

**BEFORE THE QUEENSTOWN LAKES
DISTRICT COUNCIL**

IN THE MATTER of the Resource Management Act 1991 (the "Act")

AND

IN THE MATTER of the Queenstown Lakes District Proposed District Plan

**MEMORANDUM OF COUNSEL
30 MARCH 2016**

Darby Planning LP (#608),
Soho Ski Area Limited (#610),
Treble Cone Investments (#613)
Hansen Family Partnership (#751)

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1. Introduction

1.1 This Memorandum addresses:

- (a) the Memorandum from the Hearings Panel dated 23 March 2016, concerning additional material received by the Panel while hearing stream 01B, and
- (b) confirmation of the submitters' positions on questions raised by the Hearings Panel, during the hearing on Monday 21 March.

1.2 This Memorandum and further evidence is prepared on behalf of the Submitters ("the Submitters") noted on the front cover page.

1.3 Supplementary evidence of Christopher Ferguson is attached to this Memorandum at **Appendix A**.

2. Memorandum of Counsel on behalf of QLDC providing the requested further information, 18 March 2016

2.1 The Submitters have no specific response relevant to the hearing stream 01B to the further information.

3. Memorandum of Counsel on behalf of QLDC filing redrafted objectives in Chapters 3 and 6, 18 March 2016

3.1 Where the amended objectives are inconsistent with the relief being pursued by the Submitters, as set out in Appendix 1 of Mr Ferguson's evidence in chief dated 29 February 2016, the version in Mr Ferguson's evidence is still sought, for the reasons set out in the original Submission, evidence and legal submissions.

3.2 The amended Objective 3.2.5.3 is addressed in Mr Ferguson's supplementary evidence dated 24 March attached.

3.3 Amended Objective 3.2.5.1 is relevant to identification of matters in accordance with section 6 (b). The amended version now states;

Objective 3.2.5.1 – *Protection of Outstanding Natural Features and Landscapes from inappropriate subdivision, use and development*

3.4 That Objective from the Strategic Direction Chapter is then supported by the following policy suite from the Landscapes Chapter;

Objective 6.3.1- *Landscapes are managed and protected from the adverse effects of subdivision, use and development.*

Policy 6.3.1.1- *Identify the District's Outstanding Natural Landscapes and Outstanding Natural Features on the Planning Maps and Classify the Rural Zoned landscapes as:*

- *Outstanding Natural Feature (ONF)*
- *Outstanding Natural Landscape (ONL)*
- *Rural Landscape (RL)*

Policy 6.3.1.2 - *That subdivision and development proposals located within the Outstanding Natural Landscape, or an Outstanding Natural Feature, be assessed against the assessment matters in provisions 21.7.1 and 21.7.3 because subdivision and development is inappropriate in almost all locations, meaning successful applications will be exceptional cases.*

Policy 6.3.1.3 - *That subdivision and development proposals located within the Rural Landscape be assessed against the assessment matters in provisions 21.7.2 and 21.7.3 because subdivision and development is inappropriate in many locations in these landscapes, meaning successful applications will be, on balance, consistent with the assessment matters.*

..."

- 3.5 The remainder of policy suite 6.3.1 goes on to identify how subdivision, use, and development can be managed appropriately in each of the three landscape categories as mapped in the planning maps. What is missing from the policy suite, however, is how those landscapes are identified and classified (other than by lines on planning maps) and what particular characteristics are sought to be recognised and provided for in each of those landscapes.
- 3.6 The Submitters agree with the amendments to Objective 3.2.5.1, in particular the addition of the word "inappropriate" as this accords with the duty in section 6(b) of the Act, and is consistent with Goal 3.2.5.
- 3.7 However further changes are still considered necessary to achieve the Part 2 Purpose of the Act and to set out a helpful framework for decision makers applying these objectives and policies of the PDP in future applications.

- 3.8 The High Court in the *Man o War* litigation, reasoned that characteristics of a landscape should first be identified and then provisions should be set to *recognise and provide* for those characteristics.

"It is clear from the fact that "the protection of outstanding natural features and landscapes" is made, by s 6(b), a "matter of national importance" that those outstanding natural landscapes and outstanding natural features must first be identified. The lower level documents in the hierarchy (regional and district policy statements) must then be formulated to protect them. Thus, the identification of ONLs drives the policies. It is not the case that policies drive the identification of ONLs, as MWS submits".¹

"As identified by the Council, the RMA clearly delineates the task of identifying ONLs and the task of protecting them. These tasks are conducted at different stages and by different bodies. As a result it cannot be said that the RMA expects the identification of ONLs to depend on the protections those areas will receive. Rather, Councils are expected to identify ONLs with respect to objective criteria of outstandingness and these landscapes will receive the protection directed by the Minister in the applicable policy statement"².

- 3.9 As for the process of identification of ONFLs, the High Court helpfully summarised the position as follows at para 10³;

*"The term "outstanding natural landscape" is not defined in the RMA. The Environment Court referred to the approach and factors set out in the Environment Court's decisions in *Wakatipu Environmental Society Inc v The Queenstown-Lakes District Council* ("WESI")⁴, and in *Maniototo Environmental Society v Central Otago District Council* ("Maniototo")⁵, in which the Court will first identify a "landscape", then consider whether the landscape is sufficiently "natural" to be classified as a natural landscape, then assess whether the natural landscape is "outstanding". That latter assessment is undertaken by reference to the factors set out in WESI. In essence, these require the landscape to remarkable, exceptional, or notable."*

¹ *Man O War Station Ltd v Auckland Regional Council* [2015] NZHC 767, at [59]

² *Ibid*, at [60]

³ *Ibid*, at [10]

⁴ *Wakatipu Environmental Society Inc v The Queenstown-Lakes District Council* [2000] NZRMA [59]

⁵ *Maniototo Environmental Society v Central Otago District Council* Decision C103/2009.

- 3.10 Currently this policy and other landscape provisions in chapter 3 and 6 do not provide for individual recognition of the characteristics of ONFLs within the District. What has occurred is a 'blanket' regime which is restrictive towards all development, in all ONFLs to the same level, regardless of their individual attributes.
- 3.11 If the Supreme Court's reasoning in *King Salmon* in the determination of what is 'inappropriate' is considered within the context of what is sought to be protected, then clearly those characteristics, features, and values must be more explicitly identified in the Plan if such identification is to be of meaningful assistance to decision makers.

*"We consider that "inappropriate" should be interpreted in s 6(a), (b), and (f) against the backdrop of what is sought to be protected or preserved, that is, in our view, the natural meaning."*⁶

- 3.12 It is submitted that this interpretation of 'inappropriate' does not support an interpretation that, any adverse effect other than that which is more than negligible or temporary on an ONL, will be inappropriate.
- 3.13 Any future decision as to what is 'inappropriate' in accordance with Objective 3.2.5.1 of the DPR will depend on the effects of the activity proposed and the specific nature and values of the particular ONFL.
- 3.14 That position is further supported by the Environment Court in *Calveley v Kaipara District Council* where the Court agreed with the submission of Counsel for the section 274 parties that;

*"The starting point for the assessment of landscape effects must involve developing an understanding of the characteristics and values of this ONL"*⁷

- 3.15 In that case, the Plan under consideration was the Kaipara District Plan, in particular the Court agreed that the Plan's policies for landscape recognition and protection were;

"well-aligned with King Salmon in that it indicates that judgements as to what constitutes "inappropriate subdivision, use and development" should be made with reference to what is "sought to be protected" ... the

⁶ *Environmental Defence Society Inc v New Zealand King Salmon Company* [2014] NZSC 38, at [105].

⁷ *Calveley v Kaipara District Council* [2014] NZEnvC 182, at [120]

*associated explanation also guides us to refer to the applicable worksheet to determine an ONL's characteristics and values."*⁸

- 3.16 For assistance to the Commissioners, and by way of contrast to the DPR, the relevant parts of the Kaipara District Plan which were considered to be 'well-aligned' with *King Salmon* are set out as follows;

"Policy 18.6.1 *To recognise and protect Outstanding Natural Landscapes from inappropriate subdivision, use and development by:*

(a) identifying and confirming the extent, values and characteristics of Outstanding Natural Landscapes;

(b) protecting natural and physical features and natural systems (such as landforms, indigenous vegetation and watercourses) that contribute to the character and values of Outstanding Natural Landscapes;

....

*The Council has recognised and protected Outstanding Natural Landscapes in the District and has mapped them. Subdivision, use and development within Outstanding Natural Landscapes will be managed so that the key physical characteristics and values that make up each individual landscape will be protected (as identified in Appendix 18A and the worksheets of the Kaipara District Landscape Technical Report 2010) from inappropriate subdivision, use and development. The impact of different activities on Outstanding Natural Landscapes will vary depending on the sensitivity of the landscape to a proposed activity."*⁹

- 3.17 In addition to mapping the ONFLs, the Kaipara District Plan's Appendix 18A lists over 20 distinct landscapes in the District each of which has a summary of the key outstanding attributes, including where those landscapes contain an element of human interaction. That is then supported by a 90 page landscape assessment report which is referred to within the landscape policies.

- 3.18 By contrast, the DPR has clear deficiencies in respect of recognising and providing for landscapes in accordance with section 6(b). Whilst the ONFLs are 'mapped', the particular characteristics of each identified

⁸ Ibid, at [130]

⁹ Extracts from Policy 18.6.1 and associated Explanation, Kaipara District Plan

ONFL are not stated in the Plan or in supporting documentation referred to in the Plan. If the key characteristics and values of each individual ONFL were identified in the Plan that would include (in some instances) the observance of non-natural aspects, such as ski field buildings, ski lifts, and access roads, which are all important parts of the landscapes. Any future development should be assessed for appropriateness against those particular attributes.

- 3.19 The fact that the District contains over 96% of identified ONFLs should further support the proposition that those ONFLs should be adequately identified for the particular characteristics which they contain, as otherwise a blanket, restrictive regime effectively and unjustifiably "locks up" most of the district from what could otherwise be appropriate uses.
- 3.20 Those deficiencies mean that Chapter 3 and Chapter 6 of the DPR are not in accordance with the Supreme Court's approach in *King Salmon*, the *Man o War* litigation, and section 6(b) of the Act.

4. **Ski Area Sub Zones (SASZs)**

- 4.1 It appears, from Council's revised objectives attached to memorandum of Counsel for Council dated 18 March 2016, there is no intended change to Rule 6.4.1.3.
- 4.2 That rule currently reads;

"Rule 6.4.1.3 - The landscape ~~categories~~ assessment matters apply only to the Rural Zone, and for clarification purposes do not apply to the following areas within the Rural Zones:

..."

- 4.3 It is appreciated that these amendments of 18 March were in response to the Panel's query about the wording of *Objectives* within Chapters 3 and 6, however Council should have used this opportunity to correct Rule 6.4.1.3 to align with Policy 6.3.8.3.
- 4.4 The amendment from the Section 42A Report means that SASZs (and other areas of Rural Zones) are excluded only from the *assessment matters* of the landscape categories, and not from the remaining provisions (including objectives and policies) of the landscape categories.

- 4.5 As already submitted, that amendment is assumed to be an error from Council as the result is an internal inconsistency in the application of the landscape provisions to SASZs.
- 4.6 That amendment is not considered to be within scope of the submissions on the DPR as the submission of Arcadian Trust (which this amendment apparently relies upon) did not seek this outcome. Rule 6.4.1.3 as currently drafted therefore is not;

*'reasonably and fairly raised in the course of the submissions'*¹⁰

- 4.7 Accordingly, the amendment to replace 'categories' with 'assessment matters' in Rule 6.4.1.3 should be removed and the Rule should be retained as was notified in the DPR.
- 4.8 Alternatively it is submitted that if this were an intended amendment from Council, then Rule 6.4.1.3 is inconsistent with section 6(b) of the Act in accordance with the reasoning outlined in paras 3.3 to 3.20 of this Memorandum.
- 4.9 It is not clear to what extent the modified "WESI" criteria have been applied to assess the SASZs in accordance with 'naturalness' and 'outstandingness' to support their identification as ONFLs.
- 4.10 The significant elements of human modification to SASZs must detract from the 'naturalness' of the adjacent landscapes and raise questions as to whether the SASZs could actually form part of a separate landscape. Moreover, even if the SASZs are considered to form part of the adjacent ONFL despite their significant modification, those particular and unique characteristics of the SASZs should be explicitly recognised in the Plan, by way of reference to the particular ONFL (for example, ski lifts, access roads, and lighting).
- 4.11 That explicit recognition is the only way that future decision makers will be able to have a clear understanding of how to apply landscape protection provisions of the PDP contained in chapters 3 and 6, including how to assess what will be 'inappropriate' forms of use and development.

¹⁰ The test as to 'scope' from *The Church of Jesus Christ of Latter Day Saints Trust Board v Hamilton City Council* [2015] NZEnvC 160, at 28

5. Expert Witness Conferencing Statement filed on 22 March 2016

New Zealand Standard for Airport Noise Management and Land Use Planning ("the Standard")

- 5.1 The status of this Standard is clearly intended to be as guidance document for local authorities in the formulation of provisions within a district planning instrument¹¹.
- 5.2 The Standard is material incorporated by reference into the Plan in accordance with part 3 of Schedule 1 of the RMA and section 75(5); although it appears unclear whether those Standards are referred to explicitly in any of the Chapters. It is inferred therefore that the Standards were relied upon in establishing the particular provisions of the Plan.
- 5.3 As the Standards are not prepared under the RMA, they are not binding upon a local authority in the nature of an RMA instrument such as National Policy Statement or National Environment Standard, in accordance with section 75(3).
- 5.4 As stated above the Standards do not appear to have been expressly relied upon or expressed in provisions of the Plan, and the Standards themselves state they are guidance material and provide for a 'floor' rather than a 'ceiling' in terms of restrictive provisions¹².
- 5.5 It would therefore appear open to the council to apply more restrictive provisions through its Plan, however as with all other provisions, that must be done so in accordance with a section 32 justification and analysis. Any departure over and above that which is specified in the Standards which are incorporated should presumably be thoroughly justified.



¹¹ Referring to Clause 1.1.1, Part 1, New Zealand Standard 6805:1992.

¹² Ibid at 1.1.4 "*the standards provide a minimum requirement...*"

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30 March 2016

BEFORE THE QUEENSTOWN LAKES DISTRICT COUNCIL

IN THE MATTER of the Resource Management Act
1991

AND

IN THE MATTER of the Proposed District Plan
Proposed Plan Review (Chapters 3,
4 and 6)

**STATEMENT OF SUPPLEMENTARY EVIDENCE OF CHRISTOPHER BRUCE
FERGUSON**

24 March 2016

Darby Planning LP (#608),
Soho Ski Area Limited (#610),
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INTRODUCTION

Qualifications and Experience

- 1 My name is Christopher Bruce Ferguson. I hold the position of Associate Principal with the environmental consultancy firm Boffa Miskell Limited. I am based in Queenstown and Christchurch and have been employed by Boffa Miskell since April 2015.
- 2 My qualifications and experience are set out in my Evidence in Chief dated 29 February 2016.

Scope of Evidence

- 3 This supplementary evidence has been prepared to respond to four matters raised during questioning from the Panel at the hearing on the Strategic Directions chapters on 21 March 2016. The Panel requested further evidence to consider the following matters:
 - (a) Whether there is justification for the District Plan to impose restrictions on activity proposed to occur within the Outer Control Boundary of the Queenstown Airport than indicated through the New Zealand Standard;
 - (b) The wording of my suggested additions of a new final bullet point to Policy 4.2.4.1;
 - (c) The wording of Objective 3.2.5.3 to be phrased in a way that is more like an objective and less like a policy; and
 - (d) The wording of Policy 4.2.3.8 relating to the management of activities sensitive to aircraft noise within the air noise boundary or outer control boundary.
- 4 Since appearing before the Panel on 21 March, expert witness conferencing on the provisions relating to Queenstown Airport within Chapters 3, 4 and 6 of the Proposed District Plan ('PDP') has concluded. An Expert Witness Conferencing Statement was sent to the Panel on 22 March 2016.
- 5 This conferencing statement records matters of agreement and disagreement on changes to the provisions within these chapters and includes agreement by all witnesses to the deletion of Policy 4.2.3.8 and disagreement with further changes proposed to Policy 4.2.2.4. Accordingly, I propose to focus this supplementary evidence on my further

explanation of reasons for disagreement for the changes to Policy 4.2.2.4, rather than the reworking of Policy 4.2.3.8.

Restrictions on land use activities within the Outer Control Boundary of the Queenstown Airport

6 The Panel requests further evidence on the question of whether there is justification for the District Plan to impose restrictions on activities within the Outer Control Boundary ('OCB') greater than the New Zealand Standard. I understand this question to relate to the current New Zealand Standard for Airport Noise Management and Land Use Planning (NZS 6802:1992) (the 'Standard'). A copy of the Standard is contained within **Appendix 1**.

7 Part 1 of the Standard establishes the scope of the standard as being:

This Standard is for use by territorial or regional government for the control of airport noise. It establishes maximum acceptable levels of aircraft noise exposure around airports for the protection of community health and amenity values whilst recognizing the need to operate an airport efficiently. The Standard provides a guide for territorial authorities wishing to include appropriate land use controls in their district plans, as provided for in the Resource Management Act 1991.¹

8 In addition, the Standard also states:

The Standard provides the minimum requirement needed to protect people from the adverse effects of airport noise. A local authority may determine that a higher level of protection is required in a particular locality, either through use of the Airnoise Boundary concept or any other control mechanism. Any proposal for a higher level of protection, to be included in a district plan, or rule in a plan, would be subject to the public consultation process as well as the requirement to consider alternative methods of achieving the objectives of the local authority under the Resource Management Act 1991.

9 The main features of the Standard are to establish maximum levels of aircraft noise expose at an Airnoise Boundary; a second outer control boundary for the protection of amenity values; and a consideration of

¹ Clause 1.1.1, Part 1, New Zealand Standard 6805:1992.

individual maximum noise levels from aircraft during any night-time operations².

- 10 Clause 1.4.2.1 of the Standard identifies the outer control boundary as an area outside the Airnoise Boundary within which there shall be no new incompatible land uses (see table 2). Table 2 (Recommended noise control criteria for land use planning inside the outer control boundary but outside of the air noise boundary) provides the following “recommended controls measures”:

New residential, schools, hospitals or other noise sensitive uses should be prohibited unless a district plan permits such uses, subject to a requirement to incorporate appropriate acoustic insulation to ensure a satisfactory internal noise environment.

Alterations or additions to existing residences or other noise sensitive uses should be fitted with appropriate acoustic insulation and encouragement should be given to ensure a satisfactory internal environment throughout the rest of the building.

- 11 Based on a review of the Standard itself, and without considering the legal approach to the role of standards in Plan formulation, the following conclusions can be reached:
- (a) The Standard is a guide for the formulation of appropriate land use controls relating to Airports by a territorial authority within a district plan;
 - (b) The focus of the Standard is on controlling the effects of aircraft noise and to do that it establishes mechanisms such as the Airnoise Boundary and Outer Control Boundaries, based on predicted noise generated by Airport activities;
 - (c) The Standard does not bind the Council to either these mechanisms to manage land use activities on airports, or for the imposition of a higher level of control if it wishes; and
 - (d) While the Standards identify the need to undertake public consultation and s.32 analysis in relation to any higher level of control than proposed within the standard, we consider that this obligation would exist in respect to any controls arising from the management of airport noise.

² Clause 1.1.5, *Ibid*

- 12 Returning to the question as to whether the Council has the ability to impose restrictions on activities in the OCB greater than the standard, my answer is yes, although to do so would require a clear analysis under section 32 of the costs and benefits of the proposed method and a consideration of alternatives.

Policy 4.2.4.1

- 13 At paragraph 76 of my EIC, I proposed an addition to Policy 4.2.4.1 that was designed to capture the role of the other settlements and townships in providing local commercial services and activities. The Panel has requested the wording of these additions be reconsidered to better follow the structure of the initial statement. I proposed two minor changes to the last bullet to replace the “and” with an “is” and to strike out the word “land” with this change highlighted below.

Limit the spatial growth of Queenstown, so that:

- *~~the areas of significant indigenous flora and fauna natural environment is~~ are protected from encroachment by urban development*
- *~~sprawling of residential settlements into rural areas is avoided~~*
- *residential settlements become better connected through the coordinated delivery of infrastructure and community facilities*
- *transport networks are integrated and the viability of public and active transport is improved*
- *the provision of infrastructure occurs in a logical and sequenced manner*
- *the role of Queenstown Town Centre as a key tourism and employment hub is strengthened*
- *the role of Frankton in providing local commercial and industrial services is strengthened*
- *the role of other settlements and townships in providing local commercial services and a variety of activities, and is sufficient ~~land~~ to accommodate business growth and diversification.*

Objective 3.2.5.3

- 14 At paragraph 71 of my EIC I proposed amendments to this objective, as follows:

~~Direct~~ Encourage and enable new subdivision, use or development to occur in those areas which have potential to absorb change without detracting from landscape and visual amenity values.

- 15 The Council's latest position, included within the Memorandum of Counsel on behalf of the Queenstown Lakes District Council filing redrafted objectives, dated 18 March 2016, proposes to amend Objective 3.2.5.3, as follows:

3.2.5. 3 Objective - ~~Direct~~ New urban subdivision, use or development ~~to~~ will occur in those areas which have potential to absorb change without detracting from landscape and visual amenity values.

- 16 Objective 3.2.5.3 is a high level objective sitting above the more directed provisions relating to landscapes within Chapter 6. Its attendant policy 3.2.5.3.1 is concerned with directing urban development to UGB's and this focus would explain the rationale for the Council's recommended change to add the word "urban" to the Objective. However, as stated at paragraph 70 of my EIC, the addition of 'urban' to the objective would in my view undermine its utility as a strategic objective applying to all subdivision, use and development within the District.
- 17 Putting aside whether the Objective should apply to urban areas, its wording is directive and focused on the way in which activities are managed within the landscape. Upon reflection it is not a provision that can be readily modified in a way to recast as an objective and on this basis I would suggest that it become a policy. I recognise that if Objective 3.2.5.3 is changed to a policy, it would then not sit well under the structure of other objectives within Chapter 3, which are not cast in such a broad way as to create a logical structure. In addition, it would also orphan the existing Policy 3.2.5.3.1. This situation may resolve itself once the Panel has settled on the final wording and structure of the landscape provisions within Chapter 3.

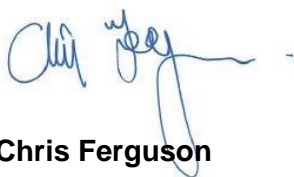
Policy 4.2.2.4

- 18 Should the Panel accept the unanimous agreement resulting from the Expert Witness Conferencing directed on the provisions relating to the Queenstown Airport within the strategic directions chapters, Policy 4.2.3.8 would be deleted. The only matter of disagreement remaining for the Hansen Family Partnership relates to the proposed changes to Policy

4.2.2.4, as detailed above. The changes proposed by the planning witnesses for the Airport and the Council, are as follows:

Not all land within Urban Growth Boundaries will be suitable for urban development or intensification, such as (but not limited to) land with ecological, heritage or landscape significance; or land subject to natural hazards or within the Outer Control Boundary. The form and location of urban development shall take account of site specific features or constraints to protect public health and safety.

- 19 Policy 4.2.2.4 relates to Objective 4.2.2 and the use of UGB's to manage the growth of urban centres within the District. In terms of the specific issues relating to the airport, these are proposed to be captured within the new Objectives 4.2.7 and 4.2.8 and related policies. I agree to the inclusion of these provisions as they span all parts of the urban development provisions within Chapter 4 and provide the specific higher order direction required to manage the airport and its effects on the environment.
- 20 In dealing with the use of land within UGBs, an evaluation of the suitability of land for urban development will require a more refined consideration of whether the activities proposed within the OCB are sensitive to aircraft noise and/or or likely to adversely impact on the efficient operation of Queenstown Airport. The suggested additions to Policy 4.2.2.4 fail to make that critical distinction and may prevent sustainable proposals with no impacts on the airport from being achieved.
- 21 The more structured approach taken to the provisions relating to the Queenstown airport under Objectives 4.2.7 and 4.2.8 provide the necessary guidance on the suitability of proposals within urban areas. Because the additions to Policy 4.2.2.4 lack such refinement, I consider them to be an inefficient and ineffective method to implement the relevant objectives of the PDP.

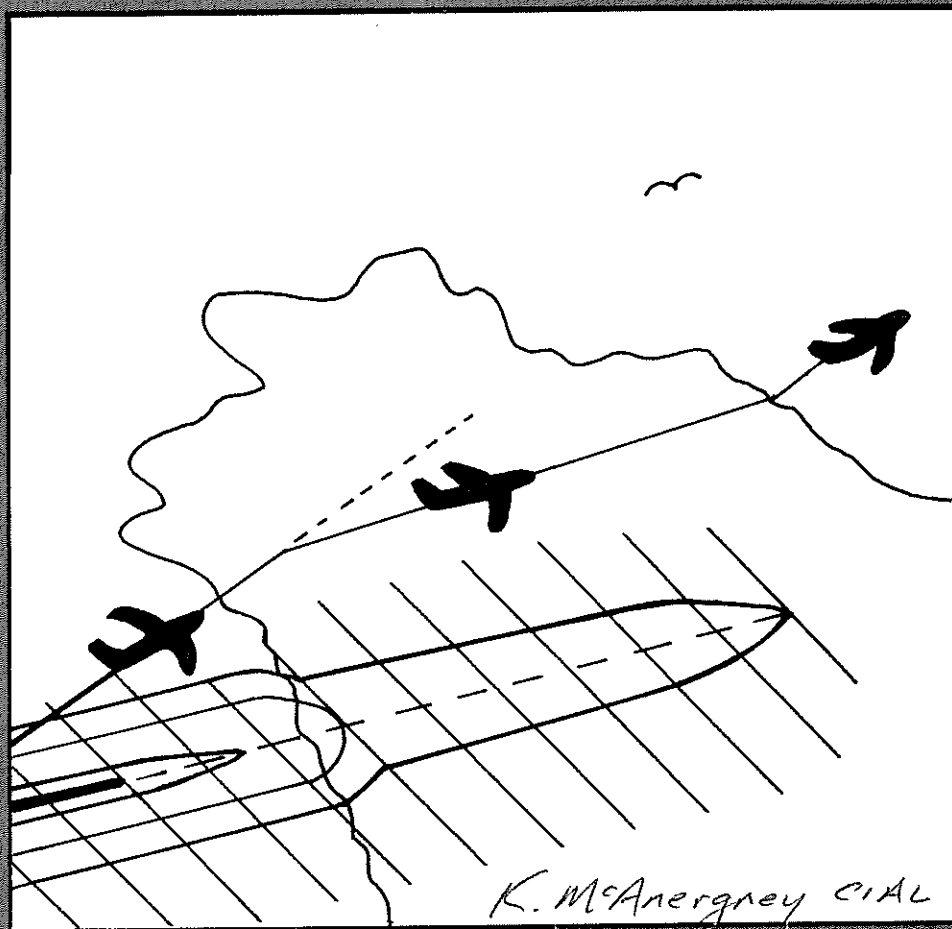


Chris Ferguson

23 March 2016

APPENDIX 1

New Zealand Standard for Airport Noise Management
and Land Use Planning (NZS 6802:1992)



NEW ZEALAND STANDARD

**AIRPORT NOISE MANAGEMENT
AND LAND USE PLANNING**

UDC 534.836 : 628.517.2

Pr FF

Standards Association of New Zealand

COMMITTEE REPRESENTATION

This Standard was prepared under the supervision of the Mechanical, Electrical and General Divisional Committee (50/-) for the Standards Council, established under the Standards Act 1988. The committee consisted of representatives of the following:

- Accident Compensation Corporation
- Department of Scientific and Industrial Research –
Physical Sciences
- Electrical Development Association
- Electrical Supply Authorities
- Electricorp
- Institution of Professional Engineers New Zealand
- Ministry of Energy
- * Ministry of Transport
- National Council of Women
- New Zealand Manufacturers' Federation
- Telecom Corporation

The Airport Noise Control Committee (P 6805) was responsible for the examination of the public comment on the draft Standard and subsequent amendment, and for acceptance of the final technical content of the draft. The committee consisted of representatives of the following organizations in addition to that marked with an asterisk (*) above:

- Airways Corporation of New Zealand Limited
- Aviation Industry Association of New Zealand Inc. (replacing NZ
Organisation of Airport Authorities)
- Board of Airline Representatives New Zealand Inc.
- Christchurch International Airport Limited
- Department of Health
- Ministry for the Environment
- NECAL
- New Zealand Acoustics Society
- New Zealand Airline Pilots Association
- New Zealand Local Government Association
- New Zealand Planning Institute
- Residents Action Group

In addition Mr R. Thorne was co-opted onto the committee.

This Standard was drafted by a technical committee comprised of specialists in aircraft noise control, airport planning, town planning, noise measurement and acoustic instrumentation, with a special technical committee auditing and directing the work throughout its draft stages and editing the final product.

During each of the draft stages, the work was discussed with end users of the Standard and with those most likely to be affected by the introduction of its recommendations. Their input was incorporated when and where appropriate.

This technical committee consisted of representatives from the following:

- Acoustic consultants Ministry for the Environment
- Department of Health Territorial Authorities
- D.S.I.R.

The work of this committee is gratefully acknowledged.

<i>AMENDMENTS</i>	
<i>Date of issue</i>	<i>Description</i>

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NZS 6805:1992

RELATED DOCUMENTS

In this Standard reference is made to the following:

NEW ZEALAND STANDARDS

NZS 6801:1991 Measurement of environmental noise

NZS 6802:1991 Assessment of environmental noise

IEC PUBLICATIONS

IEC 50:- - - International electrotechnical vocabulary
Chapter 801 Acoustics and electro-acoustics

IEC 561-1976 Electro-acoustical measuring equipment for aircraft
noise certification

IEC 651-1979 Sound level meters

IEC 804-1985 Integrating-averaging sound level meters

ISO STANDARDS

ISO 266-1975 Acoustics – Preferred frequencies for
measurements

ISO 1683-1983 Acoustics – Preferred reference quantities for
acoustic levels

ISO 3891-1978 Acoustics – Procedure for describing aircraft noise
heard on the ground - from which much of Part 2 of
this Standard is adopted

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STANDARDS NEW ZEALAND

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FOREWORD

This Standard is concerned with land use planning and the management of aircraft noise in the vicinity of an airport, or aerodrome, for the protection of community health and amenity values. It is intended to be applicable to all airports and aerodromes as defined in Civil Aviation Regulations 1953 Regulation 4, to ensure communities living close to the airport are properly protected from the effects of aircraft noise whilst recognizing the need to be able to operate an airport efficiently.

The Standard utilizes a system in which a limit is set for the average daily amount of aircraft noise exposure that is permitted in the vicinity of an airport, and only inside a fixed working area defined by the "Airnoise Boundary" is the noise exposure allowed to be greater than this. In this working area there are strict rules for compatible land use, and aircraft noise monitoring stations at the Airnoise Boundary ensure that the noise exposure is kept within the prescribed limits. Hence the control is based on the noise actually received - not what is predicted.

ACKNOWLEDGEMENT

A large number of organizations have helped in the preparation of this Standard by providing technical data and advice, and the committee has greatly appreciated this. These people include:

Air Transport Division, Ministry of Transport
British Aerospace
Environmental Protection Department, Hong Kong
Los Angeles International Airport Authority
Orange County (John Wayne) Airport Authority
San Francisco International Airport Authority
State of California Department of Transportation
Wellington Airport Authority
Western Australia Environmental Protection Authority

With special acknowledgement of the work by:

Members of the British Noise Council and members of the IEC TC 29 working groups 4 and 15 - some of whom were involved in the formulation of Part 3 of this Standard.

The sponsorship received from the Department of Health and the contributions from the Wellington Airport Authority, Nelson City Council, Ministry of Transport and the Airways Corporation of New Zealand Limited towards the development of this Standard are gratefully acknowledged.

NOTES



NEW ZEALAND STANDARD

AIRPORT NOISE MANAGEMENT AND LAND USE PLANNING

PART 1 AIRPORT NOISE MANAGEMENT USING THE AIRNOISE BOUNDARY CONCEPT

1.1 Scope

1.1.1

This Standard is for use by territorial or regional government for the control of airport noise. It establishes maximum acceptable levels of aircraft noise exposure around airports for the protection of community health and amenity values whilst recognizing the need to operate an airport efficiently. The Standard provides a guide for territorial authorities wishing to include appropriate land use controls in their district plans, as provided for in the Resource Management Act 1991. In this Standard the words "Airport" and "Aerodrome" are synonymous.

1.1.2

The Standard uses the Airnoise Boundary concept as a mechanism for local authorities to establish compatible land use planning and to set limits for the management of aircraft noise at airports where noise control measures are needed to protect community health and amenity values.

1.1.3

The approach advocated is a recommendation for the implementation of practical land use planning controls and airport management techniques to promote and conserve the health of people living and working near airports, without unduly restricting the operation of airports.

1.1.4

The Standard provides the minimum requirements needed to protect people from the adverse effects of airport noise. A local authority may determine that a higher level of protection is required in a particular locality, either through use of the Airnoise Boundary concept or any other control mechanism. Any proposal for a higher level of protection, to be included in a district plan, or rule in a plan, would be subject to the public consultation process, as well as the requirement to consider alternative methods of achieving the objectives of the local authority under the Resource Management Act 1991. However, if a higher level of protection is to be included in a district plan there shall be no deviation from standard aircraft operating procedures and there shall be no special flight procedures for noise abatement purposes to meet any unusual local situation. This Standard shall not be used as a mechanism for downgrading existing or future noise controls designed to ensure a high standard of environmental health and amenity values.

1.1.5

The main features of the recommended method of airport noise management are:

- (a) The Standard establishes maximum levels of aircraft noise exposure at an Airnoise Boundary, given as a 24-hour daily sound exposure averaged over a three month period (or such other period as is agreed).
- (b) The Standard establishes a second, and outer, control boundary for the protection of amenity values, and prescribes the maximum sound exposure from aircraft noise at this boundary.
- (c) In establishing the Airnoise Boundary, the Standard requires consideration of individual maximum noise levels from aircraft during any proposed night-time operations.

- (d) Noise control measures are necessary when the exposure of the residential community, determined according to Part 2 of this Standard, exceeds 100 pasques (or an Ldn of 65), and may be necessary when the exposure exceeds 10 pasques (or an Ldn of 55).
- (e) The Standard prescribes compatible land uses for those areas in the immediate vicinity of the airport. Compatible land uses at different levels of sound exposure are specified in table 1 and table 2.

1.1.6

The measurement of sound around an airport for use in setting the Airnoise Boundary and monitoring to ensure that the limits are not exceeded, is detailed in Part 2 of this Standard.

1.1.7

The specification and calibration of the instrumentation to be used is given in Part 3 of this Standard.

1.2 Statutory requirements

C1.2.1

The Resource Management Act 1991 is the principal statute for the management of land, subdivision, water, soil resources, the coast, air, and pollution control, including noise control. It sets out the rights and responsibilities of individuals, territorial and regional councils, and central government. The Act sets up a system of policy and plan preparation and administration which allows the balancing of a wide range of interests and values.

C1.2.1.1

The overarching purpose, which applies to every part of the Act, is:

to promote the sustainable management of natural and physical resources (section 5)

"Sustainable management" is defined as:

"managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being, and for their health and safety while ... avoiding, remedying, or mitigating any adverse effects of activities on the environment."

The definitions of "environment" (section 2) and "effect" (section 3) are very important to the Act and should be considered closely.

"Environment" includes, amongst other things, people and communities, and amenity values.

"Effect" includes any positive or adverse effect, any temporary or permanent effect, any past, present or future effect, and any cumulative effect which arises over time or in combination with other effects. "Effect" also includes any potential effect of high probability and any potential effect of low probability which has a high potential impact.

C1.2.1.2

Those exercising functions and powers under the Act are required to have particular regard to matters which include:

- (a) *The maintenance and enhancement of amenity values;*
- (b) *The maintenance and enhancement of the quality of the environment.*

C1.2.1.3 Duty to avoid unreasonable noise

Section 16 of the Act places a duty on every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in the coastal marine

area, to adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level.

This does not limit the right of any local authority to prescribe noise emission standards in plans made, or resource consents granted.

C1.2.1.4 Functions of local government
In terms of noise control, these include:

- (a) *Regional councils - control of the emission of noise and the mitigation of the effects of noise from any coastal marine area in the region;*
- (b) *Territorial authorities - control of the emission of noise and the mitigation of the effects of noise.*

C1.2.1.5 Duty to consider alternatives to policies, regulations, plans, rules etc.
The Act requires decision makers to identify the most effective and efficient way of carrying out their functions and how this will best meet the objective of the Act. In other words, before the Minister for the Environment makes or alters any national policy statement or regulation, or any local authority sets any objective, policy or rule, they must have regard to:

- (a) *The extent to which the proposal is necessary to achieve the purpose of the Act;*
- (b) *The use of alternative means, such as the provision of information, services or incentives and the levying of charges to achieve the purpose of the Act;*
- (c) *The reasons for and against the proposal and the principal alternative, including the option of doing nothing.*

C1.2.1.6 Duty to gather information, monitor, etc.
Local authorities are required to gather information and carry out research necessary to fulfil their functions under the Resource Management Act. This includes:

- (a) *Monitoring the state of the environment within a region or district;*
- (b) *Monitoring the effectiveness of any policy statement or plan;*
- (c) *Monitoring the exercise of any functions, powers and duties, and any resource consents.*

Information to be kept by a local authority includes copies of policy statements and plans, records of resource consents, and a summary of all written complaints over the preceding 5 years concerning alleged breaches of the Act.

The Minister for the Environment may request a local authority to supply him/her with information relating to the exercise or performance of any of the local authority's functions, powers or duties under the Act.

C1.2.1.7 National environmental Standards

The Act makes provision for regulations to be made, by Order in Council, which will be known as national environmental Standards. These may include technical Standards relating to noise. There will be a process whereby the public will have opportunity to comment on proposed Standards.

C.1.2.1.8 Regional policy statements, plans and rules

These must not be inconsistent with any national policy statement. Regional policy statements provide an overview of the resource management issues of the region, and policies and methods to achieve integrated management of natural and physical resources of the region.

Plans assist regional councils to carry out their functions under the Act.

Rules may be included in plans to prohibit, regulate, or allow activities.

C1.2.1.9 District plans and rules

District plans assist territorial authorities to carry out their functions under the Act. A district plan must not be inconsistent with any national policy statement or regional policy statement.

District rules may be included in district plans to prohibit, regulate or allow activities.

C.1.2.1.10 Matters which may be included in policy statements and plans

These are outlined in the Second Schedule to the Act.

Matters related to regions include the control of the emission of noise arising from activities involving the use, development, or protection of any natural and physical resources, including the coastal marine area, for which the regional council will have responsibility under the Act.

Matters related to districts include the control of the emission of noise from land and structures in the district arising from activities involving the use, development, or protection of land, and any associated natural and physical resources for which the territorial authority will have responsibility under the Act.

C1.2.2

The Health Act 1956 requires local authorities to control nuisance within their districts. The Health Amendment Act 1978 includes in its definition of "nuisance" any noise or vibration which is offensive or likely to be injurious to health.

1.3 Definitions

SOUND EXPOSURE in pascal-squared-seconds or "pasques" (Pa²s) is the time integral of squared, instantaneous A-frequency-weighted sound pressure over a particular time period, for example over a 24 hour period.

$$E = \int_{t_1}^{t_2} p_A^2(t) dt$$

where

E is the A-weighted sound exposure

$p_A^2(t)$ is the square of the A-frequency-weighted sound pressure as a function of time for an integration period starting at t_1 and ending at t_2

p_A is in pascals and t is in seconds.

NIGHT-WEIGHTED SOUND EXPOSURE (E_n) in pasques is the sound exposure over a 24 hour period from midnight to midnight, with each noise event between the hours of midnight and 0700 hours, and between 2200 hours and midnight, counted ten times.

$$E_n = \int_{0700}^{2200} p_A^2(t) dt + 10 \times \int_{0000}^{0700} p_A^2(t) dt + 10 \times \int_{2200}^{2400} p_A^2(t) dt$$

SINGLE EVENT SOUND EXPOSURE (S_e) in pascal-squared-seconds is the integral of sound pressure (squared) and time for a single noise event.

SOUND LEVEL or WEIGHTED SOUND PRESSURE LEVEL is the logarithm, to the base 10, of the ratio of the square of a given sound pressure, obtained with a standardized frequency-weighting, and a standardized exponential time-weighting or constant time-weighting during a stated time period, to the square of the reference sound pressure of 20 micropascals. Sound level in decibels is 10 times the logarithm, to the base 10, of that ratio.

NOTE –

- (1) Standardized frequency weightings A and C and standardized exponential time weightings F, S and I are given in IEC Publication 651 (1979) Sound Level Meters.
- (2) The time and frequency weighting employed should be stated, but if weightings are not stated explicitly, the F time weighting and the A-frequency-weighting are to be understood.

MAXIMUM A-WEIGHTED SOUND PRESSURE LEVEL, or MAXIMUM SOUND LEVEL, (L_{max}), is 10 times the logarithm, to the base 10, of the ratio of the square of the maximum sound pressure, obtained with a standardized A-frequency weighting and a standardized exponential time weighting during a stated time period, to the square of the reference sound pressure of 20 micropascals.

TIME AVERAGE SOUND LEVEL or EQUIVALENT CONTINUOUS SOUND LEVEL (L_{eq}) is the logarithm of the ratio of a given mean square standardized frequency-weighted sound pressure, during a stated period, to the square of the reference sound pressure of 20 micropascals. Time average sound level in decibels is ten times the logarithm to the base ten of that ratio.

NOTE- If no weighting is stated, A-frequency-weighting is to be understood.

SOUND EXPOSURE LEVEL (SEL) in dBA is defined as the level of the time-integrated mean square A-weighted sound for a stated time interval or event, with a reference time of 1 second. Or, in simple terms, sound exposure level may be considered as the A-weighted sound level which, if maintained constant for a period of 1 second, would convey the sound energy as is actually received from a given noise event.

$$SEL = 10 \log \int_{t_1}^{t_2} \left[\frac{p_A(t)}{p_0} \right]^2 dt$$

where

p is in pascals and t in seconds

p_0 is the reference sound pressure of 20 micropascals

In terms of sound exposure: 1 Pa²s is very close to an SEL of 94 dBA.

THE DAY/NIGHT LEVEL (L_{dn}) is defined as the time-average sound level in decibels (re 20 micropascals) over a 24 hour period (from midnight to midnight) with the addition of 10 dB to night-time levels during the period from midnight to 07.00 hours and from 22.00 hours to midnight, to take account of the increased annoyance caused by noise at night.

NOTE – In all aircraft noise considerations, the day/night level is based on an average day over an extended period of time - for example a season or a year.

This Standard uses the day/night level concept but utilizes the units of pascal-squared-seconds in place of decibels to give a night weighted sound exposure. In terms of sound exposure using these modern units, the day/night level equates to the total number of Pa²s units received on

average in a 24 hour period, where each event heard at night is considered to be as annoying as 10 such events during the day, and hence is multiplied by 10.

- 1000 Pa²s equates to an Ldn of about 75
- 350 Pa²s equates to an Ldn of about 70
- 100 Pa²s equates to an Ldn of about 65
- 35 Pa²s equates to an Ldn of about 60
- 10 Pa²s equates to an Ldn of about 55

AERODROME (AIRPORT) means any defined area of land or water intended or designed to be used either wholly or partly for the landing, departure, and surface movement of aircraft; and includes any buildings, installations, and equipment on or adjacent to any such area used in connection with the aerodrome or its administration.

AMENITY VALUES means those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

1.4 Control boundaries

1.4.1 *The airnoise boundary*

1.4.1.1

The airnoise boundary defines an area around an airport within which the current or future daily amount of aircraft noise exposure will be sufficiently high as to require appropriate land use controls (table 1) or other measures to avoid, remedy or mitigate any adverse effect on the environment, including effects on community health and amenity values whilst recognizing the need to operate an airport efficiently.

1.4.1.2

The average night-weighted sound exposure over a 24 hour period (at the airnoise boundary) shall not exceed 100 Pa²s (65 Ldn), see table 1. The average shall be established over a period of 3 months or such other period as agreed between the operator and the local authority.

1.4.2 *The outer control boundary*

1.4.2.1

The outer control boundary defines an area outside the airnoise boundary within which there shall be no new incompatible land uses (see table 2).

1.4.2.2

The predicted 3 month average night-weighted sound exposure at or outside the outer control boundary shall not exceed 10 Pa²s (55 Ldn).

1.4.3 *Locating the airnoise boundary and the outer control boundary*

1.4.3.1

A projection should be made of future aircraft operations to determine the 10, 35, 100, 350 and 1000 Pa²s (or 55, 60, 65, 70 and 75 Ldn) sound exposure contours. It is recommended that a minimum of a 10 year period be used as the basis of the projected contours, and their location may be estimated for planning purposes using the FAA Integrated Noise Model or other appropriate models.

1.4.3.2

Future airport operations should be projected in terms of:

- (a) Aircraft types (current and future);

- (b) Flight frequencies by aircraft type, time of day, runway use and approach/departure tracks, landing and take-off profiles, and trip lengths;
- (c) Variations in airport operations within a year (e.g. due to seasonal effects);
- (d) Current and future runway capacity and any proposed airport development.

Account should also be taken of:

- (e) Navigation system accuracy and limitations;
- (f) Aircraft operational noise abatement procedures;
- (g) Any available noise monitoring data.

1.4.3.3

The preliminary assessment of the location of the sound exposure contours and the proposed airnoise boundary should be carried out with consultation between the airport operator and the local authority and other interested parties.

1.4.3.4

Only noise resulting from aircraft operations shall be considered when determining sound exposure contours and the airnoise boundary.

1.4.3.5

In the planning stages, the sound exposure predictions should be based on an average day calculated from all operations during the busiest three months of the year.

1.4.3.6

Night-time operations shall be considered in establishing the airnoise boundary. For airports with frequent day and night operations, planning based on night-weighted sound exposure may be adequate. For smaller airports or airports with infrequent or irregular daily usage patterns, planning on the basis of sound exposure contours may not provide an adequate protection area around the airport to avoid sleep disturbance. Local authorities shall also consider the available data on noise levels for the noisiest aircraft types which it is anticipated will use the airport.

1.4.3.7

The local authority should consider whether those contours would be a reasonable basis for future land use planning taking into account:

- (a) The time frame of the projection;
- (b) The extent of non-compliance of existing land uses with table 1;
- (c) The impacts, including economic, social, health and safety of airport development on surrounding land use;
- (d) National, regional and local development, and national and international transportation requirements;
- (e) The effects of aircraft noise on the welfare, amenity values and health of any affected community;
- (f) The effect of the contours on existing aircraft operators' flexibility to meet the community's demand for services in a commercially and economically viable way;
- (g) New Zealand's obligations to international standards relating to aircraft noise emissions, and programmes to phase out noisier aircraft types;

- (h) The costs and benefits of land use controls, based on the airnoise boundary, compared to other options which would achieve the same objective of managing the adverse effects of airport noise.

1.4.3.8

After considering the matters specified in 1.4.3.6 above, the local authority should incorporate into its district plan a map showing the projected sound exposure contours, or showing the contours in a position further from, or closer to the airport, if it considers it more reasonable to do so, in the special circumstances of the case. An area shall be chosen to contain the 100 Pa²s (or 65 Ldn) contour. The perimeter of this area is the airnoise boundary. Similarly an area shall be chosen to contain the 10 Pa²s (or 55 Ldn) contour. The perimeter of this area is the outer control boundary. These boundaries should also be shown on the map.

1.4.3.9

The formal determination of airport planning involves the public process set out in the Resource Management Act 1991 First Schedule (Preparation, Change and Review of Policy Statements and Plans Part I).

1.4.3.10

If the airport operator, local authority or any other affected or interested party cannot agree on the location of the airnoise boundary and/or the outer control boundary, appropriate remedies exist within the Resource Management Act (as outlined in the First Schedule Parts I and II) for the matter to be heard by the Planning Tribunal.

1.4.3.11

Having completed the planning process the local authority shall take such steps as are necessary to give effect to the compatible land use criteria recommended in table 1 and table 2.

1.4.4 Implementation

1.4.4.1

The airport operator shall manage its operations so that the 3 month (or such other period as is agreed) average 24 hour night-weighted sound exposure does not exceed the limit at or outside the airnoise boundary. When a transition period is necessary for an airport to comply with the limits at the airnoise boundary (for example to enable the introduction of quieter aircraft) then the local authority plan shall specify the date by which compliance must be achieved.

1.4.4.2

If the noise produced by airport operations exceeds the limits at the Airnoise Boundary, the airport operator shall take immediate steps to reduce the sound exposure to meet the limits.

1.4.4.3

To facilitate a co-operative approach to managing local airport noise issues, it is recommended that the airport operator convene a standing "Airport Noise Abatement Committee" seeking involvement from:

- (a) Aircraft and airline operators;
- (b) Airways Corporation of New Zealand;
- (c) Local authorities/community representatives.

1.4.4.4

Nothing in this Standard (such as in 1.4.4.1 specifying a date by when compliance must be achieved) should be construed as to require any local authority or airport operators to take short term measures to achieve compatibility which would impose an undue burden on either the local authority, airport operators, airlines, aircraft operators or the affected community. The emphasis

should be on achieving long term compatibility within the time frame of the planning process, using practical measures.

1.5 Noise monitoring

1.5.1

The purpose of monitoring is to gather objective data of sound exposures to:

- (a) Determine compliance with the Standard and/or the District Plan provisions;
- (b) Validate the compatible land use planning process;
- (c) Provide a basis for evaluating sound reduction measures.

1.5.2

A noise measurement programme, where appropriate, should be implemented to monitor compliance with sound levels approved in the District Plan.

1.5.3

Noise measurements shall be made according to Part 2 of this Standard.

1.5.4

The instrumentation shall meet the requirements of Part 3 of this Standard.

1.6 Review of airnoise boundary and outer control boundary

1.6.1

Due to changing circumstances, it may be necessary to review the location of the sound exposure contours and the airnoise boundary during the period of the projected aircraft operations. This review should be considered if it appears that future operations would result in sound exposures more than 3 dB above the specified contours. Any review should follow the steps set out in 1.4.3 and 1.4.4.

C1.6

In any case, section 79 of the Resource Management Act 1991 requires a local authority plan to be reviewed not later than 10 years after the plan becomes operative.

1.6.3

Subsequent validation of sound exposure contours produced by computer model may be beneficial.

1.6.4

If validation is desired, this may be achieved by periodic monitoring of both airport operations (including aircraft types, flight frequencies, departure and arrival tracks) and noise measurements. Techniques for such monitoring are given in Parts 2 and 3.

1.7 Aircraft noise management

1.7.1

Aircraft operators shall ensure that emission of noise from aircraft operating within close proximity to airports is kept as low as possible, consistent with safety.

1.7.2

Aircraft operators shall ensure that standard flight procedures are followed at all airports except where terrain or airspace restrictions dictate otherwise.

1.7.3

If current or future airport operations exceed the planned sound exposure outside the

airnoise boundary then the airport operator should take steps to reduce the sound exposure, including but not limited to:

- (a) Using noise abatement procedures where applicable;
- (b) Phasing out of noisy aircraft over an appropriate period;
- (c) Utilizing air traffic control procedures to avoid noise sensitive areas;
- (d) Placing restrictions on aircraft operations by type or time of day or frequency of use.

1.7.4

Where an airport operator requires noise abatement procedures to be followed by aircraft using the airport, only standard International Civil Aviation Organisation noise abatement procedures may be imposed.

1.7.5

Nothing in this document shall preclude a pilot in command from using full power or following any flight path as he/she deems necessary in the circumstance of that flight.

1.8 Explanation of tables

C1.8.1

All considerations of annoyance, health and welfare with respect to noise are based on the long term integrated adverse responses of people. There is considerable weight of evidence that a person's annoyance reaction depends on the average daily sound exposure received. The short term annoyance reaction to individual noise events is not explicitly considered since only the accumulated effects of repeated annoyance can lead to adverse environmental effects on public health and welfare. Thus in all aircraft noise considerations the noise exposure is based on an average day over an extended period of time - usually a yearly or seasonal average. (Further details may be obtained from US EPA publication 500/9-74-004 "Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety").

1.8.2

Table 1 enumerates the recommended criteria for land use planning within the airnoise boundary i.e. 24 hour average night-weighted sound exposure in excess of 100 Pa²s (65 Ldn).

1.8.3

Table 2 enumerates the recommended criteria for land use planning within the outer control boundary i.e. 24 hour average night-weighted sound exposure in excess of 10 Pa²s.

**Table 1
RECOMMENDED NOISE CONTROL CRITERIA FOR LAND USE PLANNING INSIDE THE
AIRNOISE BOUNDARY**

Sound exposure Pa ² s (1)	Recommended control measures	Day/night level Ldn (2)
>100	New residential, schools, hospitals or other noise sensitive uses are prohibited. Steps shall be taken to provide existing residential properties with appropriate acoustic insulation to ensure a satisfactory internal noise environment. Alterations or additions to existing residences or other noise sensitive uses shall be permitted only if fitted with appropriate acoustic insulation.	>65
>350	Consideration should be given to purchasing existing homes, or relocating residents, and rezoning the area to non-residential use only.	>70
>1000	There is a high possibility of adverse health effects. Land shall not be used for residential or other noise sensitive uses.	>75

NOTE –

(1) Night-weighted sound exposure in pascal-squared-seconds or “pasques”.

(2) Day/night level (Ldn) values given are approximate for comparison purposes only and do not form the base for the table.

**Table 2
RECOMMENDED NOISE CONTROL CRITERIA FOR LAND USE PLANNING INSIDE THE
OUTER CONTROL BOUNDARY BUT OUTSIDE THE AIR NOISE BOUNDARY**

Sound exposure Pa ² s (1)	Recommended control measures	Day/night level Ldn (2)
>10	New residential, schools, hospitals or other noise sensitive uses should be prohibited unless a district plan permits such uses, subject to a requirement to incorporate appropriate acoustic insulation to ensure a satisfactory internal noise environment. Alterations or additions to existing residences or other noise sensitive uses should be fitted with appropriate acoustic insulation and encouragement should be given to ensure a satisfactory internal environment throughout the rest of the building.	>55

NOTE –

(1) Night-weighted sound exposure in pascal-squared-seconds or “pasques”.

(2) Day/night level (Ldn) values given are approximate for comparison purposes only and do not form the base for the table.

PART 2 MEASUREMENT AND DESCRIPTION OF AIRCRAFT NOISE EXPOSURE

2.1 Scope

2.1.1

This Part of the Standard describes the conditions necessary for the siting of a noise measurement terminal and the procedures to take for long term monitoring of aircraft noise exposure:

- (a) At a fixed position; and
- (b) For a roving terminal.

It does not provide a procedure for measuring and describing the noise emission from an aircraft as base data for predicting noise exposure around an airport. For such a purpose, the procedures laid down in ISO Publication 3891:1978 are recommended.

2.1.2

It provides specifications for the steps to be followed for the purpose of describing the noise exposure at a noise monitoring terminal resulting from aircraft operations.

- (a) Data acquisition. The method of measurement and recording of the noise;
- (b) Data processing. The method of determining from these data the corresponding values on the appropriate noise scale;
- (c) Data reporting.

2.2 Field of application

This Standard is intended to apply quite generally to the description of the noise exposure at a fixed location from all kinds of aircraft operations.

2.2.1

Two main applications of the measurements are covered:

- (a) Requiring the characterisation of single events such as for the measurement of the noise from an individual aircraft against specified requirements;
- (b) Requiring the determination of noise exposure for a succession of events,

2.3 Measurements

2.3.1 *Data acquisition*

2.3.1.1

To provide the necessary information on the noise produced by the aircraft at the noise monitoring terminal site, the equipment and method specified in this subclause shall be used.

2.3.1.2 *Equipment to be used*

An integrating-averaging sound measuring system meeting the requirements of Part 3 of this Standard shall be used.

2.3.1.3

Though a complete integrating system is specified, the combination of a conventional sound level meter and an accessory or plug-in, that provides the averaging capability, is permissible if the complete system satisfies the requirements of Part 3 of this Standard. The system must be capable of measuring the sound exposure of a single event and the sound exposure over an extended period of time. In this latter case the system must record the time of each event, preferably in the form of a complete noise/time history.

2.3.1.4

The unit of measurement is the basic acoustic unit for sound exposure, the pascal-squared-second or "pasque" (Pa²s), and is A frequency-weighted. Some older systems may not give results in this unit directly. In this case it is acceptable for the system to measure in terms of time average sound level (Leq), or for an individual event in terms of sound exposure level (SEL). The results may then be converted to day/night level (Ldn) and/or sound exposure in pascal-squared-seconds.

2.3.1.5

The system shall include a data storing or recording device. Its characteristics shall be such that the recorded values of A frequency-weighted sound pressure, or A frequency-weighted sound pressure level, meet the requirements of Part 3 of this Standard.

NOTE – Other equivalent equipment may be used if complying with the same characteristics.

2.3.1.6 Acoustical sensitivity check

2.3.1.6.1 For a portable or roving noise monitor

The overall sensitivity of the measuring system shall be checked before and after each measurement session, using an acoustic calibrator generating a known sound pressure (level) at a known frequency.

2.3.1.6.2 For a fixed noise monitoring terminal

The overall sensitivity of the complete system shall be checked at installation, and at regular intervals, using an acoustic calibrator generating a known sound pressure (level) at a known frequency. Regularly (normal practice is at least once a day) the sensitivity shall be checked by some means such as an electrical actuator, or other calibrated sound source at the microphone, if use of an acoustic calibrator is impracticable.

NOTE – An acoustic calibrator operating at 1 000 Hz is generally used for this purpose.

2.3.1.7 Microphone location

2.3.1.7.1

The idealized test environment is an unobstructed hemisphere over a flat and totally reflecting ground surface, with no background noise. In practice it is most unlikely such an environment can be found and the following conditions are therefore necessary to achieve an acceptable level of accuracy.

2.3.1.7.2

The microphone shall be placed in a position clear of any obstruction or reflecting surfaces that could significantly influence the sound field from the aircraft.

The microphone should also be in such a position that it will not be subject to other sounds that might significantly influence the sound field from the aircraft.

NOTE –

- (1) For fixed noise monitoring terminals this will normally entail having the microphone some 6 to 7 metres above the ground and away from any major roads or other comparable noise sources. The measured SEL from any such sources shall be at least 10 dB below the measured SEL of the aircraft, unless the measurement system contains some means of filtering out such noise components.
- (2) For a portable noise monitor, the microphone should be placed as high as practicable. It should be remembered that those people attending to the noise monitor could themselves constitute such an obstruction.
- (3) In all cases, the support should be designed so as to exert minimum influence on the directivity of the microphone and not introduce significant diffraction effects. The microphone should also be protected from the adverse effects of weather and should not be placed near any fixture that may be a source of significant wind induced noise.

2.3.1.8

In the measurement of the sound exposure for a single event, the background noise level shall be recorded immediately before and immediately after the event. During long term monitoring, the system shall record the background noise level throughout.

2.3.1.9

Measurements of aircraft noise shall be considered reliable only when the measured maximum noise level of the aircraft exceeds these background noise levels by at least 20 dB.

2.3.2 Data processing

2.3.2.1

The methods of measurement specified above provide values of sound exposure and time for each noise event measured. To provide the values on the appropriate scales characterising each noise event measured and the sound exposure from a succession of events, the procedures in this subclause shall be used.

2.3.2.2

The appropriate measures are the sound exposure (E) for each single event and the night weighted sound exposure (E_n). Both are in pascal-squared-seconds and A weighted.

$$E_n = \sum E_{\text{day}} + 10 \times \sum E_{\text{night}}$$

2.3.2.3

If the measurement system can utilize A-weighted sound pressure level only, producing for each event the sound exposure level SEL and totalling to give Day/Night level Ldn, then the results may be converted to sound exposure in pascal-squared-seconds from the formulae:

$$E_n = 3.456 \times 10^{-5} \left[\begin{array}{c} \text{Ldn} / 10 \\ 10 \end{array} \right]$$

$$E = 4.00 \times 10^{-10} \left[\begin{array}{c} \text{SEL} / 10 \\ 10 \end{array} \right]$$

2.3.3 Data reporting

2.3.3.1

As a minimum, the report shall contain:

- (a) Details of the location of the noise monitor;
- (b) A noise versus time history, with each single event sound exposure related to its time of occurrence;
- (c) A summation of the sound exposure from aircraft to give the night-weighted sound exposure for each day at that location;
- (d) The report shall also give details of the noise monitoring system used together with full details of the daily sensitivity checks on the system and the most recent laboratory calibration.

2.3.3.2

For airport noise control using the airnoise boundary concept, it may be required that each single event sound exposure be related to the individual aircraft producing the noise. It may also be required that the daily summation of noise exposure from each airline/operator be produced, as well as the total for all operations. In this case there must be some accurate means of relating each individual single event with the relevant aircraft concerned.

NOTE - There are a number of methods of relating each noise event to the individual aircraft producing the noise. These methods are outside the scope of this Standard. A number of proprietary noise monitoring systems have such a capability.

PART 3 INSTRUMENTATION FOR AIRCRAFT NOISE MONITORING

3.1 Introduction

3.1.1

This Part of this Standard specifies a monitoring system intended for the measurement of sound from aircraft in flight, typically at or near airports. It is intended to be consistent with the provisions of IEC 651 *Sound level meters* and IEC 804 *Integrating averaging sound level meters* as they describe Type 1 units.

C3.1.2

The difficulties of measurement when the source of noise is not in the same plane as the microphone should not be underestimated, particularly when the problems of protection of the microphone against rain and wind is taken into account. Many microphones intended for outdoor use, have good omnidirectional characteristics in a toroidal field – that is they exhibit nearly equal sensitivity to signals arriving from sources at or near the horizontal plane of the microphone, but exhibit some directivity when measuring sources at a high angle from the horizontal. For use with aeroplanes in flight, omnidirectionality in this plane is desirable.

C3.1.3

Instruments made to this Standard will normally be computer based with some connection between the instrument and an external computer which reads out the final data. In neither IEC Publications 651 nor 804 is there any reference to the method of linking the Sound Level Meter, to any external computer so as to standardize as far as possible the type and form of data transmitted between them.

3.2 Scope and field of applications

3.2.1

This Standard describes instruments intended to measure frequency weighted and time averaged sound pressure levels or sound exposure. The units measured should be pascal-squared seconds, but may be pascal-squared kiloseconds or pascal-squared hours or sound exposure level in decibels provided the computer software may readily convert the measurements into pascal-squared-seconds. Alternatively, the equivalent continuous sound pressure level, L_{eq} , may be displayed, with the same proviso.

3.2.2

Instruments complying with the requirements of this Standard are intended to have means of storing the units measured, in digital or other form for subsequent recall and display, without corrupting the original data. Typically, a group of instruments meeting this Standard will operate together, sending acquired data to an external computer or processor for correlation and display. For this reason, no display or read-out at each unit is mandated in this Standard.

3.2.3

An important feature of an aircraft noise monitor is the ability to differentiate between aircraft noise and other noise sources, such as road transport etc. This recognition is usually done by programmes in the computer either in each unit or in the central processor. This Standard does not cover this recognition and no tests have been devised to check on the performance of the algorithms in such devices.

3.2.4

Only instruments equipped with A frequency-weighting as defined in IEC 651 are included in this Standard. For use in other situations, the instrument may be equipped with facilities and weighting curves other than those described in this Standard, but tests are not described for such facilities.

3.3 Definitions

For most definitions in this Part of this Standard, reference should be made to IEC 50 *International electrotechnical vocabulary (IEV)* Chapter 801.

LINEARITY RANGE. The difference between the upper and lower rms levels of a continuous sinusoidal signal in which the linearity requirements of this Standard are met.

PULSE RANGE. The difference between the upper and lower rms levels of a tone burst in which the linearity requirements of this Standard are met.

REFERENCE LEVEL. The sound level used for calibrating the sensitivity of the instrument. The reference level shall be 94.0 decibels. (1 pascal)

REFERENCE FREQUENCY. The frequency shall be 1000 Hz.

SOUND PRESSURE LEVEL. 10 times the logarithm to base 10 of the ratio of the square of the sound pressure to the square of the reference sound pressure of 20 micropascals.

DIGITAL INTERFACE. For the purposes of this Standard, the mechanical and electrical connection between the instrument and its remote processor or an external computer, including the data transmission protocol.

NOTE - This definition should be used ONLY for the purposes of this Standard.

3.4 General performance requirements

3.4.1

An aircraft noise monitor is generally a combination of a microphone, a process unit, a storage device, a reprocessing unit and some read-out facility.

3.4.1.1

The process unit usually consists of the elements of a sound level meter or integrating sound level meter as described in IEC 651 and IEC 804. However, the output of the process unit is not normally displayed directly, but either sent directly to the reprocessing unit or to a storage device.

3.4.1.2

All tolerances where possible are referred to the final output by whatever method this is presented. Typical units may give the final output on a monitor screen, as a paper printout or by other means.

3.4.2 *The resultant reading*

3.4.2.1

The resultant reading of the sound level or equivalent continuous sound level shall be accurate to within ± 0.7 dB after a warm up period specified by the manufacturer.

3.4.2.2

Provision shall be made to enable calibration with an external acoustic calibrator.

3.4.2.3

A means should be provided to check the sensitivity of the system by remote means without the requirement for any outdoor enclosure to be opened. Any calibration device while fitted, but not operating, shall not cause the instrument to deviate from this specification.

NOTE –

(1) This requirement is most often met by means of an electrostatic actuation device permanently fitted to the microphone.

(2) Allowance shall be made for insertion losses produced by wind shields or other protective enclosures around the microphone.

3.4.3

The directional requirements shall satisfy the requirements of clause 5 of IEC 651, for Type 1, in a hemisphere centred on the microphone. The reference direction shall be in a horizontal plane through the acoustic centre of the microphone and the angles referred to in tables II and III of IEC 651 shall apply to the vertical plane.

NOTE –

- (1) For microphones used for continuously monitoring noise levels from aircraft operations, the effect of the above mentioned enclosures may be such that the requirements of IEC Publication 651 on the directionality of the microphone are not completely met. The ensuing loss of accuracy can be considered acceptable for this purpose if the sensitivity of the microphone to plane sound waves arriving from any direction within 45° of the axis of calibration does not differ by more than one dB below 1,000 Hz, 2 dB between 1 000 and 4 000 and 4 dB from 4 000 to 11 000 Hz, from the sensitivity to plane sound waves arriving along other directions within the same 45°.
- (2) For measurement of aircraft noise, the tolerances given in table II and table III of IEC 651 at 8000 Hz to 12 500 Hz shall be recommendations and not mandated.

3.4.4

The output signal from the process unit shall be A frequency-weighted. The tolerances specified in sub-clauses 6.1 and 6.2 of IEC 651 shall be satisfied as described for a Type 1 instrument.

3.4.5

The averaging requirements shall be as described in clause 6 of IEC 804.

3.4.6

The tests to determine compliance with this specification are given in clause 9 of IEC 804.

3.4.7

The whole instrument shall have provision for suitable input and output points to determine compliance with this Standard.

3.4.8

After a warm up time specified by the manufacturer and for a steady signal at the reference level, the final reading shall not drift during 1 hour and 24 hours respectively by more than the values shown in the following table. Means shall be provided to correct measurements periodically.

Time	Maximum change of reading
1 hour	0.3 dB
24 hours	0.5 dB

3.4.9 Power source

3.4.9.1

If the instrument is powered by means other than a conventional a.c. supply, the manufacturer shall specify the length of time the unit will continue to operate under stated conditions.

3.4.9.2

If batteries are used to supply the instrument, means shall be provided to indicate that the voltage is adequate to operate the instrument according to this specification. Alternatively the instrument shall indicate when the power supply is inadequate.

NOTE – If a conventional a.c. supply or solar, wind or other power source is used, it should be possible to go to automatic stand-by power without any pause.

3.5 Frequency weighting and amplifier characteristics

3.5.1

The instrument shall meet the requirements of IEC 651, clause 6. The tolerances specified in

sub-clauses 6.1 and 6.2 of IEC 651 shall be satisfied as described for a Type 1 instrument. The instrument will not be equipped with a manual level range control for use under normal operating conditions. Therefore sub-clauses 6.4, 6.8 and 6.9 shall not apply.

3.5.2

The manufacturer shall specify the maximum sound pressure level at all frequencies from 31.5 Hz to 12.5 kHz at which conformity to A frequency-weighting is maintained. Alternatively, the manufacturer shall specify the lowest frequency at which the linearity error between the sound input and the indicated reading is less than 1 decibel. This shall not be less than 31.5 Hz.

3.6 Averaging and indicator characteristics

3.6.1

The minimum linear operating range shall be 60 dB. The upper and lower boundaries of the linear operating range shall be specified by the manufacturer.

3.6.2

The pulse range shall be specified by the manufacturer, but shall not be less than 63 dB. The pulse range shall be contained inside the limits set by the linearity range. The permitted tolerance for the pulse range shall be ± 2.2 dB for a burst duration of not less than 1 ms and not more than 10 ms.

NOTE – It is recommended that the pulse range measured at any point inside the linearity range shall be 63 dB, providing that at no time shall the pulse range go outside the boundaries of the linearity range by more than 3 dB for a single sinusoid.

3.7 Overload and fault conditions

3.7.1

The instrument shall have means provided to indicate that any part of the measuring chain has been overloaded. Each indication of overload shall be stored together with the time of the overload. The reset of the overload indication shall only occur when a new integration period has started, or when a new sample is taken. The resolution of the overload time indication shall be at least the period of any aircraft overflight.

3.7.2

The instrument shall have automatic means to store fault indication and the manufacturer shall specify what fault data is stored. As a minimum, the time of any period of an operation, when the power supply is inadequate to maintain the requirements of this specification shall be stored and read out with the acoustic data.

3.8 Sensitivity to various environments

3.8.1

The requirements of IEC 651 for a Type 1 instrument shall be met.

3.8.2

Additionally, the manufacturer shall specify the temperature range over which any individual part of the unit satisfies these requirements. Such parts of the unit must meet the requirements of clause 8 of IEC 651 and additionally be able to withstand the annual recorded temperatures at the site of installation.

3.8.3

In particular, any part of the unit mounted in the open air, shall be able to withstand the recorded rainfall of that site without water entering the housing in quantities sufficient to cause the unit to fail to meet this specification over a 60 day period.

NOTE – As the instrument is often intended for operation on an installed basis, the temperature range over which the unit will operate to this specification should be greater than that at the installation site. Such temperatures may vary over a much greater range than the -10 °C to $+50$ °C specified in IEC 651.

3.9 Calibration and verification

3.9.1

For all tests, except microphone performance, signals are inserted electrically through the microphone preamplifier via a dummy microphone having the same impedance as that of the normal microphone.

3.9.2 *Linearity range*

3.9.2.1 *Upper boundary*

The upper boundary of the linear operating range is found by inserting a signal at the reference level and frequency of 94.0 decibels and 1000 Hz respectively. The level is increased until the final indicated output minus the output at the reference point deviates by 1 decibel from the input minus the input at the reference point.

NOTE – For units with read-out only in delayed time, it is recommended that this requirement should be deemed to be met while the graph of input versus output does not deviate by more than 1 decibel.

3.9.2.2 *Lower boundary*

The lower boundary of the linear operating range is found by inserting a signal at the reference level and frequency of 94.0 decibels and 1000 Hz respectively. The level is decreased until the final indicated output minus the output at the reference point deviates by 1 decibel from the input minus the input at the reference point.

NOTE – The lower boundary of the operating range will usually be limited by electrical noise, which may come from associated data processing equipment. It is important therefore that this test is performed with the instrument set up in the way it is actually used in the field.

3.9.2.3

The linear operating range shall be the upper boundary of the operating range minus the lower boundary of the operating range. At no point in the linear operating range shall there be a discontinuity greater than 0.3 decibels.

3.9.3 *Frequency weighting*

3.9.3.1

While the overall frequency weighting is important, it is convenient to test the electrical performance separately from the microphone transfer function and this is the preferred method. However, if this cannot be performed on a particular unit, the test method in 3.8.2.1 shall be applied acoustically to the microphone with the tolerances shown in table V of IEC 651.

3.9.3.2 *Electrical*

The electrical frequency response of the instrument shall be determined by inserting a signal at the reference level and frequency. The frequency is varied in steps no larger than one third octaves from 12.5 kHz down to 31.5 Hz, keeping a constant indicated output within 1 decibel. The ratio of indicated output to signal input shall follow the figures given in table IV of IEC 651, to the tolerances given in table V of IEC 651 for a Type 0 instrument. The results of this test shall be reported by the manufacturer.

3.9.3.3 *Overall*

3.9.3.3.1

The instrument shall meet the tolerance requirements of table V of IEC 651 for a Type 1 instrument.

3.9.3.3.2

This test will be deemed to be satisfied if the manufacturer can report data for para 3.8.2.1 which when added to the frequency response of the particular microphone in use are less than the tolerances of table V of IEC 651 for a Type 1 instrument. The manufacturer shall demonstrate that no additional errors are generated when the microphone is connected to the instrument.

3.9.4 Pulse range

3.9.4.1

An ideal integrating instrument will be limited in its pulse range only by the limits of the linearity range. However, for aircraft monitoring, the signals are not highly impulsive therefore a restricted pulse performance is acceptable.

3.9.4.2

The test is performed by applying a single short duration tone burst containing 4 cycles of a sinusoid at a frequency of 4 kHz, to the input at a peak level of 97 dB. This signal shall be correctly integrated over the shortest integrating time period of the instrument where this is longer than 10 ms. The error in the final read-out shall be less than 2.2 dB.

3.9.4.3

The background level for this test shall be at least 70 dB below the peak value of the applied signal.

3.9.5 Overload

The overload shall be checked by applying the pulse specified in 3.8.3 at increasing levels until the overload indicator latches. This shall be within 1 dB of the top of the linearity range and within it.

3.10 Provision for auxiliary equipment

3.10.1

The instrument will normally be used with the microphone connected to it by means of a cable. The instrument shall be tested with the cable in place.

3.10.2

If the instrument is provided with auxiliary outputs the conditions of sub-clauses 10.2 and 10.3 of IEC 651 shall apply.

3.11 Computer interface

3.11.1

The interface with the central computer shall comply with the requirements of EIA-RS-232 and the data format shall be specified by the manufacturer.

NOTE –

- (1) It is recommended that the RS-232 data protocol shall be 8 bit, 1 stop bit, no parity at 9600 or 2400 baud.
- (2) Other digital interfaces may be provided but it is recommended that these shall be to the requirements of an EIA Standard.

3.11.2

If a modem is used between the instrument and the remote computer, or between two or more instruments, a data correcting protocol shall be used. This protocol shall be stated by the manufacturer.

3.12 Rating information and instruction manual

The requirements of clause 11 of IEC 804 shall be met. Additionally the following data shall be provided:

- (a) The exact protocol of data transfer for all interfaces;
- (b) The maximum length of cable at each data transfer rate;
- (c) The mounting method for the microphone required to meet the tolerances of this Standard;
- (d) The duration of each calibration tone applied to the microphone;
- (e) The frequency of automatic calibration required to meet this Standard.

NOTE – Some requirements of clause 11 of IEC 804 are specified separately in this Standard and therefore need not be repeated on the rating plate or manual – namely 11.8, 11.14, 11.15 and 11.17.



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Approved by the Standards Council on 18 May 1992 to be a New Zealand Standard pursuant to the provisions of section 10 of the Standards Act 1988.

First published: 3 September 1992

The following SANZ references relate to this Standard:

Project No. P 6805
Draft for comment No. DZ 6805
Printing code: 300-1992/7036/5456
Typeset by: Standards New Zealand
Printed by: Wright & Carman Ltd.
