head
34	Vector via Engadine and Port Hacking	Vector via Calga, Barrenjoey then east of coast to Kurnell	Vector via Kurnell
07	Radio Navigation Chart route ..	Vector West of Parramatta and Bankstown	Vector via Kurnell
25	Vector via Kurnell thence east of coast to final	Vector via Calga, Barrenjoey then east of coast to final	Vector to final east of coast

NOTE: There are no special routes for arriving aircraft when the radar is unserviceable. Circuit directions should be consistent with the general noise abatement procedures.

REGULATIONS AT ESSENDON AIRPORT

A. GROUND RUN-UP NOISE ABATEMENT PROCEDURES

Airport	'Enclosed' engine test cells	Open air piston engine test bays	In-frame turbo jet planned maintenance	In-frame turbo jet fault correction	In-frame prop jet and piston engine planned maintenance	In-frame prop jet and piston engine fault correction	Compass swinging	Remarks
Essendon	No restriction	0700–2100 Monday to Saturday otherwise seek Airport Manager approval	0500–2100 daily but where possible delay to 1000 Sundays	0500–2300 otherwise limited to one hour per operator*	0500–2300 daily but where possible delay to 1000 Sundays	0500–2300 otherwise limited to one hour per operator*†	0600–2300	*Requires engineering management approval and runs recorded if outside 0500–2300 †With aircraft not required for service before 0900 delay engine test to ETD less two hours

DRAFT FUTURE AIRCRAFT NOISE ABATEMENT ARRANGEMENTS: GROUND ENGINE RUNS

Airport	'Enclosed' engine test cells	Open air piston engine test bays	In-frame turbo jet planned maintenance	In-frame turbo jet fault correction	In-frame prop jet and piston engine planned maintenance	In-frame prop jet and piston engine fault correction	Compass swinging	Remarks
Essendon	No restriction	Weekday daylight in designated remote airport areas	0700–2000 but where possible delay to 1000 Sundays	0700–2000 other wise limited to one hour per operator*	0700–2000 but where possible delay to 1000 Sundays	0700–2000 otherwise limited to one hour per operator*	0700–2000*	*Requires engineering management approval and runs recorded if outside 0700–2000

B. AIRCRAFT NOISE ABATEMENT OPERATING PROCEDURES AVOIDANCE OF NOISE NUISANCE

1 General

1.1 The following are the noise abatement procedures for Essendon Airport. Any departure, whether due to pilot request or Air Traffic Control convenience, from these procedures must be notated in the appropriate Airways Operations Journal by the officer initiating or approving such procedure.

2 Operations

2.1 Runway nomination for noise nuisance consideration

2.1.1 The runway nominated for take-off and landing shall be in accordance with the following:

(a) runway 26 is the primary runway as regards avoidance of noise nuisance and should be used whenever possible. A down wind of 5 knots is considered suitable. Requests to use runway 08 for operational reasons shall be granted;

(b) when the crosswind component is above 15 knots all aircraft shall be offered the runway nearest into wind;

(c) when the crosswind component is between 6 and 15 knots on runway 08/26 all turbo jet aircraft and other types in excess of all-up-weight of 40,000 lbs shall normally be required to use runway 26. Other aircraft shall use the runway nearest into wind;

(d) when the crosswind component is less than 6 knots all aircraft other than light aircraft shall normally use runway 26;

(e) when runway 26 is in use landing aircraft, when traffic conditions permit, may be offered the use of runway 17 providing the track would not involve a greater distance over built-up areas than if the landing was conducted on runway 26.

NOTE—The above procedures do not preclude the use of runway 17/35 when sun glare is excessive on the other runway, or delays in excess of five minutes would result in respect of aerodrome works etc.

2.1.2 Between the hours of 1300 and 2000 Air Traffic Control will instruct departing aircraft using runway 08/26 to turn right or left after take-off so that aircraft avoid the noise sensitive areas to the south of the field. The turns to be specified are as follows:

Runway 08 All turns to be left

Runway 26 All turns to be right

Aircraft proceeding on the 160° DIV are to set course not below 2000 over the field, or when departing runway 26 may maintain heading to 2000 and then turn left.

2.2 Restrictions on Turbo-jet take-offs and landings

2.3.1 Circuits and landings are not permitted.

2.3.2 Except for B727 simulated engine failure any other exercise requiring introduction of emergency conditions during take-off or landing is not permitted.

2.3.3 Repetition ILS approaches are permitted between 2100 and 1200.

2.3.4 Traffic permitting and without a request for a holding pattern by the pilot, aircraft on training ILS approaches shall be routed for a normal right circuit.

2.4 Scheduled early morning Perth/Essendon flights

2.4.1 Aircraft on these flights are not permitted to pass the threshold of the runway in use before 1955 unless operational reasons such as extraordinary high and unforecast tail winds dictate otherwise.

2.4.2 Unless there is a need for a very urgent check, a practice ILS approach shall not be used as a means of absorbing time before landing. Notice of the urgent need should be given prior to reaching YWE so that A.T.C. can ensure that the other aircraft in the sequence is not inconvenienced by the practice ILS approach.

2.4.3 Pilots-in-command and the operating companies are responsible for the observance of the considerations.

2.4.4 ATC is responsible for accommodation of pilot requests for delaying action and, where traffic, operational and weather conditions permit, routing the aircraft on tracks which provide for the minimum of time over the built-up areas i.e.

Runway 26 Right circuit

Runway 08 Left circuit or straight-in if acceding to a pilot's request.

2.5 **Restrictions to South East built-up area**

2.5.1 Between the hours of 1300 and 2100 the following restrictions shall apply:

(a) Inbound aircraft shall proceed Wonthaggi-Plenty-Essendon.

(b) Outbound aircraft shall proceed on the 160 Radial for 20 miles thence direct Cowes.

2.6 **Public Gatherings**

2.6.1 When requested, aircraft shall be diverted around public functions such as Music for the People in order to eliminate noise nuisance.

3 **Ground Running**

3.1 Application of the avoidance of noise nuisance policy with respect to ground running, is the responsibility of the operators.

3.2 The running of aircraft engines associated with compass swinging shall be restricted to the period between 2000 and 1300 daily.

COMPASS SWINGING B727 AIRCRAFT

1. (a) The existing compass swinging base on the southern end of 04/22 runway can be used for B727 aircraft.

(b) The companies have been advised that the AUW of the aircraft is not to exceed 112,000 lbs. and the tyre pressure is not to be more than 135 pounds per square inch.

(c) Should pavement damage become excessive then the use of this area should be discontinued.

DAMAGE TO PUBLIC PROPERTY

1. (a) When a report is received by any officer that public property has been damaged by aircraft flying in the vicinity of the aerodrome the following action is to take place.

(b) All complaints of alleged damage in respect of dislodged tiles or in any other form should be referred to the Airport Manager for further investigation and consideration and care should be exercised to ensure that there is no inference as to an acceptance of liability.

(c) The question of this alleged damage is a delicate one and staff should not hesitate to contact the Airport Manager at any time and make him aware of the facts as early as possible.

NOISE COMPLAINTS

1. In the event of any noise nuisance complaints being received by operations outside the normal hours of the Airport Manager the Senior Operations Controller shall record all relevant details on the complaint form and advise the

person concerned that the Airport Manager will consider the matter when he resumes duty. Controllers shall not become involved in detail other than that of accepting the complaint.

BRISBANE AIRPORT, QLD—NOISE ABATEMENT PROCEDURES

0 INTRODUCTION

0.1 The following noise abatement procedures are effective at Brisbane Airport as from 1st January 1970.

1 PREFERRED RUNWAYS

1.1 The preferred runways which are applicable to jet aircraft and all other aircraft over 12,500 lb maximum AUW are:

TAKE-OFF—Runway 04

LANDING—Runway 22

1.2 Aircraft will be delayed as necessary to comply with the preferred runways *except for the following reasons:*

(A) Safety;

(B) In conditions of low cloud, thunderstorms and/or poor visibility;

(C) When the crosswind exceeds 10 knots and/or the downwind component exceeds 5 knots.

2 PREFERRED FLIGHT PATHS

2.1 **Arriving Aircraft**

(A) *Landing Runway 22.*

Aircraft from the south can expect to be instructed to track for a left base. Aircraft from the north can expect to be instructed to track for a right base. Should a right base be unavailable, aircraft will be instructed to overfly for a left base.

(2) *Landing Runway 04.*

Aircraft from the south can expect to be instructed to track for a right base or a direct approach. Should either be unavailable, aircraft will be instructed to overfly for a right base. Aircraft from the north can expect to be instructed to overfly for a right base.

2.2 **Departing Aircraft**

(A) *Take-off Runway 22.*

Except for traffic and/or weather reasons, right turns are not permitted. When a right turn is authorised it shall not be commenced until 3 DME Brisbane.

(B) *Take-off Runway 04.*

Except for traffic and/or weather reasons, left turns are not permitted for southbound aircraft.

2.3 ATC may vary preferred flight paths as required by weather and/or traffic conditions.

3 CURFEW—JET MOVEMENTS

3.1 Jet aircraft operations are not permitted at Brisbane Airport between 2300 and 0600 and without the specific approval of the Regional Director or the Superintendent of Operations. This includes the departures of jet aircraft which have landed using Brisbane as an alternate.

3.2 Mercy flights and the planned or unplanned use of Brisbane Airport as an alternate are excluded from this restriction.

3.3 Approved southbound jet flights within curfew hours will be required to accept radar vectoring clear of coast until abeam of Redland Bay.

4 TRAINING FLIGHTS

4.1 Circuit training will be permitted at Brisbane Airport only between 0700 and 2180 and is limited to Runway 04—right circuits, Runway 22—left circuits, Runway 13—left circuits and Runway 31—right circuits.

4.2 No jet flying training, except that authorised in paragraph 4.3 is permitted without the specific approval of the Superintendent of Operations.

4.3 Practice ILS/LLZ approaches by civil or military jet aircraft are permitted subject to prior arrangements and observance of the following:

(A) Between the hours of 0800 and 2130;

(B) All aircraft shall break at the Myrtle locator on completion of each approach and re-position over Moreton Bay. On completion of the exercise, military aircraft shall depart for Amberley from the Brisbane NDB at a minimum altitude of 5,300 feet.

4.4 Asymmetric take-offs or overshoots are permitted only on Runway 04.

BRISBANE

Ground Engine Running

Airport	'Enclosed' engine test cells	Open air Piston engine test bays	In frame all engine types planned maintenance and fault correction	Compass swinging
Brisbane ..	N/A	N/A	Up to 5 minutes adjacent to maintenance hangars **0530 to 2300** EST must be carried out on or n.e. of centre taxiway north of control tower or associated loop. **2300 to 0530** EST a senior engineer must decide that run up is essential and advise SOC who will designate area. Record of these runs logged by watchman at fire station. *Sunday* limit running between 0530 EST and 1000 to minimum	Daylight hours on retained section of Runway 07

ADELAIDE AIRPORT—NOISE ABATEMENT PROCEDURES

0 INTRODUCTION

0.1 The following noise abatement procedures are effective at Adelaide Airport.

1 PREFERRED RUNWAYS

1.1 The preferred runways, which are applicable to jet aircraft and to other aircraft over 30,000 lb AUW, are:

TAKE-OFF—Runway 23
LANDING—Runway 05.

1.2 Aircraft will be delayed as necessary to comply with the preferred runways except for the following reasons:

(a) safety;

(b) in conditions of low cloud and/or poor visibility;

(c) when the cross wind exceeds 10 knots and/or the down wind component exceeds 5 knots.

2 PREFERRED FLIGHT PATHS

2.1 *Arriving Aircraft:* When preferred runway procedures are in use, arriving jet aircraft will not be descended below 1500 ft until established over the sea and the subsequent flight path, except for the final approach leg, will be clear of built-up areas.

2.2 *Departing Aircraft:* Jet aircraft departing runway 23 will maintain runway heading until 3 DME or, if non-DME-equipped, until 3 miles from the south west end of runway 23, before commencing a turn.

3 TRAINING FLIGHTS

3.1 Circuit training will be permitted at Adelaide only between 0630 and 2100.

3.2 Airwork flying training clear of built-up areas is permitted at any time.

3.3 No jet flying training, except that authorised in paragraphs 3.4 and 3.5, is permitted without the specific approval of the Superintendent of Operations.

3.4 Unless arrangements have been made through the Airport Manager before take-off, practice ILS/LLZ approaches by civil jet aircraft are not permitted except when runway 23 is the duty runway for landing jet aircraft. Non-jet scheduled arriving aircraft are permitted to make one practice instrument approach at any time.

3.5 Simulated engine failures after take-off, or on overshoots, are permitted only on runway 23 or 30.

4 CURFEW—JET MOVEMENTS

4.1 Jet aircraft operations are not permitted at Adelaide Airport between 2300 and 0600 without the specific approval of the Regional Director. This includes departures of jet aircraft which have landed using Adelaide as an alternate.

4.2 Mercy flights and the planned or unplanned use of Adelaide as an alternate are excluded from this restriction.

ADELAIDE GROUND MAINTENANCE RUNNING

1. Ground operation of all engines is normally prohibited between the hours of 2300 and 0500, however, if an operator considers he has a vital need to depart from this prohibition he may:

(a) Operate a turbo-prop or piston engine in the vicinity of the maintenance apron for a single period not exceeding 5 minutes and at not more than 50% power;

(b) operate a turbo-prop or piston engine for a single period not exceeding 5 minutes at more than 50% power provided the aircraft is towed to an area on the airport designated by the DCA Senior Operations Controller on duty;

(c) operate a pure jet engine in the vicinity of the maintenance apron not above ground idle power;

(d) operate a pure jet engine for a single period not exceeding two minutes at above ground idle power provided the aircraft is towed to an area on the airport designated by the DCA Senior Operations Controller on duty.

PREFERRED RUNWAYS—JET MOVEMENTS

1. In the interest of noise abatement preferred runways are Take Off/23, Landing/05 provided that:

(a) *Crosswind* component does not exceed 10 knots,

(b) Down wind component does not exceed 5 knots, *and*

weather conditions for landing are equal to or better than:

(a) Cloud base 1,500 ft.

(b) Visibility 3 miles.

CANBERRA'S CIVIL TERRAIN CLEARANCE RULES AND NOISE ABATEMENT PREFERENCES

Runway	Aircraft	Noise abatement preference 2200–0600
12	F27 and Viscount ..	Runway 12 is THIRD preference for noise abatement take-off, but requires RUNWAY HEADING to be maintained to 1,200 ft
30	F27 Mk 1 ..	Runway 30 is FOURTH take-off preference; the right turn is some help in limiting noise nuisance to Campbell and eastwards; the left turn is adverse
30	Viscount ..	Runway 30 is FOURTH take-off preference; but left turn takes aircraft over Canberra
17	F27	Runway 17 is SECOND take-off preference, subject to LEFT turn on take-off
17	DC9	Runway 17 is SECOND take-off preference, subject to LEFT turn on take-off
35	F27	Runway 35 is FIRST preference, subject to RIGHT turn after take-off
35	Viscount ..	

NOTE: In many cases the rate of turn or angle of bank is stipulated; the heights are given above an aerodrome level of 1,800 ft.

HOBART

Operational and Ground Running Noise Abatement Arrangements

No procedures exist in relation to noise abatement either on the ground or in the air, and no complaints of aircraft engine noise have been received by the Department of Civil Aviation.

The ground running of aircraft engines has not created a problem at Hobart Airport. Isolated instances of in-frame ground running of the larger type of piston engine do occur, sometimes at night. General aviation maintenance at Cambridge creates the main source of noise in this respect, occurring in daylight only and of comparatively low frequency and intensity.

PERTH—AVOIDANCE OF NOISE NUISANCE

1. The following operational procedures are currently in force at Perth Airport to alleviate noise nuisance.

2. The procedures require that all hospitals and high density residential areas be avoided wherever possible.

3. A preferred runway system is in operation 24 hours of the day.

4. This preferred runway system operates up to a maximum cross wind component of 10 knots.

5. The preferred runways are for landing 24, 20, 02 and 06 in that order.

6. The preferred runways for take-off are 20, 02, 06 and 24 in that order.

7. To reduce turbo jet noise from aircraft approaching Perth Airport they are required—

(a) when approaching from the East to enter direct from a right hand base leg,

(b) when approaching from the North or West to approach via the PH NDB or a long final approach.

8. When International turbo jet aircraft take off from Perth Airport they must maintain the runway heading at a speed not exceeding V2 plus 20 knots using take-off thrust to a height of 1,200 ft.

9. It is expected that domestic turbo aircraft will also comply with similar procedures to those applicable to International turbo jet aircraft within the near future.

10. Perth-Mauritius flights during the hours 2200-0600 are required to comply with noise abatement procedures as follows:

TAKE-OFF

RUNWAY

20 Clearance 51 maintain runway heading until reaching 4,000 ft or DME 7 whichever is sooner then turn right heading 310—intercept VOR 285 radial.

02 Clearance 51 maintain runway heading until DME 5 then turn left heading 275 until DME 15 then turn left—intercept VOR 285 radial by DME 25.

11. All Jet aircraft departing Perth for Sydney, Melbourne or Adelaide are required to comply with noise abatement procedures appropriate to the take-off runway as follows:

TAKE-OFF

RUNWAY

20 and 24 *All S DC's*

Maintain Runway Heading until DME 3 then turn left *Heading* 125 at DME7.
Crossing VOR 150 Radial turn left
CLEARANCE 64, 67 or 81 HEADING 095—Intercept VOR 125 Radial
CLEARANCE 66, 71 or 77 HEADING 060—Intercept VOR 097 Radial

02 *All S DC's*

Maintain Runway Heading until DME 4 then turn right *Heading* 140
CLEARANCE 64, 67 or 81 Intercept VOR 125 Radial
CLEARANCE 66, 71 or 77 Intercept VOR 097 Radial

06 CLEARANCE 64, 67 or 81—Maintain runway heading to a minimum of 500 feet when terrain clearance assured
turn right *Heading* 095 until DME 6 then
turn right *Heading* 165—Intercept VOR 125 Radial
CLEARANCE 66, 71 or 77—Standard procedures apply.

The procedures are effective 24 hours per day.

12. Flying training circuits are not permitted between 2300 hours and 0700.

13. Low level circuits are not permitted between 1800 and 0800. When these low level circuits are permitted they are restricted to left hand circuits on Runway 20, right hand circuits on Runway 02 and must be carried out not below a height of 500 ft.

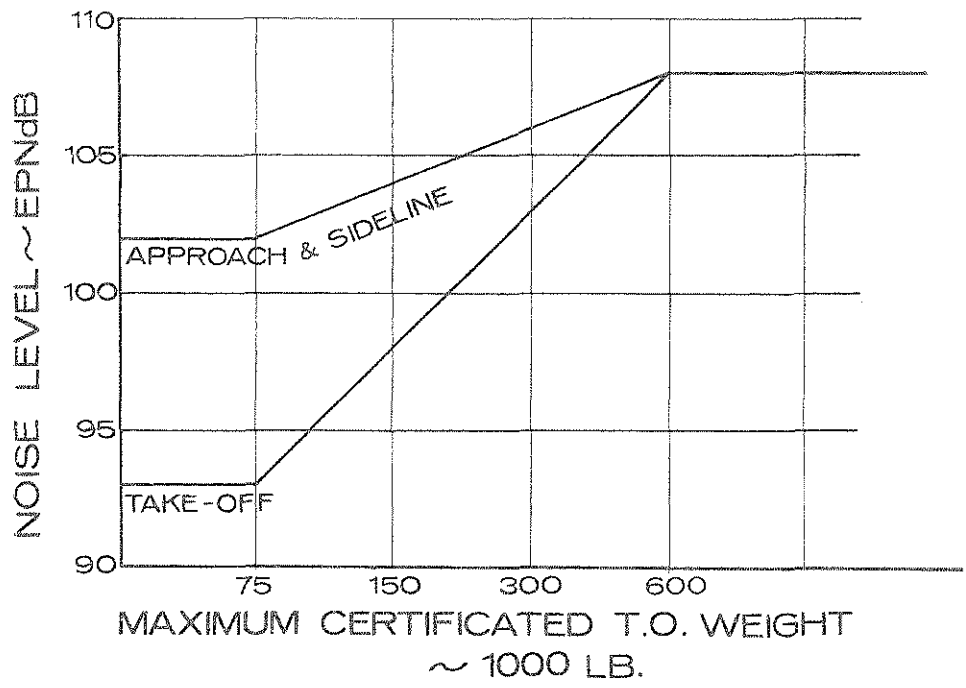
14. Any instrument approaches which are carried out between 2300 and 0700 are limited to procedures which terminate with a straight in approach and landing on the preferred runway.

15. The Noise Abatement Procedures for ground engine runs are as follows:

(a) 'Enclosed' Engine Test Cells	0600-2300 Monday to Saturday otherwise Airport Manager approval required.
(b) Open Air Piston Engine Test Bays	0700-2100 Monday to Saturday otherwise Airport Manager approval required.
(c) In frame turbo jet planned maintenance	0600-2100 Monday to Saturday; 1000-2100 Sunday.
(d) In frame turbo jet fault correction	0500-2300. Outside these hours 10 minute limits. * Periods in excess of 10 minutes with engineering management approval to 20 minutes.
(e) In frame prop jet and piston engine planned maintenance	0600-2100 Monday to Saturday; 1000-2100 Sundays.
(f) In frame prop jet and piston engine fault correction	0500-2300. Outside these hours 10 minutes limit. * Periods in excess of 10 minutes with engineering management approval to 20 minutes.
(g) Compass swinging	0500-2300 daily.
Remarks	* = to be recorded and co-ordinated with the Airport Manager.

16. *Complaints*—Details of noise nuisance complaints received from the public are recorded on a form and forwarded to the Airport Manager who in turn takes the appropriate action.

Appendix M F.A.A Noise Certification Requirement. New Subsonic Transport Aircraft



Appendix N Persons and Organisations from whom the Committee Received Evidence

Alan, Mr E. R.	City of Keilor
Alderman, Mr G. T.	Royal Aero Club of South Australia (representing the Royal Federation of Aero Clubs of Australia)
Ammerman, Mr F. L.	Pinkenba Progress Association
Anderson, Mr C.	Eastlakes Progress Association
Anderson, Mr J. P.	Electrical Trades Union of Australia
Apperley, Mr O. B.	Association of Commercial Flying Organisations of Australia; Aircraft Owners and Pilots' Association and the Royal Federation of Aero Clubs of Australia
Apitz, Mr N. N.	Randwick Municipal Council
Ashton, Mr J.	Royal Federation of Aero Clubs of Australia
Austin, Mr F. W.	Trans Australia Airlines
Austin, Capt. R. J.	Australian Federation of Air Pilots
Axon, Mr D. H.	Tullamarine Progress Association
Baddeley, Mr J. G.	Newcastle City Council
Ball, Capt. F. J.	Trans Australia Airlines
Barclay, Mr K. M.	Department of Civil Aviation
Barter, Mr G. M.	A.L.P. (Gymea Branch)
Bassett, Mr D. C.	District Commissioner of the Territory of Papua and New Guinea
Bastow, Mr J.	Madang Chamber of Commerce
Bear, Dr V. D.	Otalaryngological Society of Australia
Bechtel, Mr L. C.	Department of Civil Aviation
Bell, Mr T. A., M.L.A.	Member of the Northern Territory Legislative Council
Belton, Mr R. J.	The Administration of the Territory of Papua and New Guinea
Begg, Mr S. W.	Tullamarine Syndicate
Benson, Mr P. D.	Rockdale Citizens' (Noise) Committee
Bermann, Mr J.	Corporation of the City of Salisbury
Bibo, Mr J. H., M.B.E.	Ansett Airlines of Australia
Bohman, Mr F. C.	Madang Chamber of Commerce
Bormann, Mr J.	Corporation of the City of Salisbury
Bosher, Mr V. J. M.	Private Citizen
Boud, Mr W. E.	Department of Civil Aviation
Boult, Mr L. A.	Melbourne Chamber of Commerce
Brough, Mr J. F.	Department of Civil Aviation
Brown, Mr F. W.	Federated Clerks Union of Australia
Brown, Mr W. L.	Brain & Brown Airfreighters Pty Ltd
Brownbill, Miss K. C. M.	Former M.P. for Kingston
Bulteau, Dr V. G.	Commonwealth Acoustic Laboratories (Consultant)

Bunting, Mr B.	Deputy District Commissioner, Territory of Papua and New Guinea
Burke, Mr A. C.	Goroka Chamber of Commerce
Butcher, Mr F. L.	Ansett Airlines of Australia
Butlers, Mr R. J.	Department of Civil Aviation
Cairns, Mr K. M. K., M.P.	Member for Lilley
Caldwell, Mr D. T.	Lake Macquarie Shire Council
Cameron, Mr C. R., M.P.	Member for Hindmarsh
Cameron, Mr D. M., M.P.	Member for Griffith
Cameron, Mr R. A. C.	Warden of Evandale
Carr, Dr D.	Town Planning Department (W.A.)
Carr, Ald. J.	Marrickville Municipal Council
Carter, Mr N. L.	Commonwealth Acoustic Laboratories
Carter, Mr R. G. V.	Private Citizen
Cass, Dr M. H., M.P.	Trade Union Clinic & Research Centre Limited. Now Member for Maribyrnong
Challis, Mr L. A.	Rockdale Municipal Council (Consultant)
Cleaver, Mr R.	Former M.P. for Swan
Cohen, Mr K. D.	MacRobertson-Miller Airlines Ltd
Coleman, Mr D. G.	Australian Licensed Aircraft Engineers' Association
Coleman, Mr R. G.	A.L.P. (Leichhardt Branch)
Collett, Mr R. H.	Department of Civil Aviation
Conley, Mr R. G.	Trans Australia Airlines
Cook, Mr L. I.	Qantas Airways Limited
Coombes, Mr B. B.	Department of Civil Aviation
Costello, Mr B. F.	Madang Chamber of Commerce
Crampton, Mr R. B.	Department of Civil Aviation
Daniel, Mr W. P.	Gold Coast City Council
Dawes, Mr K. J.	Department of Civil Aviation
Dent, Mr A. H.	Department of Works (Commonwealth)
Dingle, Mr W. A.	Private Citizen
Douglas, Mr G.	Department of Civil Aviation
Doyle, Mr F. E.	Australian Federated Union of Locomotive Enginemen
Doyle, Mr J., M.L.A.	Member of the Legislative Assembly for Gisborne
Dubout, Mr P.	Commonwealth Scientific and Industrial Research Organisation
Dunn, Mr M. D.	Department of Civil Aviation
Duthie, Mr G. W. A., M.P.	Member for Wilmot
Eddy, Mr K.	Department of Civil Aviation
Edey, Mr R. J. M.	Department of Civil Aviation
Edmunds, Mr C. T., M.L.A.	Member of the Legislative Assembly for Moonee Ponds
Edwards, Mr L. R.	Attorney-General's Department
Elliott, Mr D. J.	Ansett Airlines of Australia
Fahey, Mr J. C.	Royal Newcastle Aero Club (representing the Royal Federation of Aero Clubs of Australia)
Fardon, Mr R. H.	Belmont Shire Council (W.A.)
Forster, Miss A. L.	Private Citizen
Francis, Wing Cdr J. M.	Department of Air
Franck, Mr M.	State Planning Authority (N.S.W.)
Fullarton, Cnclr G. G.	City of Keilor

Garlick, Mr R. J.	Civil Air Operations Officers' Association of Australia
Garrett, Mr J. J., M.H.A.	Madang Chamber of Commerce
Gibbes, Capt, P. J., M.V.O., D.F.C., A.F.C.	Ansett Airlines of Australia
Giesberts, Mr H.	Social Credit Movement of Queensland
Gillan, Mr C. L.	Original, Aged, Invalid and Widow Pensioners' Association of Australia
Glassey, Mr G. A.	Ansett Airlines of Australia
Graham, Mr J.	Department of Civil Aviation
Green, Mr A. H.	Department of Civil Aviation
Green, Mr R. M.	Department of Civil Aviation
Gun, Dr R. T., M.P.	Member for Kingston
Hain, Mr R.	National Capital Development Commission
Haines, Cnclr M. W.	Shire of Corio
de Hamel, Mrs J. B.	Private Citizen
Harper, Mr J. H., A.F.C.	Department of Civil Aviation
Hart, Mr S. B.	State Planning Authority (S.A.)
Head, Mr W. R.	Private Citizen
Hepburn, Mr J. A.	Melbourne and Metropolitan Board of Works
Higgins, Mr T. J.	A.C.T. Law Society
Hill, Mr W. J. M.	Qantas Airways Limited
Honan, Mr R. F.	Department of Civil Aviation
Honn, Cnclr	Madang Town Advisory Council
Howells, Capt. A. D.	Australian Federation of Airline Pilots
Howison, Mr L. J.	Rockdale Citizens' (Noise) Committee
Huggett, Mr J. W. E.	Department of Civil Aviation
Irvine, Mr J. A.	Private Citizen
James, Mr I.	Department of Civil Aviation
James, Mr R. A.	Kuring-Gai Municipal Council
Jamieson, Mr C. J., M.L.A.	Member of the Legislative Assembly for Belmont
Jauncey, Mr L. R.	Botany Municipal Council
Jeffery, Mr E. R.	Kurnell Progress Association & Kurnell Parents' and Citizens' Association
Johnson, Mr C. R.	Standards Association of Australia
Jones, Mr A. T.	Department of Civil Aviation
Jude, Capt. G. M.	Department of the Navy
Kelly, Mr R. F. B.	City of Keilor
King, Mr R. B.	Consultant to the City of West Torrens and the Corporation of the Town of Thebarton
Knight, Mr J. W.	Department of Air
Kolau, Mr L.	Madang Town Advisory Council
Lam, Mr R. C.	Department of Civil Aviation
Lawrence, Mrs A. B.	Private Citizen
Leplaw, Mr P. C.	Australian Licensed Aircraft Engineers' Association
Lewis, Mr N. B.	Private Citizen
Lewis, Mr R. G.	Corporation of the Town of Thebarton
Leslie, Mr D. G.	The Administration of the Territory of Papua and New Guinea
Lindeman, Mr A.	Department of Civil Aviation
Logue, Mr S. H.	Trans Australia Airlines
Long, Mr H. H.	Northern Territory Administration

McArdle, Dr E. J.	Department of Health Services (Tasmania)
McCloughlan, Mrs M.	Blacksmith Progress Association
McCulloch, Mr P. T.	Department of Civil Aviation
McDonnell, Mr J. C. D.	Northern Territory Administration
McGregor, Mr P. R.	Arundel Farm Pty Ltd
McIvor, Mr J. B.	Civil Air Operations Officers' Association of Australia
McLean, Mr R. S.	Private Citizen
Mather, Miss C. E.	Department of Architecture, University of Sydney
Mathieson, Mr O. J.	District Commissioner, Territory of Papua and New Guinea
Maxwell, Mr G. A.	Rockdale Citizens' (Noise) Committee
Menzies, Mr A. C. C.	Attorney-General's Department
Michelmore, Mr D. P.	Royal Australian Institute of Architects (S.A. Chapter)
Mohring, Mrs C.	Nightcliff Community Association, Ratepayers' Association and the Liberal Party of Australia (Darwin Branch)
Murphy, Mr W. V.	Private Citizen
Nash, Mr R. E.	Corporation of the Town of Henley and Grange
Nissau, Cnclr	Madang Town Advisory Council
Oakley, Capt. P. L.	Qantas Airways Limited
O'Farrell, Cdr J. A.	Department of the Navy
Pascoe, Mr F.	Ansett Airlines of Australia
Paynter, Mr M. E.	Macair Charters Pty Ltd
Perry, Mr D. J.	The Royal Federation of Aero Clubs of Australia, and the Association of Commercial Flying Organisations
Phelan, Mr W. J.	Department of Civil Aviation
Philipus, Cnclr	Madang Town Advisory Council
Pickwell, Mr D. J.	Angus & Coote Acoustics
Piesse, Mr R.	Commonwealth Acoustic Laboratories
Pirie, Mr A.	Department of Civil Aviation
Pond, Mr C. A.	Madang Chamber of Commerce
Potter, Mr K. J.	Private Citizen
Powell, Dr K. C.	Angau Memorial Hospital (Lae)
Powell, Mr R. J.	Department of Civil Aviation
Powell, Mr R. T.	Department of Civil Aviation
Price, Mr G. E.	City of Keilor
Price, Mr R. A.	Victorian Chamber of Manufactures
Properjohn, Mr N. J.	Department of Civil Aviation
Quinlan, Mr E.	Private Citizen
Rapup, Cnclr M.	Huon Local Government Council
Rathbone, Ald. R. W.	Rockdale Municipal Council
Regan, Mr J. M.	Madang Chamber of Commerce
Richards, Rev. J.	St John's Church of England, Rockdale
Robinson, Mr V. R.	Clarence Municipal Council (representing Southern Metropolitan Master Planning Authority)
Rolfe, Miss H. A.	United Farmers' & Woolgrowers' Association of N.S.W.
Rose, Mr J. A.	Commonwealth Acoustic Laboratories

Sain, Mrs G.	Marks Point Progress Association
Sanderson, Mr C. J. S.	Private Citizen
Schoenberg, Mr D. D.	Tullamarine Syndicate
Schofield, Mr J. E.	Department of Civil Aviation
Seale, Mr H. P.	District Commissioner, Territory of Papua and New Guinea
Seymour, Mr R. M.	Department of Civil Aviation
Shelley, Mr P. J.	Private Citizen
Simkin, Col. M. B.	Department of the Army
Smith, Mr K. R.	Department of Civil Aviation
Somerville, Capt. A. J.	Australian Federation of Airline Pilots
Souter, Mr H. J.	Australian Council of Trade Unions
Sparks-Carroll, Mr C. W.	The Administration of the Territory of Papua and New Guinea
Squire, Mr F. J.	Private Citizen
Stark, Mr R.	Rockdale Municipal Council
Stitt, Mr M. W.	Tourist Industry Council of Queensland
Stott, Mr M. G.	City of West Torrens
Stratton, Ald. C.	Marrickville Municipal Council
Strauss, Dr W.	Department of Industrial Science, University of Melbourne
Swadling, Mr F. J.	Department of Civil Aviation
Tanner, Mr P. C.	Aero Club of Southern Tasmania (representing the Royal Federation of Aero Clubs of Australia)
Taylor, Mr C. J.	Launceston City Council
Thompson, Mr C. H. C.	Department of Civil Aviation
Thynne, Mr T. C.	Hamilton-Ascot Progress Association
Tilley, Mr R. F.	Tasmanian Aero Club (representing the Royal Federation of Aero Clubs of Australia)
Wainer, Mr J. M.	Ansett Airlines of Australia
Wann, Mr M. J.	Brisbane City Council
Warton, Mr L. C.	Ansett Airlines of Australia
Ward, Brig. M. A.	Salvation Army, Bethesda Hospital, Sydney
Watkins, Mr J. L., O.B.E.	Trans Australia Airlines
Webb, Cnclr R. J.	City of Keilor
West, Mr H. W.	District Commissioner, Territory of Papua and New Guinea
Weston, Mr E. T.	Private Citizen
White, Mr A. E.	Local Government Association of W.A.
Whiteford, Mr A. D.	Corporation of the Town of Henley and Grange
Whitehead, Wing Cdr E. J.	Department of Air
Wickham, Mr J. J.	State Planning Authority (N.S.W.)
Wilkinson, Mr J. T.	Ansett Airlines of Australia
Wilkinson, Mr R. C.	Carr & Wilkinson Consultant Acoustical Engineers
Williams, Mr H. C.	Eastlakes Progress Association
Willis, Mr L. B.	Department of Civil Aviation
Wilson, Mr I. A.	Aircraft Owners and Pilots' Association, Association of Commercial Flying Organisations of Australia, Royal Federation of Aero Clubs of Australia