SEPA
Scottish Environment Protection Agency

GUIDANCE

ON THE CONTROL OF NOISE AT PPC INSTALLATIONS

Contents

Background

Purpose of The Guidance
and
Objective of Noise Control at PPC Installations

Chapter 1 Overview of the legal and regulatory framework.

Chapter 2 Application Processing

Chapter 3 Monitoring and Enforcement

Annex 1 Technical Aspects of Noise Control

Appendix 1 Legislative Framework

Appendix 2 Noise Management Plan Template

Appendix 3 Specification for Noise Survey

Appendix 4 Noise Survey Report Form

Appendix 5 References

Background

This guidance on the control of noise and vibration at PPC sites regulated by SEPA has been prepared at the request of the SEPA PPC implementation Team. The document should be viewed as complimentary to guidance currently being prepared by the Environment Agency in consultation with SEPA and the Environment and Heritage Service , Northern Ireland.

Although SEPA is working in liaison with the EA on the production of noise and vibration regulation and control guidance the PPC regulatory regime in Scotland differs significantly from that in England and Wales, where local authorities will continue to have a regulatory role with respect to A2 activities. There is no such division between Part A activities in Scotland where SEPA is the sole regulator of all PPC processes. Consequently it is appropriate to have a SEPA specific guidance although the technical aspects on noise and vibration control are of course common.

Guidance on the Control of Noise and Vibration at PPC Installations

Purpose of this Guide

This guidance aims to provide SEPA staff with practical guidance on the assessment of applications and the setting and enforcement of conditions placed on permits issued by SEPA in respect of noise and vibration arising from activities subject to controls placed on them by the Pollution Prevention and Control Act 1999 and associated Pollution Prevention and Control (Scotland) Regulations 2000.

This guidance, which is specifically designed for the different regulatory regime within Scotland for the control of PPC activities, is to be viewed as complimentary to the guidance on noise and vibration control at PPC installations being produced by The Environment Agency, The Environment and Heritage Service and SEPA.

Objective of Noise Control

The principal objective of setting noise control conditions in PPC permits is:

To prevent or minimise environmental pollution or harm to human health and preserve local amenity.

To achieve that objective

- Conditions placed in permits must be :

  Necessary
  Comprehensive
  Unambiguous
  Enforceable

- SEPA will not require permit holders to undertake extensive noise surveys in situations where it is clear that noise associated with an activity is unlikely to cause environmental pollution, harm to human health or be detrimental to the amenity of the locus.

- Conditions will placed on permits having due regard to cost / benefit and the principles of Best Available Techniques (BAT) for the type of activity being regulated.

- Conditions will be either descriptive or numeric dependant upon the individual circumstance with the level of control being balanced against environmental requirements.

- Conditions will be designed to ensure the process operator can readily and proactively monitor and ensure compliance with his permit and SEPA can undertake audit monitoring which is consistent and comparable with the monitoring methods required of the permit holder.

- SEPA will maintain close liaison with Local Authorities in respect of noise control at PPC installations in order to ensure that effective and appropriate preventative or remediation measures are incorporated into permits.

SEPA Guidance on the Regulation of Noise and Vibration

Chapter 1 The Regulatory Framework

1.1 Introduction

This document gives guidance on the regulation of noise and vibration in line with the concept of Integrated Pollution Prevention and Control (IPPC), implemented in Scotland by the *Pollution Prevention and Control (Scotland) Regulations 2000*, (The PPC Regs) made under the *Pollution and Prevention Control Act 1999.*

1.2 Integrated Pollution Prevention and Control

The IPPC regime employs an integrated approach to regulating certain industrial activities and installations that may cause pollution or have other environmental effects. These activities include major process industries, waste management and the intensive farming of certain livestock.

The fundamental philosophy of IPPC is that environmental problems should be addressed in an integrated way which is intended to avoid problems that may arise if separate approaches are taken to controlling releases to the air, water and land.

IPPC requires that installations should be operated in such a way that all appropriate preventative measures are taken against pollution, in particular with the application of Best Available Techniques (BAT). BAT includes both the technology used and the way in which the installation is designed, built, operated and decommissioned. *Installation* is defined as the regulated unit under the IPPC regime as implemented by the PPC Regulations, comprising one or more Part A activities as defined by the PPC Regulations.

The Act defines “emissions” as the direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in an installation into the land, air or water. Noise and vibration are therefore now included in this definition and the requirement to apply BAT is now equally relevant to emissions of noise and vibration as it is to other emissions.

It should be noted that Part B installations are specified in the Regulations, but the noise and vibration provisions of the new regime do not apply to the Part B activities.

1.3 Definition and Use of BAT

BAT is defined by the Regulations as *“the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole”.*

The full implication of this definition is that BAT covers both the plant used in the installation and the way it is operated. BAT will apply to any system or personnel that may have any influence on the installation's environmental impact. This means that adequate technical controls alone are not sufficient. Operating staff must therefore be properly trained and management must ensure that appropriate procedures are strictly adhered to. Management systems will therefore play an important role in this respect.

IPPC requires the use of BAT in setting emission limit values and conditions relating to the process parameters or technical measures. Limits and conditions are set at a level commensurate with BAT or such that BAT will be achieved within a specified period, by way of an ongoing improvement programme.

In determining BAT for a particular installation a number of factors will require to be considered and compared. These include costs and benefits, the technical characteristics of the installation concerned, geographical location and the local environmental conditions.

1.4 SEPA's Responsibilities

The responsibilities of the Regulator include:

- Determining applications for permits and setting appropriate permit conditions
- Inspection of installation and enforcement
- Review and revision of permits, and
- Determining applications for surrender of permits

Interfaces with Other Noise Legislation

1.5 Environmental Protection Act 1990

Local Authorities have a duty to inspect their area from time to time to identify any statutory nuisances and where a complaint of a statutory nuisance is made by a person living in the area, to take such steps as are reasonably practical to investigate the complaint.

Where a Local Authority is satisfied that a statutory nuisance exists or is likely to occur or recur in its area, legislation requires that the authority shall serve an abatement notice requiring any of the following:

- the abatement of the nuisance or prohibiting or restricting its occurrence or recurrence, and/or
- the execution of such works and the taking of such other steps as may be necessary for any of these purposes.

It is an offence not to comply with an abatement notice without reasonable excuse. A defence is to prove that the best practicable means were used to prevent or minimise the effects of the nuisance if the nuisance arose from industrial, trade or business premises.

The PPC Regulations provide however that statutory nuisance provisions contained in Part lll of the Environmental Protection Act 1990 (EPA90) do **not** apply where action may be taken under the PPC Regulations. This means that where a noise incident arises from a Part A installation which is found to be in breach of a permit condition, formal action will be taken under the PPC Regulations

This is to avoid "double jeopardy" for PPC operators and is consistent with previous arrangements under the Integrated Pollution Control regime. Activities that are not covered by a PPC permit even although they are on the sites of PPC installations, may be regulated by the Statutory Nuisance provisions. Examples include a barking dog or a burglar alarm as they do not form part of the installation. **The Regulators should come to an agreement at the application stage on which potential sources of noise on the site fall outside of the definition of the activity will continue to be regulated primarily by the Statutory Nuisance provisions.** In these situations a strategy on permitting and enforcement should be agreed and documented by the regulators.

The Regulations do not restrict the scope of aggrieved persons to take action under section 82 of EPA 90 and members of the public will still be able to take private prosecution under this section.

1.6 Control of Pollution Act 1974

The main provisions of the Control of Pollution Act 1974 (COPA) with respect to noise are to control noise from construction sites and also to allow for the creation of noise abatement zones.

Where it appears to a Local Authority that construction works are being, or are going to be carried out on any premises, the Local Authority may serve a Section 60 Notice imposing requirements as to the way the works are to be carried out. The Notice may specify the type of plant to be used or restrict the times that work can be undertaken or may impose noise level limits.

Where construction work is carried out on a PPC installation, conditions may have to be applied by way of planning permission or with the use of a Section 60 Notice if the Local Authority consider that the work may cause a noise problem.

Sections 63-67 of COPA allow Local Authorities to designate Noise Abatement Zones. The Local Authority will maintain a register of acceptable noise levels permitted within the Noise Abatement Zones and monitoring is undertaken at specified monitoring points. Where a noise level is exceeded without consent the Local Authority may serve a noise reduction notice.

Noise Abatement Zones have been criticised for their complexity and consequently few have been designated and specifically none have been introduced in Scotland.

1.7 Noise & Statutory Nuisance Act 1993

The 1993 Act amends the Environmental Protection Act 1990 to control statutory nuisances arising from vehicles, machinery and equipment on roads. The Act makes provisions for control of audible intruder alarms although in Scotland this provision has not yet been adopted and audible intruder alarms are dealt with by Statutory Nuisance proceedings.

1.8 Noise at Work Regulations 1989

The objectives of the permits issued under the PPC Regulations is to achieve environmental protection and reduce harm to human health not secure worker protection from exposure to noise which is controlled by a separate regulatory regime. Full co-operation between the HSE and the Local Authorities and SEPA is essential to ensure that noise controls placed on scheduled activities are effective and compatible.

Neither set of controls should adversely affect the protection of the environment, sensitive receptors or the workers. Where environmental protection demands tighter standards of control than are required to safeguard persons at work, these tighter standards should apply provided they have no adverse effects on the worker protection.

1.9 Noise Act 1996

The 1996 Act provides for the control of noise from dwellings at night and for the forfeiture and confiscation of equipment. The only provision relating to industry is section 10 which amends the Environmental Protection Act 1990 by allowing Local Authorities to seize and remove any equipment that appears to be used for the emission of the noise in question. **The 1996 Act does not apply in Scotland.**

1.10 BS 4142

Due to its variable character industrial noise can be difficult to assess. BS 4142, *"A Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas"*, promotes a method for assessing whether industrial noise is likely to give rise to complaints from people living nearby. Whilst a useful guide, BS 4142 should not be solely relied upon to accurately establish the impact of industrial development in terms of noise.

The standard uses comparisons between the measured background levels of a location (measured as the LA90) and the anticipated noise levels from proposed activities (measured as LAeq). BS 4142 suggests that in general a difference of 5dB is likely to be marginal, whilst an increase in 10dB will likely give rise to complaints. Tonal or impulsive characteristics are likely to increase the likelihood of complaints and this is taken into account by the "rating level" defined in the standard. This rating level should then be used when setting the level of noise that can be permitted.

The L_{Aeq} is defined as the value of the A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval has the same sound pressure as a sound that varies with time.

The L_{A90} is defined as the A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval.

1.11 BS 5228

British Standard 5228, "*Noise Control on Construction and Open Cast Sites"* is a soon to be updated code of practice comprising of 4 parts. This code of practice like others made under COPA 1974 does not have the force of regulation and non compliance with the code is not an offence. However, non compliance with the code may be considered in any proceedings.

Part 1: This part of the standard gives recommendations for methods of basic noise control relating to construction sites and other open sites where noisy work activities and operations are carried out.

Part 2: This part is a guide to noise and vibration control legislation for construction and demolition including road construction and maintenance.

Part 3: This part is a code of practice applicable to surface coal extraction by open cast methods.

Part 4: The final part is a code of practice for noise and vibration control applicable to piling operations.

The standard forms a series of codes of practice for construction sites. However sections of Part 1 provide useful guidance for any situation where noise is generated by plant outdoors for example on landfill sites. Part 1 provides a method of calculating noise from construction plant, including tables of noise source levels; a method for combining contributions from intermittently operating plant; a procedure for calculating noise propagation over soft and hard ground; a method for calculating noise screening effects and a way of predicting noise from mobile plant.

Part 1 also provides guidance on subjects that may be useful in other outdoor situation, such as, legislative background, community relations, training, noise and vibration neighbourhood nuisance, project supervision and control of noise and vibration. The standard gives examples of the noise control achievable through various methods and gives diagrams illustrating simple designs of noise enclosures and barriers.

In summary, BS5228 provides guidance that may be useful when predicting noise and when considering noise control techniques for plant operating outdoors, in particular on landfill sites.

1.12 BS 7445

This British Standard, *"Description and Measurement of Environmental Noise"*, gives clear guidance for the collection of noise data by monitoring in the field. It defines noise terms, describes the appropriate procedures for selecting monitoring locations and suitable time periods. It gives guidance on tonality and suggests that where a single third octave band level is at least 5dB higher than the level in both the adjacent bands then tonal character may be present.

1.13 Planning Advice Note PAN 50

PAN 50, Annex A "The Control of Noise at Surface Mineral Workings" provides advice on how the planning system can be used to keep noise emissions from surface mineral workings within environmentally acceptable limits without imposing unreasonable burdens on site operators.

The document recommends a set of absolute values for limits on site attributable noise, linked to day time and night time working periods that are considered to be related to the tolerance levels of most people. It is said that best available techniques should be adopted to achieve quieter working practises where desirable and technically feasible. Although the Annex does recommend a procedure for setting noise limits, it also recognises that each case should be treated on its merits, having regard to the particular circumstances of the site and its surrounding area.

Waste disposal sites share many common features with surface mineral workings and much of the advice contained in the document will be appropriate to noise control at such operations. As such, PAN 50 is a useful tool for assessing the noise from landfill operations that are covered by PPC.

1.14 Planning Controls

It is recognised that control of noise is achieved primarily through environmental protection legislation and implementation of the legislation will usually fall to the Environmental Health Department of the Local Authority and to SEPA. The bodies and authorities responsible for offering advice or for implementing these controls will therefore have expertise and experience which planning authorities may find useful in assessing planning applications. It is therefore important for planning authorities to liaise with the relevant body because some part of the activity for which planning permission has been sought may be subject to another more appropriate means of control or licensing condition. The planning permission should not seek to duplicate such controls.

It is not the purpose of the planning system to intervene in existing noise problems from lawful land use activity. However, the planning system has a role to play in preventing and minimising the impact of noise through its influence over the location and design of new developments. It should aim to do this without placing unreasonable restrictions or adding unduly to the costs and administrative burdens of business.

Where appropriate, planning conditions should be attached to planning permissions, which would reduce the adverse impact of noise and enable development to proceed where it would otherwise be necessary to refuse planning permission.

Planning Advisory Note, PAN 56 sets out advice as to how the planning system can implement policy on noise in order to prevent, control and manage possible noise pollution without overlapping with other statutory control measures. PAN 56 introduces the concept of noise exposure categories for proposed developments. These range from category A where noise is not likely to be a significant factor to Category D where noise is so

important that planning permission for an incompatible use should normally be refused. Policies incorporating the noise exposure categories should normally be included in Local Authority Plans so that noise can be considered at an early stage in the process.

1.15 Liaison with Planning Authorities

At an early stage, SEPA will liaise with the Local Planning Authority including Environmental Services to discuss a proposed application for a PPC permit. It is important at this stage to determine any existing noise conditions previously imposed by the Planning Authority. Relevant information relating to local history, agreements with neighbouring local authorities, existing ambient noise levels and planning policies concerning "creeping ambient" levels will be established as will any other known site specific information. The regulators will then determine and agree exactly which noise sources are included within the definition of the installation and will be regulated by SEPA, as detailed in Chapter 2.

Should there be an existing noise condition imposed on an installation falling within the scope of PPC, SEPA shall then examine the suitability of the content of the condition with regard to noise and vibration. Thereafter, in consultation with the Planning Authority, SEPA will either adopt the condition and/or strengthen and enforce its content. Depending on circumstances it may be good practice to set either an absolute limit based on the level of noise which should not be exceeded in a specified time period or a relative limit based on the permitted increases in noise level with respect to the background level. This is the approach detailed in BS4142.

Should it be the case that no noise condition exists SEPA shall impose an appropriate condition, taking into account local factors, in liaison and in agreement with the Planning Authority.

In the eventuality that SEPA and the Planning Authority fail to agree with the requirements of a noise condition, SEPA shall record the opinion of the Planning Authority and will put in writing the reason(s) for making such a decision and imposing the permit condition.

As stated in circular 10/99, *Planning and Noise*, planning permission shall not seek to duplicate other statutory more appropriate means of control; therefore it will be the responsibility of SEPA to take a lead role and enforce, when appropriate, permit conditions relating to noise and vibration.

SEPA and the Planning Authority will agree in writing as to the decisions made on a site specific basis in an attempt to prevent any possible duplication of work and/or confusion to site operators and members of the public at a later date.

The Planning Authority and SEPA will update each other accordingly should further information or details come to light regarding the PPC activity. This will include public complaints regarding the activity, changes to the activity or details of any formal action taken.

SEPA will make every effort to impose permit conditions relating to noise and vibration in line with the Planning Authority's local plans and policies through

the application of BAT, in setting emission limit values and conditions relating to the process parameters or technical measures.

1.16 The National Society for Clean Air has expressed the view that *inter alia* the BSI should consider the introduction of a new method of assessment of nuisance arising from industrial processes which will better reflect the impact of industry on the noise climate of neighbourhoods. However, the development of such a new assessment method will only be achieved following considerable research into cause and effect relationships of industrial noise and human health and the most appropriate parameter to best reflect that relationship.

Chapter 2 Application Processing

2.1 Background

Chapter 1 deals in detail with the regulatory framework but it is worth re-iterating here the general background to noise control at installations which fall to be regulated under the PPC regime.

The Pollution Prevention and Control (Scotland) Regulations 2000 (The PPC Regulations) require installations be operated in such a way that through the application of Best Available Techniques (BAT) pollution is prevented or minimised.

The definition of pollution includes: emissions as a result of human activity which may be harmful to human health or the quality of the environment, cause offence to any human senses, ... or impair or interfere with amenities and other legitimate uses of the environment." BAT in respect of noise and vibration control is therefore likely to be similar to the statutory nuisance legislation currently controlling noise which requires the use of "Best Practicable Means" to prevent or mitigate the effects of noise.

The PPC Regulations require SEPA to include within any permit conditions which will include emission limit values having due regard to BAT.

- Emission in relation to Part A installations or mobile plant is defined as: The direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in an installation or mobile plant into the air, water or land.

- Emission in relation to Part B installations or mobile plant is defined as: The direct release of substances or heat from individual or diffuse sources in an installation or mobile plant into the air.

Noise and vibration control by SEPA in respect of PPC is therefore restricted to the regulation of Part A installations with noise control at Part B installations continuing to be the responsibility of Local Authorities using statutory nuisance provisions.

Part III of the Environmental Protection Act 1990 which is regulated by Local Authorities deals with statutory nuisances which may include noise causing nuisance. However, in order to avoid possible double jeopardy for PPC operators a Local Authority may not, except with Scottish Ministers consent, institute nuisance procedures if proceedings can be brought in terms of the PPC permit issued by SEPA in respect of an installation.

Close liaison with Local authorities in respect of noise control at Part A installations is therefore essential to ensure that conditions specified by SEPA adequately address actual or potential noise nuisance arising from operations forming part of the process.

On a large site the installation may not take in all activities under the control of the Operator. The noise sources outside of the installation "boundary" will remain under the provisions of Statutory nuisance.

Within the boundary of the installation there may be activities or types of sources which are covered by other legislative provisions which have not been repealed or amended by the PPC Act and which might legitimately be non-installation noise.

This might include construction work, intruder alarms and guard dogs. It is likely that discussions with the Local Authority will identify a common sense approach for a given installation.

As a guide, the following activities or sources (in addition to that arising from the prescribed PPC activity) are likely to fall within the definition of an installation, provided that they are technically connected, and will need to be considered:

I. transport of materials between parts of the activity - including non-vehicular means of transfer such as pumping, blowing, conveyors. Vehicular transport off-site is not covered

II. warehousing and associated transportation

III. flares, even if physically remote from the activity

IV. cooling towers

V. extraction/ventilation fans

VI. raw material or other stockyards, and associated transport and stock management activities

VII. waste recycling or waste storage areas

VIII. overhead cranes

IX. emergency equipment - generators, flares, dump stacks

X. boiler blowdown and maintenance activities

XI. commissioning and construction or modification work which is not covered by planning provisions - for example, where SEPA requires modifications to a bund, storage area, drainage etc.

XII. high level alarms or other audible warning devices (external)

Some sources of noise although arising within an installation may still be covered by other legislation because they are not considered to be part of the activity being controlled by a PPC permit.

What will be excluded from an installation?

XIII. intruder alarms on buildings

XIV. guard dogs

XV. transport on access roads

XVI. tannoys, particularly when these are external to process buildings, provided that they are NOT associated with management of the process or activity.

2.2 Information to be provided with an Application

The information to be submitted with an application is specified in Schedule 4 of the Regulations but specifically in regard to noise the Operator must provide information relating to:

(i) Emissions of noise and vibration from the installation

(ii) Any noise sensitive receptors

(iii) Provide an assessment of the likely impact of those emissions on the identified receptors

Although Local Authorities will, as described in Chapter 1, be formally consulted at the application stage, pre-application knowledge of any noise issues in which the Local Authority has been involved with respect to a particular installation will be invaluable. Discussions with the Local Authority at the outset of the application procedure will assist in deciding the level of detail required from the operator with respect to noise and vibration from specific installations.

The level of detail required should be balanced against the degree of risk to the environment. The expectation is that the higher the risk of annoyance being caused the more detail required and the higher the expectation that a proactive approach will be adopted.

Where there is no history of complaint concerning noise from the installation because the process is inherently quiet then information requirements will be minimal. If a process has noisy components but there is no history of noise nuisance being caused by reason of remote location or other factors that may be subject to future change **it is expected that due regard must be given by the operator to the possible transient nature of the situation and the need to preserve and improve upon local environmental quality through the BAT obligation.** Under such circumstance the operator should be expected to provide a noise management and improvement plan detailing time scales for identified improvements.

Information needed to determine BAT for noise and vibration

Application Form Question	Describe the main sources of noise and vibration (including infrequent sources); the nearest noise-sensitive locations and relevant environmental surveys which have been undertaken; and the proposed techniques and measures for control of noise.

Existing Noise Situation

The operator should provide information on the following:

1. **The main sources of noise and vibration**, that fall within the PPC installation, providing the following information for each source;

   - whether continuous/intermittent/impulsive or tonal;
   - the hours of operation;
   - the type, e.g., aural or vibrational, elements;
   - its contribution to overall site noise emission (categorise each as high, medium or low unless supporting data is available).

   A common sense approach needs to be adopted in determining which sources to include. The ones which need to be considered are those which may have environmental nuisance impact, e.g., a small unit could cause an occupational noise issue in an enclosed space but would be unlikely to cause an environmental issue. Conversely, a large unit or a number of small units enclosed within a building could, for example, cause a nuisance if doors are left open. It must also be remembered that noise, which is not particularly noticeable during the day, may become more noticeable at night.

2. **Infrequent sources of noise and vibrations** not listed above (such as infrequently operated/season operations, cleaning/ maintenance activities, on-site deliveries or collections or out of hours activities) providing the information required in (1) for each source plus its time of operation.

3. **The nearest noise-sensitive sites** (typically dwellings, parkland and open-spaces - schools, hospitals and commercial premises may be, depending upon the activities undertaken there) and any other points/boundary where conditions have been applied by Local Authority Officers or as part of a planning consent, relating to:

   (a) the local environment:

   - provide an accurate map showing grid reference,

Information needed to determine BAT for noise and vibration	nature of the receiving site, distances and direction from site boundary; (b) conditions/limits imposed which relate to other locations (i.e., boundary fence or surrogate for nearest sensitive receptor): • any conditions imposed by the Local Authority (day/ evening/night*); • other conditions imposed, e.g., limits on operating times, technologies etc.; (c) the noise environment: • background noise level, if known (day/night/ evening) $L_{A,90,T}$. • specific noise level (day/night/evening) $L_{A,eq,T}$. • Pre-existing or Residual noise level (day/night/evening) L_{EQ}. • vibration data which may be expressed in terms of the peak particle velocity (PPV) or the vibration dose value (VDV). Additional statistical parameters such as $L_{A}50_{T}$,$L_{A}10_{T}$ L_{A}max, L_{A}min. will provide a better picture of the noise emission arising from the activity and the residual noise of the locus and should be provided where possible 4. **Details of any environmental noise measurement surveys,** any noise modelling work or any other noise measurements undertaken relevant to the environmental impact of the site, identifying: • the purpose/context of the survey; • the locations where measurements were taken; • the source(s) investigated or identified; • the outcomes; • The type of equipment used and calibration details.
BAT for noise and vibration	**Noise Control Techniques** The Operator should describe the techniques taken or proposed to control noise from the activities. The likely impact of these measures on the background levels measured as LA90 and the pre-existing ambient (residual noise level) measured as LAeqT in the locality and on the noise-sensitive locations in particular should be given; with indication of the likely cost and the Operator's view as to whether such further steps would be most cost-effective and would constitute BAT for the installation. The timescale for any planned improvements should be stated.

	Improvement Table Any improvements identified should be carried out at the earliest opportunity and in any case should normally be implemented no later than 24 months from the issue of the permit.
Failure to supply information Consultation with statutory consultees	Failure on the part of the Operator to supply the required information will result in the application not being 'duly made'. Failure to supply the sufficient level of information would be likely to result in a notice requiring information, or might form part of an improvement programme if not immediately available. Monitoring data might fall into this latter category.

Permitting Procedures are described fully in the Scottish Executive/SEPA joint publication "The Pollution Prevention and Control (Scotland) Regulations 2000 - a practical guide" from which the following flow chart has been taken and amended to highlight the stage(s) at which noise control issues should be considered.

Figure 1: The Permitting Procedure for New Permits

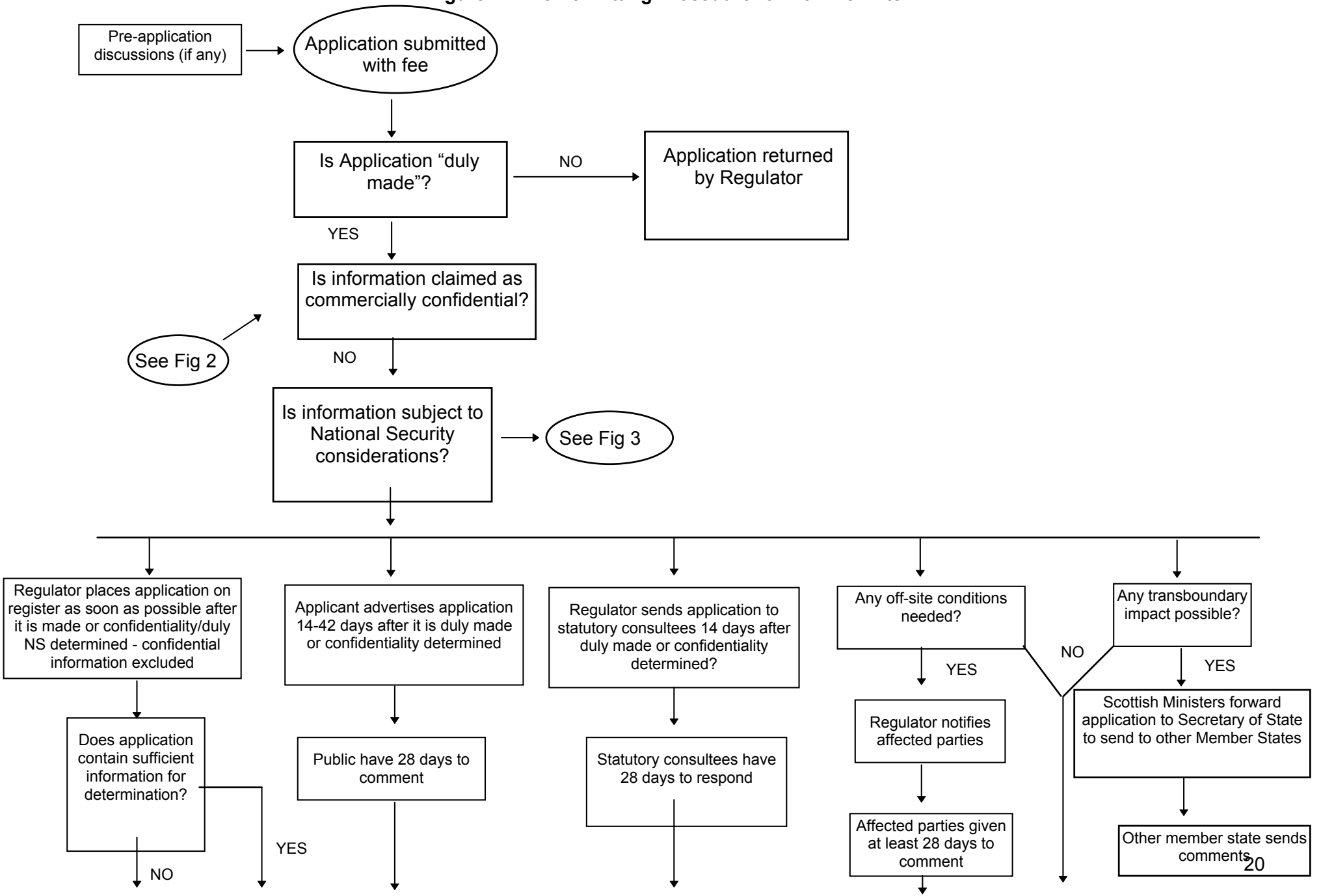


Figure 1: The Permitting Procedure for New Permits (cont'd)

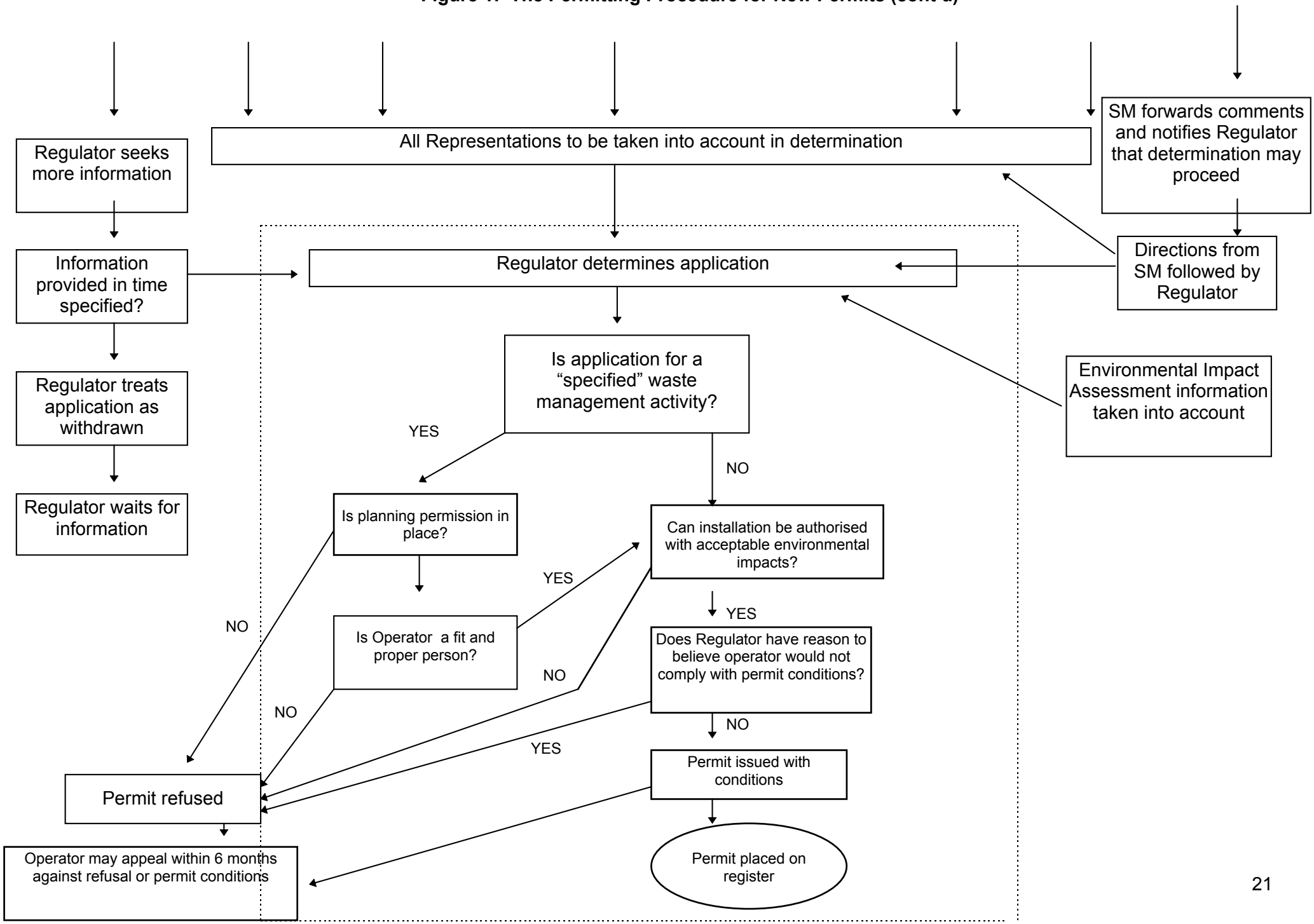
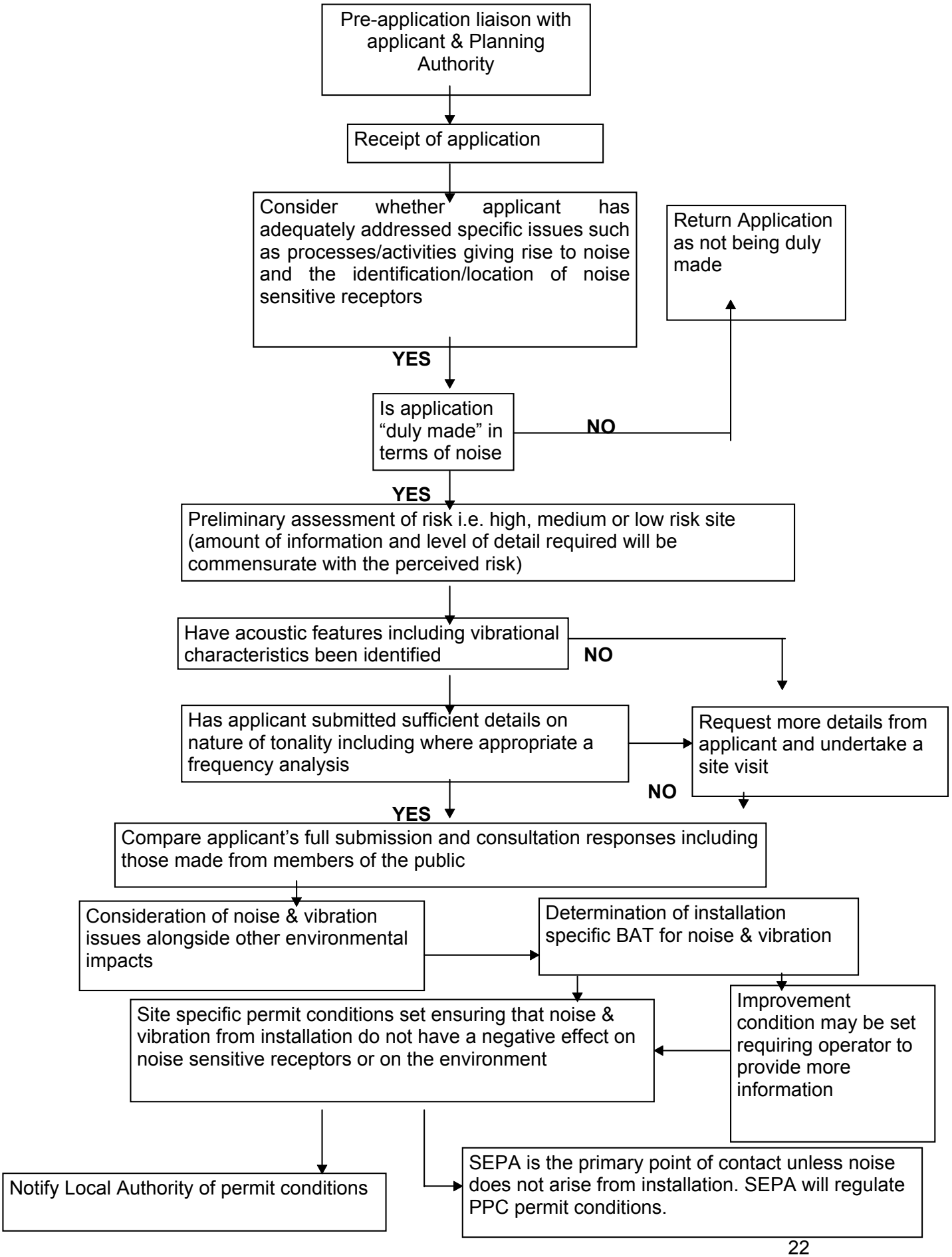


FIG 2

Noise Determination Flowchart



2.3 Consideration of Application

There are a number of steps in the process of determination of the Operator's application:

(i) **Evaluation of the Operator's Application**

- Is there sufficient information?
- Preliminary assessment of risk - is this high, medium or low risk site? (If a low risk site, the following steps can be minimised accordingly.)

(ii) **Comparison of the applicant's submission and consultation responses** (including those from members of the public) with the noise and vibration aspects of this and sector specific guidance notes.

(iii) **Consideration of noise and vibration issues alongside other environmental impacts** (Environmental Assessment for BAT).

(iv) **Determination of installation specific BAT for noise and vibration**.

(v) **Assessment of the existent regulatory framework** in terms of its ability to meet some of the requirements of BAT.

The outcome will be a set of requirements which will compliment the existing regulatory framework and for which appropriate conditions need to be framed which are proportionate to the risk to the environment.

Overarching Considerations:

- The Operator will need to have addressed all of the information requirements set out in this section or to have accounted for why these are not relevant to his application.

- All relevant aspects of the operation or process should have been covered, not just those aspects which the Operator happens to have existing information for.

- The amount of information supplied and the level of detail should be commensurate with the perceived risk (as gained from some knowledge of the previous noise history of the activity). The information supplied must, however, be sufficient to allow the actual level of risk to be determined. Depending on the circumstances, information relating to night-time operations, occasional noisy activities and types of noise generated (i.e. where more likely to cause annoyance - impulse noise, tonal noise) is particularly important.

- Where study of the application shows that more detailed information is required and the Operator cannot produce this quickly, e.g. monitoring work. **It may be appropriate to obtain this information through an improvement condition**.

Specific Considerations:

a) Submission of noise monitoring reports with the application

Noise assessment reports may have been submitted with the application. The case officer will need to decide how far these go in providing useful information, taking the following considerations into account, as appropriate:

- are they sufficiently up to date or purely of historical interest?
- Is the methodology and the British or other standard used given (including measurement points)?
- Have details of equipment used and calibration been given?
- Have prevailing meteorological conditions and plant operations at the time of measurement been set out?
- Where modelling has been undertaken, has the model been identified and the inputs detailed?
- Have noise predictions been verified by later measurement?

"The Technical Annex" describes assessment methodology and the most commonly encountered Standards and other guidance that are relevant to this document. Specialist advice should be sought where there is doubt.

b) **The application of BAT**, to prevent and, where that is not practicable, generally to reduce the impact on the environment as a whole, applies equally to noise and vibration as to other pollutants.

In determining BAT for a particular situation the following aspects need to be considered and balanced:

- BAT for the sector
- BAT for noise & vibration (general)
- Costs & benefits

How far should BAT go?

Prior to PPC noise control, the activity would have been subject to the Statutory Nuisance provisions. Preventing or minimising harm remains a primary aim for PPC and in most cases the costs and benefit balance of BAT would show that there is little benefit in going beyond the point at which noise is no longer causing a nuisance. It is feasible, however, that noise may still be irritating or undesirable even if it is not causing complaints and that, if it could be reduced at reasonable cost, BAT may allow such further steps to be taken.

The consultee response from the LA will be an important input to the permitting process.

Where the LA is unable to provide sufficient information and the required shortfall cannot be obtained during the determination period it is suggested that the following approaches be considered:

Over and above the operators general BAT obligation SEPA may evaluate whether it is likely to need to include specific noise conditions within a permit. If so, conditions are drafted on the basis of the information that is available. **When further information becomes available the permit conditions can be varied if necessary by the variation procedures.**

As noise is an amenity issue, responses might also be received from members of the public. There may also be requirements relating to SSSIs or other designated areas. The Agency's responsibilities **do not extend to control of occupational noise** although there may be some areas of overlap between health & safety and environmental legislation.

In the case of noise and vibration abatement, consideration of Best Practical Environmental Option will be required and there may be a trade-off in terms of possible additional energy usage or sustainable level of discharge if noise can be reduced where found to be necessary or desirable. It is likely that in many cases the balance would be **in favour of avoiding noise annoyance**, or perhaps finding a longer term solution which was less energy intensive.

2.4 Options for Permit Conditions

The installation-specific noise conditions and/or limits will be determined by SEPA in discussion with the Operator having due regard to relevant PPC guidance material and of the relevant British standards and other guidance.

The limits which could be applied to the control of noise and/or vibration can take the form of:

- **numerical**
  for example, specifying a noise level at the boundary or another specified point

- **descriptive/qualitative**
  for example, relating to specific equipment or containment requirements or timing of certain operations or other management issues.

Some requirements might be included in an improvement programme but it is expected that any improvements identified should be carried out at the earliest opportunity and in any case should normally be carried out no later than 24 months from the issue of the permit.

Low Risk Sites

Where an installation has no history of a noise or vibration related problem it will often be sufficient to rely upon the implied condition that the Operator will use BAT to implement and maintain appropriate preventative measures against noise and vibration. **However, where this is due to remote location, the Operator should still be required to reduce noise levels as far as the balance of cost and benefits allows.**

For all installations, whatever the noise history, it may be appropriate to make reference in the PPC permit to specific parts of the application where the Operator sets out his techniques for noise management so that they form an integral part of the permit, against which compliance may be determined.

Noise Management Plan

A noise Management Plan will be required to be drawn up by the Operator and agreed by SEPA. Such a Plan serves to formalise good practice (BAT for that installation) and sets out a framework within which noise control can be tackled actively. It should identify sources of noise/vibration and show how the environmental impact has been prevented or minimised. Of particular importance will be the Operator's procedures for dealing with unusual circumstances, failure of plant or utilities such as power or water, which could foreseeably lead to an increase in the amount or character of noise emissions. The actions identified should be incorporated into on-site operation and emergency procedures.

These issues may be covered within an Operator's environmental management system.

SEE Appendix 2 Noise Management Plan Example template.

Permit Conditions:

Consistent with SEPA's regulatory aims and objectives in all media the overriding requirement of any conditions placed within a PPC permit must be that they are:

Necessary
Unambiguous
Comprehensive
Enforceable

a) General Descriptive Conditions

i) Noise Management

The Operator shall set up, agree with SEPA and maintain a Noise Management Plan with the purpose of providing a framework for the ongoing management and review of noise and to drive continuing improvement. This will be incorporated into the management structure of the Organisation.

(ii) Restrictions on activities/timing, location, e.g.

- Loading, unloading and other activities carried out at [location] must not be undertaken between the hours of [time] and [time].

N.B. This is **not** a good way of reducing noise - it only restricts it, but could potentially be used for one-off or occasional activities. This finds wider use in planning than pollution control.

(iii) Conditions relating to noise source(s) or their containment, e.g.

- silencing equipment on specified powered plant and equipment shall be maintained in accordance with manufacturer's instructions.
- Noise bunds shall be constructed at locations (xyz) all in accordance with Planning consent for the facility.
- Emergency exit doors at [location] shall at a// times be fitted with a device to prevent them being opened except in an emergency.

(iv) External doors shall be fitted with self-closing mechanisms. Emergency situations e.g.

- In cases of periodic testing of safety equipment, emergency or unforeseen circumstances (such as plant failure), the specified noise levels may be exceeded, provided all reasonably practicable steps are immediately taken to reduce the noise levels as far as reasonably possible and to restore them to specified levels within the shortest possible time

(This could form part of the noise Management Plan - developing contingencies for foreseeable noise-producing events and specifying actions to be taken. Compliance with the agreed plan might also be offered by the Organisation as a defence in case of such events where it can be demonstrated that the contingency plans identified were followed to minimise the impact).

b) Numerical Conditions

There are several potential approaches to setting numerical standards. It is proposed that, where numerical limits are appropriate, *inter alia*, the following might be used according to prevailing circumstances:

(i) PANs 50 & 56 Adopt the approach of a proposed absolute noise limit but with a sliding limit based upon background noise + lOdB where background noise levels are in the 35 to 45dB range. This outline could be applied to waste disposal sites, or similar undertakings which share common features with surface mineral workings.

(ii) World Health Organisation - Guidelines for community noise 2000 provides guidance aimed at avoiding/minimising general community disturbance associated with noise exposure and specific environments. Whilst guideline values are offered, there is a large and well-respected body of research underlying the recommendations.

(iii) BS4142 (1997). Method for rating industrial noise affecting mixed residential and industrial areas. This is intended as a tool for assessing whether industrial noise is likely to give rise to complaint. It

is referred to in PAN 56 Planning and Noise, in the context of framing noise conditions for certain developments. Consideration of acceptability of a given exposure will need to take other factors unique to the local environment into account.

Numerical limits should be applied only when there is particular need and a demonstrable benefit. The limits applied should be appropriate to the particular situation. Determination of compliance in any meaningful way can be very time consuming and expensive and may not provide any real benefit. In particular, the following should be noted:

- It is fairly common to encounter a situation where there are multiple noise impacts on a receptor from a variety of sources. This frequently occurs in, for example, industrial estates surrounded by residential development. In cases such as these, noise, particularly that of low frequency, may be reflected leading to difficulties in identifying the actual source of complaint. In such cases close liaison with the local authority is essential in order to properly identify the source.

- Where a source is within a PPC installation limits or conditions may need to reflect the multiple sources and there may need to be a greater reliance placed upon at source conditions and operational restrictions where compliance can be determined by means other than measurement.

- The measurement of vibration is a specialist subject and advice should be sought as appropriate.

Wherever possible the emphasis should be upon good design, control at source and use of best practice to prevent or minimise emissions.

Measurement Location

The choice of measurement location is often not straightforward where noise permitting is concerned. Generally the main interest is in the noise level that is experienced by the affected person or people. This usually implies measurement outside the window to the buildings that they occupy.

However this is not practical in so far that the process operator will have no right to enter private property in order to check whether compliance with noise conditions within the permit is being achieved. Measurement must therefore be taken elsewhere at locations carefully recorded to allow meaningful repeat measurements to be made.

Site Boundary

The site boundary is a readily available location for setting a permit level which can be checked. If receivers are close to the boundary the situation is straightforward, but if not then calculation of noise levels at the receivers is required. Calculation will not be as accurate as measurement however it will be unavoidable in many circumstances. The method of calculation is given in detail in ***The Technical Annex***.

A planning condition or agreement may already have been set limiting noise emissions beyond the site boundary in order to safeguard future noise sensitive development in the vicinity and prevent creeping growth in ambient noise levels. In

cases where new noise sensitive development is possible then enforcing noise levels at the site boundary will be appropriate.

There can be problems with measuring at site boundaries due to local screening effects, for example by a boundary wall. In these cases the monitoring location should be chosen to best mimic the screening effect at the nearest receivers, so that any interpolation by calculation is as simple as possible, in order to minimise the error in the calculation process. Judgement will be required to determine the best compromise location, but it should always be chosen to be as representative of the levels at noise sensitive buildings as possible.

Methods of calculation are described in more detail in ***The Technical Annex***.

Monitoring is likely to be required on commissioning of new plant or additions to existing plant (this may form part of a demonstration of compliance with planning conditions).

It is unlikely that detailed regular monitoring would be required in the absence of any particular noise problem as, unlike releases to air, noise and/or vibration does not add to an environmental load in the same way. It must however be remembered that it is possible to have an underlying level of dissatisfaction without a large number of complaints being made.

In addition to commissioning, monitoring may however be required, for example, for comparative purposes, to demonstrate improvement, if complaints are received or to demonstrate compliance with specific limits.

It would normally be appropriate for the Operator to arrange to undertake the work according to the relevant British Standards or other guidance. The appropriate Standard would either be specified in the permit condition, or the Operator would demonstrate that he has selected the most appropriate Standard for the purpose. Refer to ***The Technical Annex***.

Assessment may be required as a precursor to improvement work or to evaluate the degree of attenuation provided by a particular course of action.

For an enclosed plant, it may be reasonable to assume that the plant can be designed to achieve an ambitious level of noise control (walls can be upgraded, openings attenuated etc.) and so a noise limit can be set without a detailed understanding of the mitigation measures that will be needed. However, where engineering solutions are not available it is more important for licensing conditions to be based on the results of detailed noise modelling which has explored all available mitigation options. Landfills are a good example. The design of the way a landfill operates and perimeter bunding, and the choice of inherently quiet plant and operating methods, can all reduce noise arriving at surrounding areas, but in many cases only by a limited amount. In such cases the setting of noise limits should be based on the results of detailed noise modelling of available mitigation measures, as well as the results of noise surveys and consideration of other local conditions and factors, otherwise the limit may not be achievable.

Chapter 3 Monitoring & Enforcement

3.1 Introduction

Noise can be defined as unwanted sound. The impact of noise can cause annoyance and stress to individuals exposed to its effects. Whilst it is relatively easy to measure and quantify sound using appropriate equipment, the annoyance factor remains subjective and is dependent upon the hearing sensitivity of receptors.

Noise and vibration are included within the definition of "emissions" as set out in the Pollution Prevention and Control Act 1999. The inclusion of noise assessment and control within the PPC regime will necessitate monitoring and enforcement duties being undertaken by SEPA. These are discussed below.

It is expected that at the application stage, discussed in Chapter 2, the operator of a facility will provide information not only on any potential noise sources but, also noise sensitive sites nearby. If noise becomes an issue it is likely to be at noise sensitive sites that complaints would arise.

The assessment of noise emissions will require monitoring of the process and surrounding area. Monitoring will be carried out by both the operator and SEPA in order to ensure ongoing compliance with BAT and any specific numeric conditions applied in permit.

Many process operators will utilise the methodology described in BS4142: 1997 "Method for Rating Industrial Noise Affecting Mixed Residential & Industrial Areas". All staff wishing to undertake noise surveys must be familiar with this standard and be trained in the use and interpretation of any noise equipment used.

3.2 Monitoring of Noise Emissions

These are undertaken for a number of purposes:

a) To assess noise levels pre-development so that any residual noise is determined;

b) So that noise conditions can be applied as appropriate;

c) Routine monitoring to ensure ongoing compliance;

d) In response to complaints received from local authorities or members of the public or other affected persons;

e) Pre or post modifications to the process.

In all instances Type 2 sound level meters or better will be required as these have the capability to measure a range of noise parameters. Those of most interest are:

L_{A90T} and L_{AeqT} (See Technical annexe).

The L_{Aeq} is defined as the value of the A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval, T, has the same mean-squared sound pressure as a sound that varies with time.

The L_{A90} is defined as the A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels.

The purpose of measurement is to determine the specific noise level that is the level of noise when the installation is operational. This level may be subject to corrections discussed later to give a rating level. (For definition see Technical Annex.)

Whenever possible the L_{AeqT} shall be measured pre and post development of the site and once operational prior to any modification of the installation which may impact upon noise emissions.

Noise meters must be calibrated before and after carrying out a noise survey in order to ensure that the measurements made are accurate. Any calibrator used must conform to BS7189.

The calibrator shall be independently verified every year to the UKAS standard and the sound level meter shall be independently calibrated every 2 years.

3.3 Measurement Locations

Ideally during noise investigations, measurements of the specific noise level being assessed are determined at the site boundary as specified in the site permit.

In order to minimise the influence of reflected noise from structures the measurement position should be at least 3.5 metres from any reflecting surface other than the ground. The microphone should be at a height of between 1.2 to 1.5 metres above the ground.

If it is necessary to undertake measurements above ground floor level, then this is permissible provided the microphone is 1 metre from the facade on the relevant floor of the building.

In either case the microphone will be covered by a windshield in order to minimise the effect of wind passing over the diaphragm of the microphone.

All measurements and prevailing weather conditions must be recorded.

The sound level meter shall be calibrated both before and after use and the readings recorded.

All readings obtained shall be recorded on the SEPA standard form.

For additional advice see Technical Annexe which gives further details on how to carry out and record measurement procedures.

3.4 Specific Monitoring by the Operator

Any application for a PPC permit must include information on actual or projected emissions. This will take the form of a statement which includes details of:

- the existing noise situation from the activities
- a description of the measures taken or proposed to control noise from the activities.

(See Chapter 2 for further details).

In order to address the above points the operator may well have to commission a noise survey of their plant which includes environmental monitoring beyond their site boundary in order to gauge any adverse impact upon the environment. Thereafter a Noise Management Plan, as detailed in Chapter 2, will be required to be drawn up by the Operator and be agreed with SEPA.

Noise emissions from each individual component of plant may be required. This should preferably involve direct measurement of the noise level produced close to the source at the site boundary as agreed by SEPA. The monitoring should include all operational or representative weekdays and weekends and be carried out at varied times during the day and night. Where tonal characteristics are present consideration should also be given to carrying out frequency analysis of any specific noise sources on site.

A suggested specification for noise surveys and survey report form is given in Appendices 3 & 4 of this guidance.

3.5 Evaluation of Noise Monitoring Results

The assessment of specific noise level readings obtained is indicative of the likelihood of noise giving cause for complaint or, where limits are included in the permit of any breaches.

Corrections to noise level readings obtained are applied where deemed appropriate. This allows the specific noise level to be determined at the assessment location without the influence of other sources which may contribute to ambient noise. An example of this would be where the level of residual noise is less than 9 dB below the specific noise.

Although not specifically referred to in BS4142 it may be appropriate to carry out frequency analysis on the noise sources on the site in question particularly where emissions of a type referred to in (i) and (ii) above are present. This will allow items of equipment responsible for distinguishable noise emissions to be more readily identified. Efforts to remedy any problem emissions may centre upon a specific piece or pieces of equipment/plant

3.6 Assessment of Noise Emissions

Noise emissions can be assessed by a number of methods, for example, by comparing the measured background noise level (expressed as LA90) with the level produced by the process (expressed as LAeq.)

Due to its variable character industrial noise can be difficult to assess. However BS 4142, *"A Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas"*, for example promotes a method for assessing whether industrial noise is likely to give rise to complaints from people living nearby. The standard uses comparisons between the measured background levels (measured as L90) of a location and the anticipated or actual noise levels from proposed activities (measured as the LAEQ). The standard suggests that in general a difference of 5dB is likely to be of marginal significance, whilst an increase in 10dB will likely give rise to complaints. Tonal or impulsive characteristics are likely to increase the likelihood of complaints and this is taken into account by corrections being applied to the measured level (typically +5 dB.) resulting in what is termed a "rating level" defined in the standard.

However unless there is a steady and non fluctuating ambient noise level then the LAEQ level will always be found to be higher than the LA90 level. This is because the comparison is being made between two quite distinct and different measurement parameters. The LA90 will not necessarily reflect higher short term noise events such as **infrequent** transport movements nor does it necessarily capture the minimum noise levels which occur over a measurement period. These shorter term noise events are however captured within the LAEQ parameter thus giving the higher number which can easily be as much as 5dBA above the LA90 measurement. Consequently the LAEQ parameter is a better and more accurate indicator of the pre-existing ambient or total noise climate against which noise from processes may be compared and planning of development considered.

There is much criticism of BS4142 with strong feeling that the Standard should be reviewed. The Standard is useful in determining the likelihood of complaints in a given situation but if it is to be used to determine an acceptable permit level then great care is needed since BS4142 is and has often been misused in this way. Similarly for the reasons mentioned in the preceding paragraph a marginal situation as described in the standard can be deemed to exist even before the process under consideration is in operation if the information obtained and the standard is not very carefully considered and used.

When assessing acceptable noise limits several unique local factors must be taken into consideration and these include -

- The absolute levels of ambient noise in an area;
- Types of noise present;
- Potential future noise sources;
- Local opinion of the noise environment

The LAEQ parameter as the measure of pre-existing ambient noise has already been successfully used by SEPA to set noise levels at process boundaries in relation to the conditioning of waste management licenses. Levels have been set following consultation with the relevant Local Authority in order to try and ensure that any noise condition relating to the control of noise from a process regulated by SEPA does not conflict with the requirements of the Local Authority or undermine the Authority's statutory nuisance powers. Local Authorities retain statutory nuisance powers until such time as a particular process falls to be regulated as a Part A process under the new PPC regime.

LAEQ is increasingly being introduced via EU Directives on noise control as the most appropriate indicator and measure of human response to environmental noise. It is considered particularly useful in the planning of development because if applied correctly will achieve protection of the environment from increased and creeping increases in ambient noise for particular localities.

One of the objectives to be attained by the regulatory authorities in terms of the PPC Regulations is to guard against creeping ambient noise i.e. the prevention of a gradual or step change in the ambient noise level of an area. Such creeping growth in noise can result from general development of an area or the introduction of a specific noise source to a locality. For the reasons detailed above it is considered that the LA90 parameter will not necessarily guard against creeping background noise levels whereas the LAEQ parameter being a measure of total noise within specific time periods will provide a stronger defence against increasing ambient noise levels.

Accordingly in view of the above SEPA would prefer to use the pre-existing (the residual noise level) measured as LAEQ as the most appropriate basis for the setting of noise level conditions within permits issued in terms of The Pollution Prevention and Control (Scotland) Regulations 2000.

BS4142 is not the only reference standard available to assess environmental noise but it is currently the only available relevant British Standard designed to assess the likelihood of complaints. The Environment Agency and the Environment and Heritage Service propose to use the standard in terms of the regulation of PPC processes and Local Authorities already use the standard in the assessment of noise complaints. In addition SEPA staff will be aware that many operators will also utilise the methodology described in that standard when considering noise emission from processes.

Accordingly in order to ensure consistency with the Environment Agency, the Environment and Heritage Service and Local Authorities SEPA will where appropriate use the guidance contained in BS4142 as the base for the setting of noise conditions. This procedure will however be open to continuing review by SEPA pending consideration of further advice and guidance which may be developed concerning the control of noise specifically from industrial processes.

3.7 Enforcement

The appropriate legislation for enforcement purposes under PPC is the Pollution Prevention and Control Act 1999 and subsequent Pollution Prevention and Control (Scotland) Regulations 2000.

The aim of enforcement is to prevent and control pollution of the environment through preventative or remedial action so as to ensure compliance with the regulatory system.

Part III of the 2000 Regulations deals with enforcement whereas Part VII deals with offences.

There is a duty on SEPA to ensure that operators comply with the conditions of the permit granted to them. **SEPA will undertake audit monitoring of noise emissions as necessary. (annually or biennially)**

3.8 Non-Compliance

Where the operator fails to comply with noise conditions an Enforcement Notice may be served. Said Notice will specify the steps to be taken by the operator and give a time scale in which to achieve the same. Failure to comply with such a Notice is an offence.

Where in the opinion of the enforcing officer a risk of serious pollution is involved SEPA must serve a Suspension Notice on the operator. The effect of such a Notice is to cease either specified activities or the operation of the whole installation until remedial work is carried out and the Notice is withdrawn.

SEPA may also serve a Revocation Notice on the operator. This may cease any activity undertaken on site or the whole operation of the installation.

3.9 Appeal Rights

SEPA may withdraw a Revocation Notice, Enforcement Notice or Suspension Notice at any time.

Any person who has been served with any of the aforesaid Notices may appeal against said Notice to the Scottish Ministers. In the event of an Appeal being lodged Part IV and Schedule 8 of the 2000 Regulations come into play. Guidance on the appeal process is also contained within Section 14 of the document. "The Pollution Prevention and Control (Scotland) Regulations 2000 - A Practical Guide" issued jointly by the Scottish Executive Environment and Rural Affairs Department and SEPA.

If a Revocation Notice is appealed, the revocation does not take effect until the appeal is determined in SEPA's favour or the appeal is withdrawn.

In regard to Enforcement or Suspension Notices, the terms of the Notice must be obeyed pending the outcome of the appeal.

An appeal can be conducted either by written representations from all interested parties or by holding a hearing. Once a decision is reached it is notified to all affected parties. The decision of the Scottish Ministers may, where justified, be the subject of judicial review by the Court of Session. Were this to occur the decision may be quashed and the matter sent back to

the Scottish Ministers for reconsideration. Further representations may be invited and any hearing may be reopened.

An appeal may be withdrawn at any time by giving notice in writing to the Scottish Ministers, copied to SEPA, who will then inform anyone with an interest in the appeal.

3.10 Offences and Legal Proceedings

Where an operator commits an offence that causes pollution, SEPA may arrange for remedial work to be undertaken. SEPA may recover costs from the Operator, unless the Operator can show that there was no emergency or costs were incurred unnecessarily.

If a criminal offence has been committed then a report may also be forwarded to the Procurator Fiscal. Grounds for referral to a Fiscal comprise:-

- incidents or breaches cause, or have the potential to cause, significant consequences for the environment;
- operations are undertaken without a permit;
- there have been excessive or persistent breaches of regulatory requirements in relation to the same permit or installation;
- there has been failure to comply, or to comply adequately, with formed remedial requirements;
- there has been a reckless disregard for management or quality standards;
- the operator has failed to supply information without a reasonable excuse or has knowingly or recklessly supplied false or misleading information.

Where SEPA intends to pursue enforcement action it must be sure of its grounds for doing so. This means that where noise issues are apparent a proper assessment of the same must be made by staff familiar with the legislation, BS 4142 and the use and limitations of noise equipment utilised to assess noise emissions. This latter point is critical as should legal action result any officer involved may be subjected to rigorous cross-examination on their experience, methods and standards used and their findings in the field.

TECHNICAL ASPECTS OF NOISE CONTROL

Section 1 The Physical Nature of Sound

This section sets out the basic physics associated with the topic to act as supporting information for the subsequent sections. This is not intended to be a substitute for more detailed study but is included to provide a basic level of reference material.

1.1 Basic Noise Physics

1.1.1 The Difference Between Sound and Noise

Sound is the sensation produced in the ear as a result of pressure variations set up in the air by a vibrating source. Such vibrations set up a series of alternate regions of increased and decreased pressure in the surrounding air or other medium. The longitudinal motion of these pressure fronts from source to receiver through a medium (air, ground, buildings, water) takes the form of sound waves.

Noise has been defined in various terms but is essentially sound of undesirable quality. Whilst the various physical attributes of sound can be quantified, the subjective aspects of noise - the degree of annoyance and stress which can result from exposure - is less easily measured. Annoyance and attitude towards noise varies widely between individuals, hence the apparent effectiveness of control measures may vary according to the individual exposed.

1.1.2 Basic Principles

A soundwave has both frequency and wavelength:

***1.1.2.1 Wavelength*:**

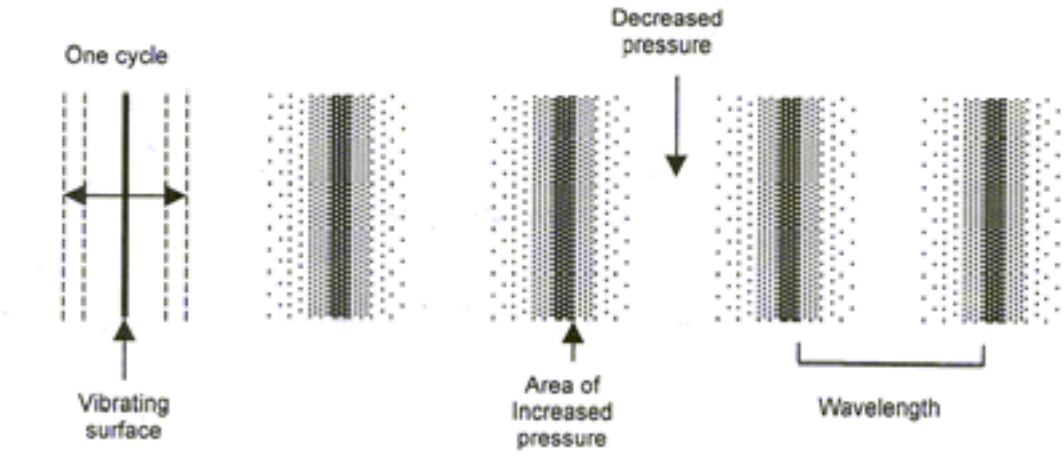
Each vibration of the source produces one pressure wave in the transporting ***medium***. Wavelength is the distance between successive pressure waves - i.e., during one cycle from low - high - low pressure.

1.1.2.2 Frequency:

Frequency is the rate at which the source vibrates and hence the rate at which the sound travels. It is measured in terms of cycles per second (Hertz - Hz). Frequency determines the pitch of the sound. Doubling of frequency produces an approximate increase of one octave.

The frequencies which the ear can detect range from approximately 20Hz to 20 kHz. Below 20Hz lies the range of infrasound and above 20kHz lies the ultrasound range.

Fig 01: Propagation of a sound wave



1.1.2.3 The speed of sound:

The speed with which the sound travels is dependent upon the medium through which it travels, particularly its elasticity and density. The speed of sound in air at 20°C is 344 m/s. Speed decreases as temperature decreases and at 0°C the speed of sound in air is 332 m/s.

The speed is related to frequency and wavelength by:

Velocity = frequency x wavelength (m/s)

As the velocity of sound is constant for any given medium, if frequency increases then wavelength decreases. Low frequency sounds have long wavelengths and high frequency sounds have short wavelengths. Low frequencies tend to travel over much longer distances and are much less easily blocked than high frequencies. Compare this with longwave radio frequencies which travel across continents.

1.1.2.4 Sound pressure:

The pressure waves set up in the conducting medium by the vibrating source consist of a number of positive pressures balanced by a number of negative pressures. Sound pressure can be defined as force per unit area:

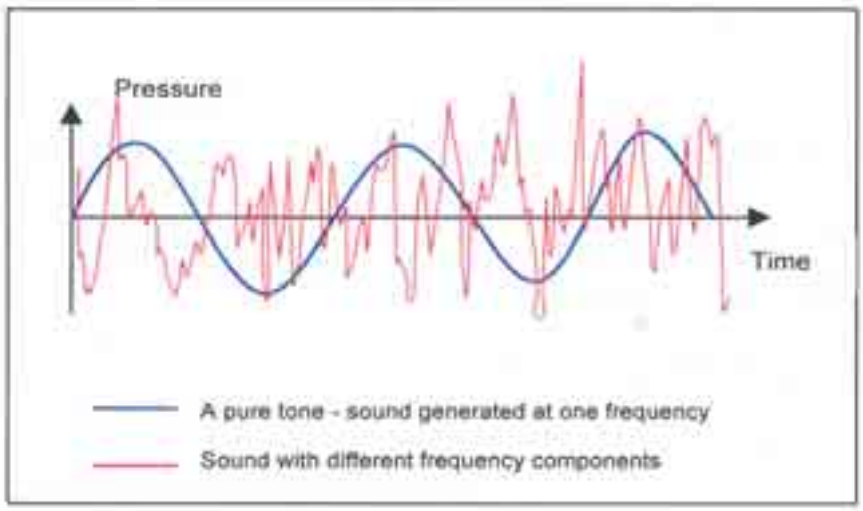
Pressure = force (Newtons or Pascals)/per metre^2

1.1.2.5 Pure tones:

Figure 02 depicts a sound wave consisting of just one frequency - a pure tone. The sound of a flute or a tuning fork are pure tones. Most sounds encountered in an industrial or environmental context consist of many different frequencies overlaid on top of one another, although pure tones can be

generated by equipment such as fans, turbines, transformers etc.Pure tones are often at the root of complaints concerning irritating whines, whistles or hums as they tend to stand out against a background of more general noise, particularly at night when the background level noise subsides. They can be notoriously difficult to deal with.

Fig 02: Characteristics of a pure tone



1.1.2.6 Mixed noise:

Most sounds are made up of many components at different frequencies and the overall sound is the combination of the pressure levels at the different frequencies.

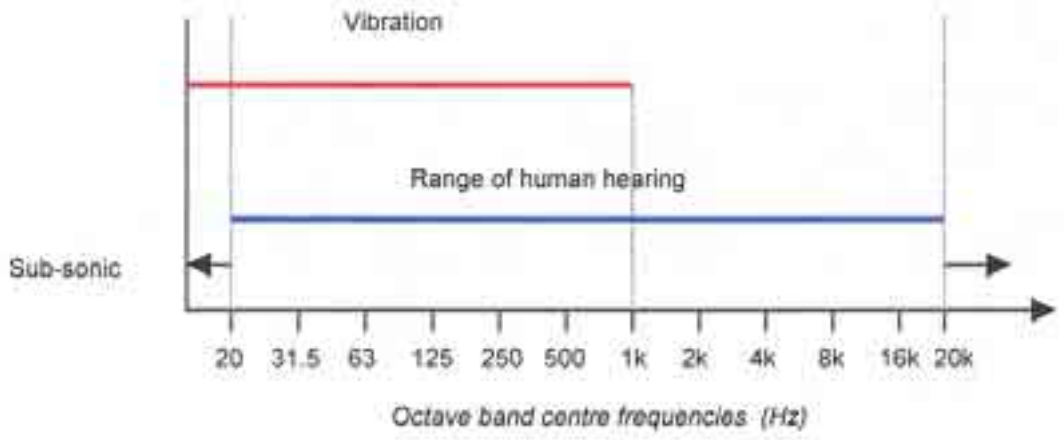
1.1.2.7 Impulsive noise:

Sounds of very short duration, typically less than a second, can also be particularly annoying. These impulsive noises include hammering, tapping and clattering.

1.1.3 Vibration

Like sound, vibration is the oscillation of a body about a reference point and the number of oscillations or cycles per second gives the frequency of vibration (Hz). What differentiates the sound and vibratory forms of energy is in the way they are perceived - sound can be detected by hearing whilst vibration can be felt as it is transmitted through solid structures.

Fig 03: Vibration and sound frequencies



As with sound, vibration may occur at a single frequency (simple periodic vibration) or more usually there are a number of different frequency components imposed on top of each other and occurring simultaneously - often different parts of a machine will vibrate at different frequencies. A combination of superimposed frequencies can also form a repetitive periodic motion - for example motors and fans.

'Random' vibration occurs where there is a wide range of frequencies present which vary randomly with time. Vibration may also be 'transient' and die away after a period of time such as occurs with the use of heavy presses or the passage of a heavily loaded vehicle.

Vibration is quantified in terms of three parameters: acceleration, velocity or displacement. Displacement is the distance moved from the fixed reference position (amplitude) and may be positive or negative (mm or μm). The velocity is the rate at which displacement varies with time (m/s or mm/s) and acceleration which is the rate of change of velocity over time (m/s^2). The latter are generally used for the purpose of determining the various frequencies of vibration and the severity. Displacement is often used to indicate the degree of unbalance in rotating machine parts.

Commonly encountered parameters for measurement are:

- *Peak Particle Velocity*

  Vibration measurement parameter that corresponds to the highest speed in a given direction during a sample period. Often used to assess the potential for building damage but sometimes used to establish if vibration will be perceptible.

- *Vibration Dose Value*

  Vibration measurement parameter that combines the magnitude of vibration and the time for which it occurs. The measurement is based on a form of acceleration which is frequency weighted to reflect human sensitivity to various frequencies (see BS6472).

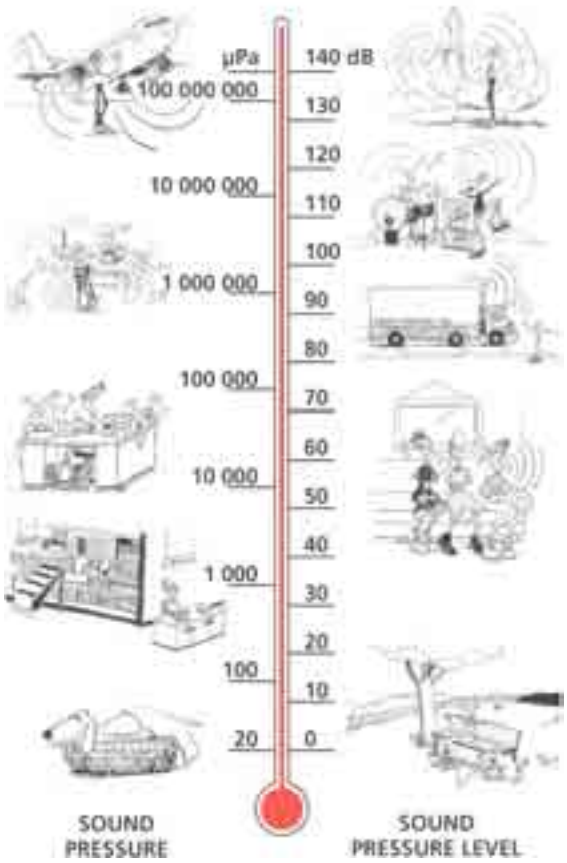
The field of vibration measurement and control is a complex area and in situations which are other than very simple generally requires specialist knowledge.

1.2 Units of Sound

1.2.1 The Decibel Scale of Sound

The range of human hearing ranges from around 20Hz to 20,000Hz. In order to cover this very large range, noise levels are measured using the decibel (dB) scale. This is not an additive system of units (as are, for example, metres or kilograms) but a proportional system (a logarithmic progression).

Fig 04: Typical noise levels in everyday situations



(Figure - courtesy of Bruel & Kjaer)

1.2.2 Frequency Analysis

Just as a given noise is characterised by the way in which it varies over time, it will also be made up of a wide range of different frequencies. The spread of noise energy across the audible frequency 'spectrum' (about 20Hz to 20,000Hz) is one factor that helps to make it identifiable to the human ear. Often the highest levels of sound energy will be spread over a wide band of frequencies ('broad-band' noise) and the frequency spectrum will follow a smooth curve. Sometimes, however, a noise source will emit noise that is concentrated in a 'narrow band' of the spectrum and contains a high proportion of energy at a single frequency (a 'pure tone'). Examples of sources that can give rise to tonal noise include fans, compressors, motors and transformers. Most have moving parts that rotate or vibrate at a given, audible frequency.

For example, a fan with four blades, rotating at 600 revolutions per minute (10 times per second) has a fan blade passing frequency of 40Hz. Whilst noise from fans is commonly the result of complex aerodynamic effects, this fan could potentially produce tonal noise at 40Hz. Mains electrical power is a common source of tonal noise, for example in transformers. The 'fundamental' frequency (i.e., the frequency of the driving force that generates the noise) for mains electricity is 50Hz. Other 'harmonics' may also be produced, at multiples of 50Hz (100Hz, 200Hz etc.) as a result of further modes of vibration being set up in structures or in the air.

Tonal noise is generally more noticeable and more annoying than non-tonal noise of the same level and in order to take this into account can be penalised in assessments of noise impact, usually by 5 dB. Whilst tonality can be judged subjectively, it will often be useful to measure it. This is achieved through ***octave band analysis***.

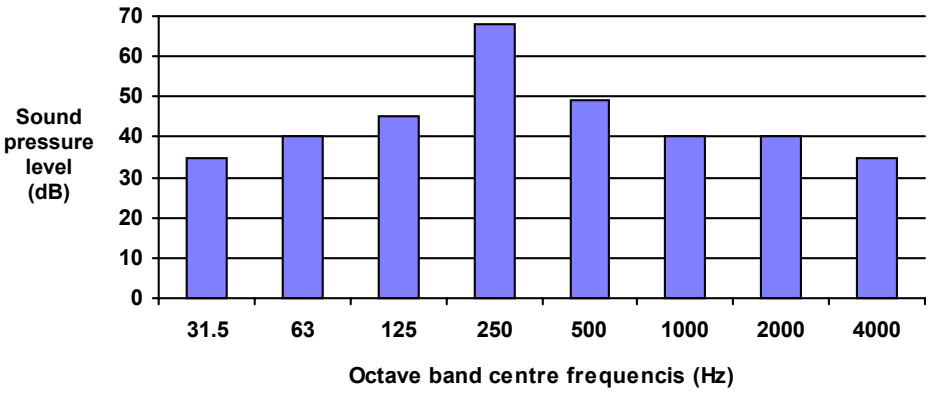
1.2.2.1 Octave band analysis:

A sound is subdivided into frequency bands in order to look at the distribution of components across the frequency spectrum. By international convention, the frequency spectrum is divided into bands with a width of one octave. The centre frequencies of the octave bands are (in Hz):

31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000, 16000

One octave represents a doubling of frequency, hence the band width increases with increasing frequency.

Figure 05: Octave band analysis



Frequently the information provided by octave band analysis is insufficiently detailed to allow a particular source or causative factor to be identified. A more detailed breakdown can be obtained by 'third octave band analysis' whereby the sound level meter divides the sound signal into band-widths of 1/3rd of an octave. The sound pressure level is determined within each octave band and the total sound pressure energy will be the sum of all the octave band levels. Most sound level meters will perform this analysis and also give a total.

Third octaves split each octave into three, for example centred at 32, 40, 50, 63 Hz etc.

Figure 06 gives an example of a 1/3rd octave band spectrum from a cooling plant inside a plant room.

Fig 06: Noise spectrum from cooling plant

A distinct peak can be seen at 50 Hz which could be judged as tonal. BS 7445 gives guidance on tonality and suggests that where a single 1/3rd octave band level is at least 5 dB higher than the level in both of

the two adjacent bands, then tonal character may be present. The broader peak around 700 Hz would not be judged as tonal.

Conditions or permit levels should require that tonal noise or noise with any other clear character (see BS 4142[1]) is avoided.

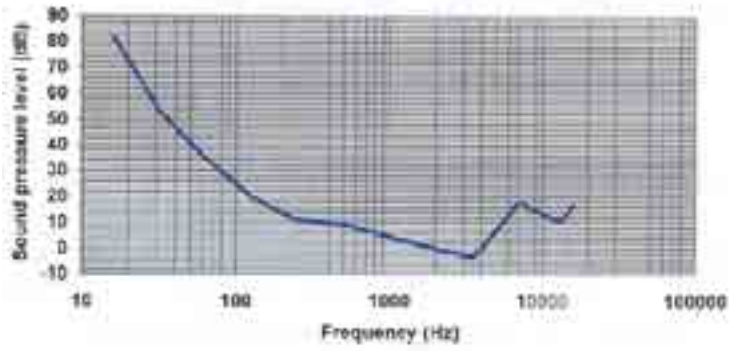
1.3 The Response of the Ear

The human ear converts pressure fluctuations in the air into signals which are transmitted by the auditory nerve to the brain where they are perceived as sound.

Figure 07 shows the threshold of hearing for people aged 18-25. This shows that the ear has a relatively low response to low frequencies whilst it is highly responsive in the range 1-5Hz with a peak response at 2.5 to 3kHz. Hearing deteriorates with age, the higher frequencies being most affected and the curve becomes flatter

[1] British Standard BS 4142 Method for rating industrial noise affecting mixed residential and industrial areas. Bsi 1997

Fig 07: Threshold of audibility (18-25 age range)

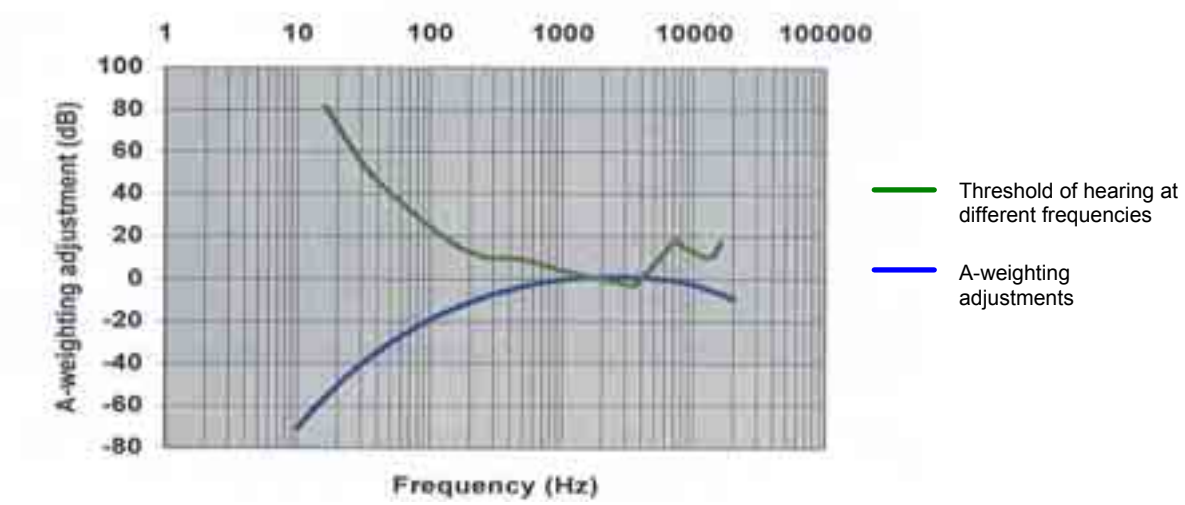


This means that exposure at a given sound pressure level to frequencies around 1-5kHz will be perceived as being much louder than the same sound pressure level at 32Hz. Therefore in assessing the subjective impact of noise on individuals both the sound pressure level and the frequency need to be taken into account. Weighting networks are used to account for this.

1.3.1 Weighting Networks

There are four weighting networks - A, B, C and D which were developed for different purposes and give emphasis to different frequencies. For most purposes, A-weighting is used. This weighting attempts to mimic the response to the ear by giving progressively lower cut off points at low frequencies.

Fig 08: A-weighting adjustments



E.g., At 20Hz, a level of 70dB would become 20dB with A-weighting (i.e., the A-weighting is -50dB at 20Hz).

50Hz gives a relative response of -30dB with A-weighting, therefore 70dB become 40 dBA.

All weightings have a flat response at 1000Hz, i.e., the actual sound pressure level is used.

Although each frequency is considered independently in terms of its weighting, the total can be summated to give an overall A-weighted figure which best represents the response of the ear. This concept is widely used in environmental measurement and acoustic engineering. Most sound level meters will carry out this adjustment and can give values in terms of dB (linear) or dB(A). See ***Table 09*** below.

Table 09 - A-weighting adjustment for octave bands

Octave band centre frequency (Hz)	A-weighting adjustment
31.5	-39
63	-26
125	-16
250	-9
500	-3
1k	0
2k	+1
4k	+1
8k	-1
16k	-7

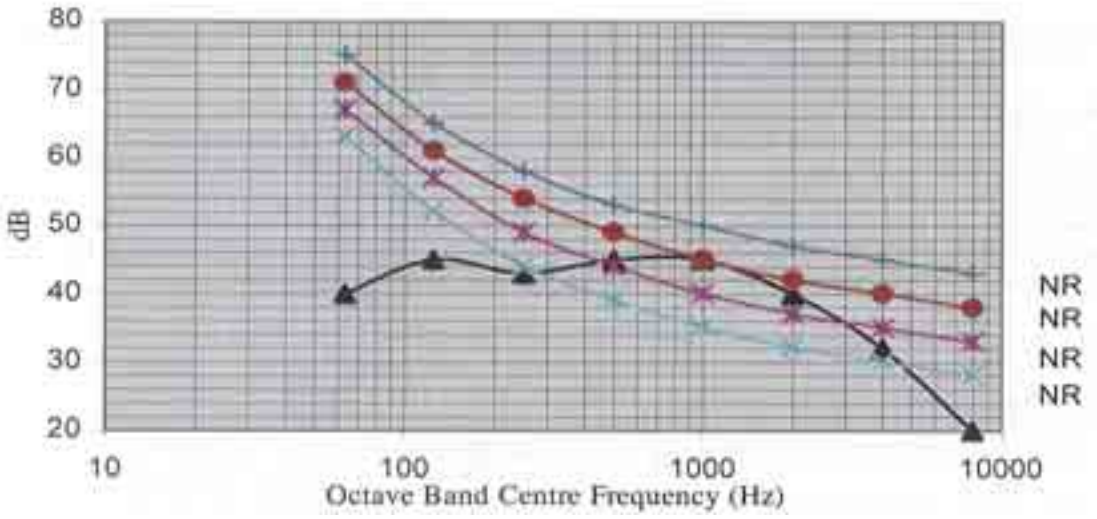
1.3.1.1 Low frequency noise:

The A-weighting frequency network applies the highest attenuation to low frequencies (e.g., 26 dB at 63 Hz) and when measuring noise with a high content of low frequency energy A-weighting can give non-representative results, i.e., it would not give sufficient emphasis to the 'annoyance' value of the low frequencies. There is a recent trend to use 'linear' noise levels (i.e., with no frequency weighting at all) when quantifying a low frequency noise source. This is a valid technique but would generally require specialist advice.

1.3.2 Noise Rating Curves

Noise Rating (NR) and Noise Criterion (NC) curves were developed for setting noise limits in internal rooms. The curves specify limiting sound pressure levels in each separate octave band, but unlike A-weighting, the levels in different bands are not summed in any way. Instead the NR level is taken as the highest NR level in any separate octave. ***Figure 10*** shows NR 35, 40, 45 and 50dB curves and a spectrum from a noise source. This source has its highest NR level of 45dB in the 1000Hz octave band and so is rated as NR 45.

Fig 10: Sample NR Curves



NR curves are rarely used for environmental noise but have in the past been considered as a way of attempting to apply a tighter limit than a dB(A) so as to provide extra assurance that tonality will not be audible. It sets a limit for each of usually 8 octave bands. The bands follow roughly an A-weighting shape and are usually set so each band (and the NR) is 5dB below the A-weighted level such that when the octave band levels add up they are typically below the dB(A) total you wanted to set.

However, even if an NR limit is set below the A-weighted background noise level it is still possible that a distinct tone in the new noise source will be discernible. It is more usual to set noise limits in dB(A) although NR-based limits may be encountered in existing conditions or limits.

1.4 Statistical and Energy-Based Noise Parameters

1.4.1 Quantifying a Varying Sound Level

The noise levels we hear are rarely constant because the sound pressure arriving at our ears is usually the result of numerous different sources of noise, each of which may be varying in strength from one second to the next. Exceptions tend to be when one particularly constant source is very loud compared to the rest (e.g., close to a extract fan in a factory wall) or when all noise sources are at large distances from the receiver (e.g., in the bedroom of a remote house at night). Therefore it is usual to quantify a noise level over a period of several minutes by taking numerous very short samples (typically half a second long) and the result is reported as statistical analysis of sampled levels.

1.4.1.1 L_{max} and L_{min}

The simplest statistical metrics include the level of the highest noise sample (L_{max}, the maximum level) and the level of the lowest sample (L_{min}, the minimum level). These are commonly used, particularly L_{max}, as it is a measure of the most obtrusive facet of the noise, even though it may only occur for a split second. L_{min} is rarely used, but can be a powerful way of measuring a constant noise in amongst other intermittent noises.

1.4.1.2 Percentile parameters

L_{50}, is the median level, or 50^{th} percentile, and is rarely used.

The L_{90}, 90^{th} percentile, is the level exceeded for 90% of the time and will be a little above the L_{min}, and has been adopted as a good indicator of the 'background' noise level. Whilst it is not the absolute lowest level measured in any of the short samples, it gives a clear indication of the underlying noise level, or the level that is almost always there in between intermittent noisy events.

L_{10}, the tenth percentile, or the level which 10% of the samples exceed, has been shown to give a good indication of people's subjective response to road traffic noise, and in this country is used in assessments of road traffic noise impact. This is presumably because it is the general peakiness of road traffic noise that people notice, but not the absolute peaks (L_{max}) that occur only occasionally.

1.4.1.3 Equivalent continuous sound pressure level (L_{eq}):

The equivalent continuous sound pressure level (L_{eq}) is a form of 'average' level - an average of all the sampled levels, but to take account of the logarithmic nature of the decibel scale of sound, it is not the arithmetic mean, it is the logarithmic mean.

L_{eq} is the level which, if generated continuously, would give the same energy content over a time period (T) as the fluctuating sound being measured. It is the most widely used parameter for assessment of environmental noise.

Selection of an appropriate duration for T will depend upon a number of factors. The nature of the source being measured and the purpose of the measurement are of relevance.

If the noise is steady, a relatively short measurement period will be sufficient to characterise it. If it fluctuates randomly or has cyclical elements then a longer period of measurement will be required to obtain a representative sample. Usually a measurement period of 15 minutes is adequate to obtain repeatable results. If the objective of the measurement is to measure the level of a noise source underlying an intermittent noise event a useful technique is to 'pause' the sound level meter during noisy events. Clearly, only part of the noise climate is being quantified when using this technique. As demonstrated below, L_{eq} can fail to describe fluctuation adequately as both of the above sources have the same L_{Aeq}.

It may be necessary to divide the measurement time up into periods of different activity if these produce significantly different noise levels or characteristics. It is frequently necessary to consider the impact of a noise source on the local community both during the day and also at night when background levels are much lower and the noise source stands out to a far greater extent. In these cases, both the background and the noise source need to be measured. BS4142 gives further assistance on selection of suitable reference periods.

1.4.1.4 Changes in background:

It will often be necessary to assess the background level upon which a specific source is imposed. Although road traffic noise is not specifically covered by this guidance note, traffic noise will often form a large component of background noise and it is a good example of the degree to which background noise levels can vary.

Road traffic noise varies with the time of day and the day of the week as the traffic flow varies. Other factors affect traffic noise level, but in general there is a familiar pattern of noise levels through the day. *Figure 12* gives a plot of noise level against time for a period of one week at a location about 10m from a busy main road within a city.

Fig 12: Time history plot of road traffic noise

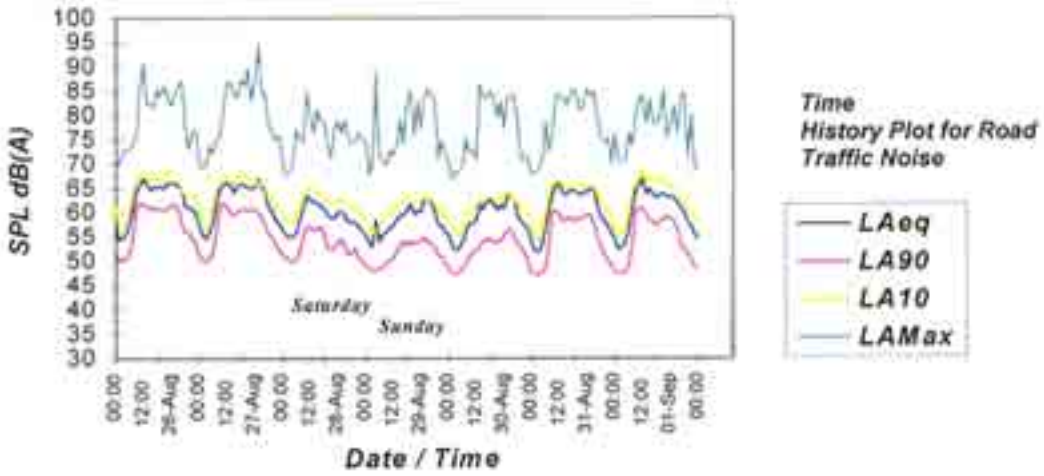


Figure 12 gives the values of L_{A10}, L_{Aeq}, L_{A90} and L_{AMAX} for each hour of the day and night. The following typical observations can be made:

- On weekdays, the morning and evening peak rush hours are visible.
- At night, noise levels drop by about 10 dB.
- L_{MAX} levels vary over a wide range from hour to hour.
- Saturdays and Sundays are generally quieter during the day, but not at night.

Whilst these are typical observations, they are by no means predictable and the pattern of noise levels will depend on local conditions. This figure does however illustrate the relationship between the different noise parameters, and also some of the factors to be considered when carrying out a noise measurement which will include road traffic noise as part of the background. BS4142 gives guidance on determination of background levels.

For any particular measurement situation there will be a range of noise parameters to choose from. Criteria used to assess noise impact have historically used a variety of parameters which makes comparison difficult. In recent years there has been a move towards using $L_{Aeq,\ T}$ wherever possible. This trend is continuing with the European Commission's work on future European noise policy. Discussions on future harmonised noise metrics are focused on $L_{Aeq,\ T}$ with weighting factors for time of day, noise character and frequency content.

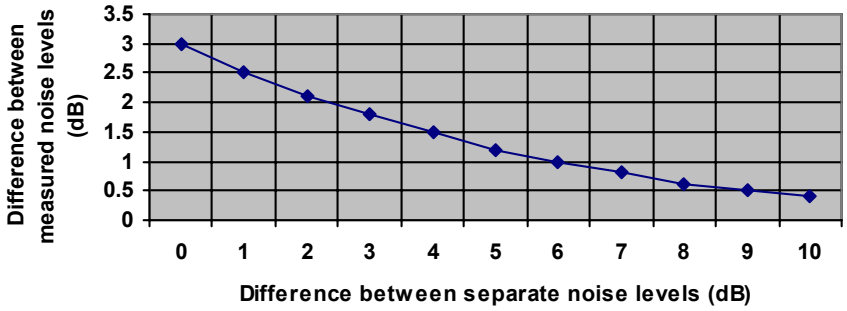
1.5 Calculating Noise Levels

Whilst measurement is clearly the best means of establishing noise levels in a particular location, this option is sometimes not available for a variety of reasons. Similarly, it is sometimes difficult to avoid the presence of significant background noise levels when taking measurements. In these cases it may be necessary to adjust a measured level by calculation to determine the level that is actually of interest. Some of the calculations that can be used are explained below.

1.5.1 Adding and Subtracting Noise Levels

It may be possible to determine the parameter of interest by adding or subtracting noise level from two or more measurements. A good way to measure the noise level from a piece of building serviced plant is to measure the total noise level at the receiver first with the plant running, and then with it switched off. The noise level of the plant is then calculated by subtracting the second level from the first. This subtraction must be done logarithmically, either using the graph below or by calculation.

Figure 13: Adding and subtracting Noise Levels



This chart can be used to add or subtract:

- if the difference between the second and the first measured levels is 1.5dB (y axis) then the plant noise must be at a level 4.0dB lower than the first measurement (x axis).

- if the difference between two separate noise levels is zero, then the additive effect is plus 3dB.

There are a number of rules of thumb which can be applied to the addition and subtraction of decibels and these are given in Section 2, together with the relevant calculated methods.

1.5.2 Facade Effects

When sound is incident on a building (or any acoustically 'hard' surface) the majority of it is reflected back off the facade. Thus a measurement made close to the facade will record the summation of the noise incident on the facade and the noise reflected away from the facade. The reflected noise is rather like a second source of the same magnitude and the effect is to add approximately 3dB to the level of the incident sound. Measurements should be made either at a facade location, approximately 1m from the facade, or in a 'free-field' location, at least 4m away from any reflective surface (apart from the ground). If the receiver is the occupant of a building it is better to measure at the facade, since facade effect can be less than 3dB, for example, if the noise is not incident perpendicular to the building.

1.5.3 Distance Attenuation

Sound intensity falls with increasing distance from the source. In an industrial context, most sources will be point sources and for a point source the inverse square law applies - doubling the distance from a point source produces a reduction in sound level of 6dB. In most cases the sound can be thought of as being dissipated over a hemisphere, or a sphere if the source is at height, *Fig 14*.

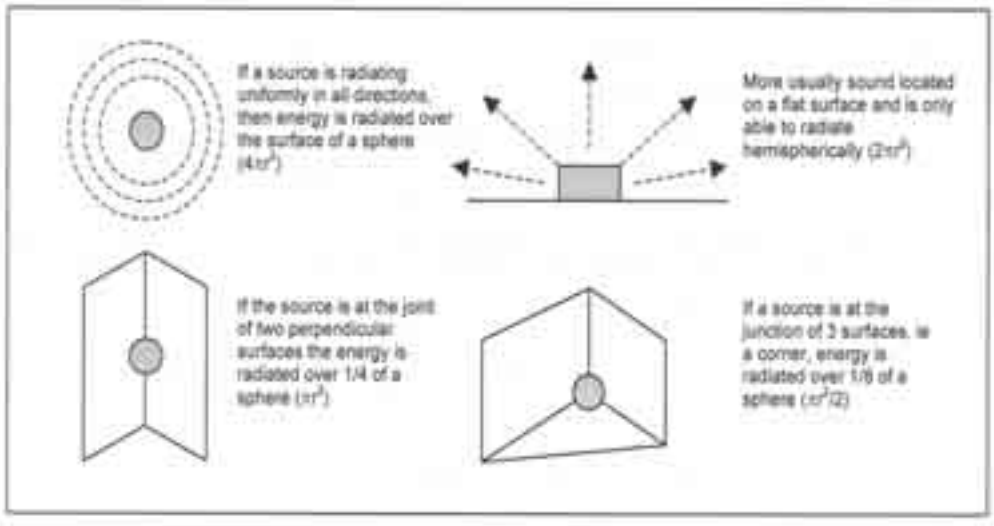


Fig 14: The directivity factor for point sources

Consideration of line sources is largely restricted to traffic and railway noise. In these cases sound power is dissipated over a cylinder, rather than a hemisphere. In practice this means that if the distance from the source doubles, the intensity of sound halves.

1.5.3.1 Prediction of the noise level at the receiver:

Where it is not possible to measure at the receiver it may be necessary to calculate the level at the receiver from the level measured somewhere else. In general if a parallel location can be used that is the same distance from the source, and is next to the receiver (so it has the same screening effects etc.), then no correction will be needed. If measurements are made on the site boundary it may be necessary to correct for the additional distance to the receiver. This is usually relatively straightforward.

The general relationships between noise level and distance from source for a point and line source are as follows:

- Point source - Measured level - 20log (distance 1/ distance 2); and

- Line source - Measured level - 10log (distance 1/distance 2)

When measuring at the site boundary a relatively small item of plant can generally be thought of as a point source. A conveyor or road may be a line source if there is an unobstructed field of view of it from the measurement point.

Example: if measurements of a chiller on top of a building gives 60dB at the site boundary which is at a distance of 100m, and the receiver is a further 50m away, then the calculated level at the receiver is 60 - 20log (150/100) = 56.5dB.

These simple relationships do not hold where there is a significant level of acoustic screening or acoustically 'soft' ground. BS 5228[2], Part 1 gives methods of calculating these effects. Soft ground effects can produce additional attenuation of up to about 3 dB(A) over distances of 100m and up to about 9 dB(A) over 1000m.

The more complex the calculation, the lower the certainty in the predicted level, so complex interpolations of measured levels should be avoided wherever possible.

1.5.3.2 Predicting sound level at a distance from plant noise output data:

Prediction of noise emitted by plant and machinery as experienced at a distance using the noise output data supplied by manufacturers (sound power level) is useful for planning purposes - predicting the outcomes of changes to plant layout, operating procedures, addition or substitution of equipment before changes are made. The sound power level is a measure of the energy output of a source which is independent of the environment around the source. It is a property of the source itself and eliminates the variability introduced by measuring at a distance. It is also given in decibels.

A useful formula for point sources is:

$L_p = L_w - 10 \log_{10} A$

Where: L_p is the sound pressure level (dB)

L_w is the sound power level of the source (dB)

A is the area over which the sound is being dissipated (m^2) in practice this is often $2 \pi r^2$ for a source at ground level producing hemispherical radiation r is the distance from the source (m).

Example: A compacting machine on a landfill site has a rated sound power output supplied by the manufacturers of 110dB. To calculate the sound pressure level at the boundary fence (20m away):

$L_p = L_w - 10 \log_{10} 2\pi r^2$ dB

$L_p = 110 - 10\log_{10} r^2 - 10 \log_{10} 2\pi$ dB

$L_p = 110 - 20\log_{10} r - 8$ dB

$L_p = 110 - 20\log_{10} 20 - 8$ dB

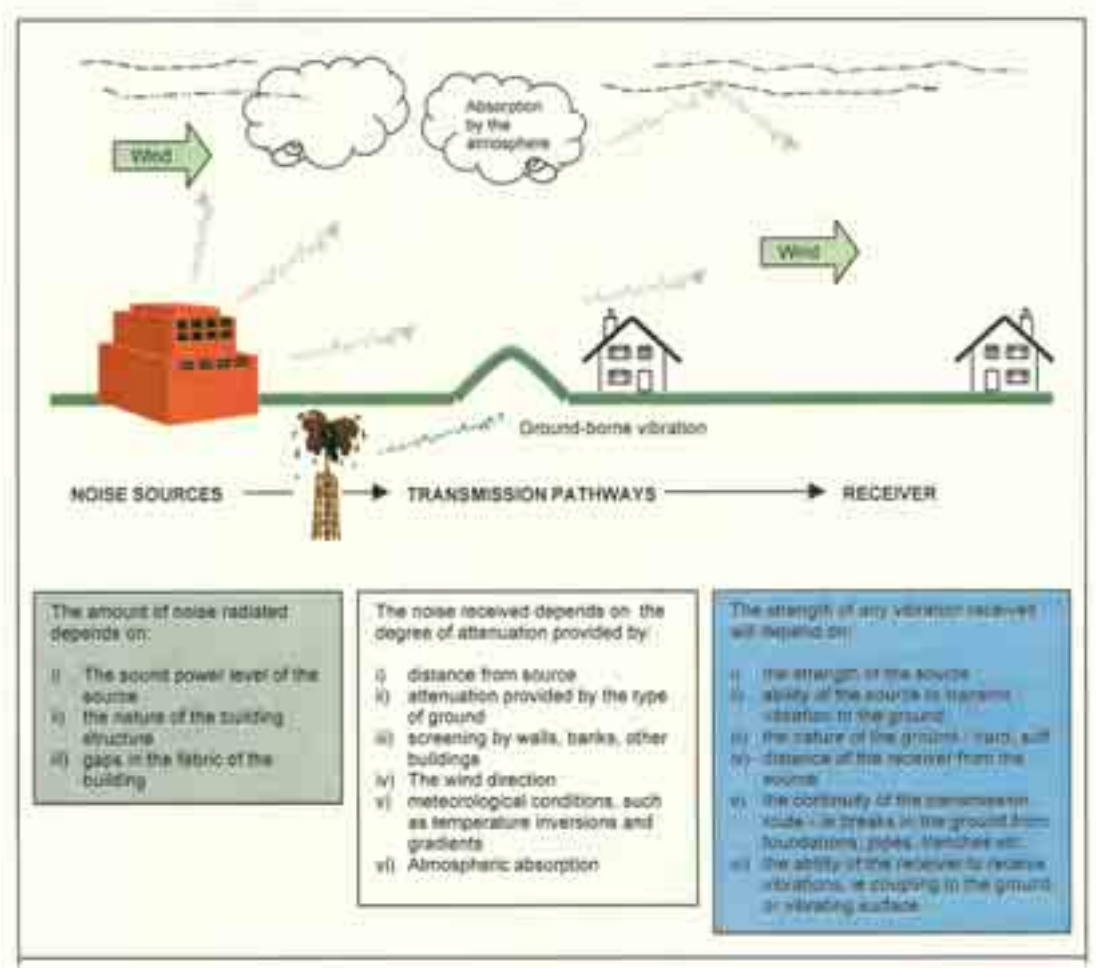
$L_p = 76$ dB

[2] British Standard BS 5228 Noise control on construction and open sites: Bsi, 1997

Section 2 Noise Control – General Principles

Once noise has been generated, there are a number of physical factors involved in determining how the noise is propagated and how much reaches the receiver:

Propagation of noise to the community



Control can be effected at 2 points in this chain:

- By **reducing at source** – by design or management
- By **blocking or impeding the transmission paths**, control by distance, direction or some form of noise abatement equipment

In determining the degree of control required, it is usual to calculate or measure the sound pressure level close to the source and, knowing the desired end-point, to calculate:

- The attenuation provided by the environment at the sensitive location
- The additional attenuation required.

The Decibel Scale

Generally measurements taken or calculations performed for acoustic and engineering purposes are considered in terms of **pressure** or **intensity**. The range of pressures and intensities that the human ear is capable of detecting gives a scale range of 10^{14} w/m^2 and 10^7 N/m^2 respectively, and therefore the decibel scale is generally used to compress these ranges into more manageable units.

Use of the logarithmic scale reduces the range of values of 0 dB at the threshold of audibility to 140 dB at the threshold of pain.

3 decibel scales are generally used:

- Sound intensity level
- Sound pressure level
- Sound power level

Of these, sound pressure level is the most commonly used.

Sound pressure level (L_p)

Microphones, which are the interface between the environment and the recording medium, are pressure sensitive. The sound pressure level is the quantity which is actually measured when a microphone is placed in a sound field. The ear is pressure sensitive and therefore measurement of this parameter is useful for assessing the impact on people and is the most commonly used dB scale, often referred to as SPL, and now known as L_p.

As with sound intensity level, sound pressure level is also a ratio but in this case of the difference of the squares of the sound pressure (p) and the reference sound pressure (p_0) which is at the threshold of audibility (2 x 10^{-5} N/m^2, or in Pascals, 20μPa)

$$L_p = 10\log_{10} \frac{p^2}{p^2_0} \quad dB$$

$$L_p = 20\log_{10} \frac{p}{p_0} \quad dB$$

Sound intensity level (L_I) is a measure of the amount of energy involved:

Intensity = energy flow per unit area (watts/m^2)

It is a vector quantity, i.e., it has both direction and magnitude. Measurement requires sophisticated techniques.

The human ear is sensitive to a wide range of frequencies

- The 'quietest' sound which can be heard = approx 10^{-12} w/m^2
- The 'loudest' (without pain) sound which can be heard = approx 10 w/m^2 (e.g. aircraft)

The intensity is in dB is a ratio of two quantities – the intensity of the sound being measured (I) and a reference intensity (I_0) which is normally the threshold of hearing (10^{-12} w/m^2).

Sound intensity is defined as: $10 \log_{10} I_2 / I_1$ dB

Example: HGV: 0.001 w/m^2 (10^{-3} w/m^2)

$L_I = 10\log_{10} 10^{-3} / 10^{-12}$ dB

$L_I = 10\log_{10} 10^{9}$ dB

$L_I = 10 \times 9$ dB

$L_I = 90$ dB

Sound power level (L_w)

This is a measure of the energy output of a source which is independent of the environment around the source. It is a property of the source itself and eliminates the variability introduced by measuring at a distance. This variability arises largely as a result of reflection from the different surfaces within a room or environment. This allows direct noise rating of machines, appliance, tools etc. which must be quoted by manufacturers and therefore allows direct comparison of sources.

The sound power level is defined as:

$$L_w = 10\log_{10} \frac{w}{w_0} \text{ dB}$$

… Where: W is the sound power of the source (watts)

W_0 is the reference sound power (10^{-12} watts)

The decibel scale – adding sound levels

As the decibel scale is logarithmic, values cannot be directly added or subtracted.

A change of 1dB(A) is only perceptible under controlled conditions. A change of 3dB(A) is the minimum perceptible under normal conditions and a change of 10dB(A) corresponds roughly to halving or doubling the loudness of a sound.

The following are general rules of thumb:-

- If two sources with the **same** sound pressure level are **added**, then the result is equivalent to an increase of 3dB.

  60dB + 60dB = 63dB

- The converse applies to subtraction:

  Two machines of 70dB, one is removed and the resultant L_P is 67dB.

When **adding two levels that are different** then use the following guide:

Difference between values to be added	dBs to be added to the higher value
1	2.5
2 or 3	2
4 to 9	1
10 or more	0

When **subtracting two levels that are different** then use the following guide:

Difference between values to be subtracted	dBs to be subtracted from the higher value
10 or more	0
6 to 9	1
4 to 5	2
3	3
2	4.5

- When **adding a series of different levels** there are two options:

  convert back to pressure/intensity levels and add

  70 dB + 74 + 76 + 80 + 81 + 83

  $L = 10\log_{10}(10^7 + 10^{7.4} + 10^{7.6} + 10^8 + 10^{8.1} + 10^{8.3})$

  L = 87 dB

- A graphical method of addition and subtraction is given in Section 1.5.1.

Some helpful ‘rules of thumb’

Point source:	double distance	sound level drops by **6** dB
Line source:	double distance	sound level drops by **3** dB
Any source:	double energy	sound level increases by **3** dB
Any source:	noise source being measured should be at least **10** dB above background	

Glossary of Terms

Acoustics:

I. The science of sound, including the generation, transmission and effects of sound waves, both audible and inaudible.

II. The physical qualities of a room or other enclosure (such as size, shape, amount of noise) that determine the audibility and perception of speech and music within the room.

Ambient Noise: The total of all noise in the environment, other than the noise from the source of interest. This term is used interchangeably with background noise.

A-weighted sound level: A measure of sound pressure level designed to reflect the acuity of the human ear, which does not respond equally to all frequencies.

Attenuation: The reduction of sound intensity by various means (e.g., air, humidity, porous materials...).

Band: Any segment of the frequency spectrum.

Damping: The dissipation of energy with time or distance. The term is generally applied to the attenuation of sound in a structure owing to the internal sound-dissipative properties of the structure or to the addition of sound-dissipative materials.

dBA: Unit of sound level. The weighted sound pressure level by the use of the A metering characteristic and weighting specified in ANSI Specifications for Sound Level Meter.

Decibel: A unit of sound pressure level, abbreviated dB.

Equivalent A-weighted Sound Level (LAeq): Is the value of A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval has the same sound pressure as a sound that varies with time.

Frequency: The number of times per second that the sine wave of sound repeats itself, or that the sine wave of a vibrating object repeats itself. Now expressed in hertz (Hz), formerly in cycles per second (cps).

Frequency Spectrum The range of noise frequencies usually audible to the average ability of the ear of a human being to hear. The frequency spectrum can be Broad Band (equal to one octave between frequencies) or Narrow Band (equal to one-third octave between frequencies) or narrower (Fast Fourier Transform) frequency bands.

For calculating or predicting noise levels, octave spectra are often used to account for the frequency characteristics

	of sources and propagation.
Hearing:	The subjective human response to sound.
Hearing Level:	A measured threshold of hearing at a specified frequency, expressed in decibels relative to a specified standard of normal hearing. The deviation in decibels of an individual's threshold from the zero reference of the audiometer.
Herts (Hz):	Unit of measurement of frequency, numerically equal to cycles per second.
Intensity:	The sound energy flow through a unit area in a unit time.
L_{10}	The noise level which is exceeded 10% of the measurement time.period
L_{90}	The noise level which is exceeded 90% of the measurement time period.
Logarithm:	The exponent that indicates the power to which a number must be raised to produce a given number. For example, for the base 10 logarithm, used in acoustics, 2 is the logarithm of 100.
Loudness:	The subjective judgment of intensity of a sound by humans. Loudness depends upon the sound pressure and frequency of the stimulus. Over much of the frequency range it takes about a threefold increase in sound pressure (a tenfold increase in acoustical energy, or, 10 dB) to produce a doubling of loudness.
Sound Exposure Level (SEL) **LAE**:	is a parameter closely related to **Laeq** for assessment of events (intermittent transient noise) that have similar characteristics but are of different duration. The LAE value contains the same amount of acoustic energy over a normalised one second period as the actual noise event under consideration.
LAFMax, **LASMax**, or **LAIMax**	: represents the Maximum A-weighted noise level measured with Fast (F), Slow (S) or Impulse (I) time weighting. They are the highest level of environmental noise occurring during the measurement time. They are often used with another noise parameter (LAeq) to ensure a single noise event does not exceed a limit. (NB it is essential to specify the time weighting (F, S or I).
LAFMin, LASMin or **LAIMin**	: represent the Minimum A-weighted noise level measured with Fast (F), Slow (S) or Impulse (I) time weighting. They are the lowest level of environmental noise occurring during the measurement time.

LAFN,T Percentile levels : the level of A-weighted noise exceeded for N% of the measurement time. For example **LAF90,T** is the noise level exceeded for 90% of the measurement time. (NB the time weighting should be stated in such measurements and it is normally Fast).

Noise Contours : these are used to show the location and extent of noise problem areas. The number shown with each contour indicates the noise level exceeded within that contour. When superimposed onto a map, and compared to noise limits, they pinpoint areas in need of noise attenuation or noise reduction measures.

LAr,Tr Rating Level: The A-weighted equivalent continuous noise level (LAeq,T) during a specified time period with specified adjustments for tonal, impulsive or intermittent noise.

Sound Exposure Level (SEL): See **LAE**.

Noise:

1. Unwanted sound.
2. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources.
3. An erratic, intermittent, or statistically random oscillation.

Octave: The interval between two sounds having a frequency ratio of two - there are 8 octaves on the keyboard of a standard piano.

Octave Band: A segment of the frequency spectrum separated by an octave.

Noise Level: For airborne sound, unless specified to the contrary, it is the A-weighted sound level.

Noise Reduction (NR): The numerical difference, in decibels, of the average sound pressure levels in two areas or rooms. A measurement of 'noise reduction' combines the effect of the sound transmission loss performance of structures separating the two areas or rooms, plus the effect of acoustic absorption present in the receiving room.

Octave Band Level: The integrated sound pressure level of only those sine-wave components in a specified octave band.

Oscillation: The variation with time, alternately increasing and decreasing, of (a) some feature of an audible sound, such as the sound pressure; or (b) some feature of a vibrating solid object, such as the displacement of its surface.

Peak Sound Pressure: The maximum absolute value of the instantaneous sound pressure in a specific time interval. Note: in the case of a periodic wave, if the time interval considered is a complete period, the peak sound pressure becomes identical with the maximum sound pressure.

Pitch: The attribute of auditory sensation that orders sounds on a scale extending from low to high. Pitch depends primarily upon the frequency of the sound stimulus, but it also depends upon the sound pressure and wave form of the stimulus.

Pure Tone: A sound for which the sound pressure is a simple sinusoidal function of the time, and characterized by its singleness or pitch.

Resonance: The relatively large amplitude of vibration produced when the frequency of some source of sound or vibration 'matches' the natural frequency of vibration of some object, component, or system.

Residual Noise The residual noise is the noise remaining at a point under certain conditions when the noise from the specific source is suppressed.

Reverberation: The persistence of sound in an enclosed space, as a result of multiple reflections, after the sound source has stopped.

Sound Level: The weighted sound pressure level obtained by the use of a sound level meter and frequency weighting network, such as A, B or C.

Sound Level Meter: An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

Sound Power: The total sound energy radiated by a source per unit time. The unit of measurement is the watt.

Sound Pressure: The instantaneous difference between the actual pressure produced by a sound wave and the average or barometric pressure at a given point in space.

Sound Pressure Level (SPL): 10 times the logarithm, to the base 10, of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter. In equation form, sound pressure level in units of decibels is expressed as SPL (dB) = 2- log p/p_r.

Temporary Threshold Shift (TTS): A temporary impairment of hearing acuity as indicated by a change in the threshold of audibility.

Ultrasonic: Sounds or a frequency higher than 20,000 hertz.

Vibration: An oscillatory motion of solid bodies described by displacement, velocity, or acceleration with respect to a given reference point.

Wavelength: For a periodic wave (such as sound in air), the distance between analogous points on any two successive waves. The wavelength of sound in air or in water is inversely sensed in the head. Onset may be due to an acoustic trauma and persist in the absence of acoustical stimulation (in which case it may indicate a lesion of the auditory system).

Tone: A sound of definite pitch. A pure tone has a sinusoidal wave form.

Weighting: Prescribed frequency filtering provided in a sound level meter.

Example of Condition Setting for a Waste Management Facility

EIS Waste Services, Checkbar, Nigg, Aberdeen. This site is licensed for the keeping and treating of wastes (primarily dry wastes) within a purpose-built shed. The measurement position was as described in BS4142 (1997) (microphone position 3.5m from building and 1.5m from ground to minimise reflections of sound)

The following parameters were determined: (see plan below)`

Distance from nearest dwelling to transfer shed: 110m (r_1)
Distance from nearest dwelling to boundary: 40m (r_2)
Background reading from nearest dwelling: 55dB(A)

Using the formula $L_P = L_W - 20 \log r - 8$ for a point source;

the sound power level (L_W) is required to be calculated to determine the noise which could be produced by waste management activities without affecting the background levels:

(N.B. Leq_A was used to characterise the pre-existing ambient noise level for the area and the base line against which to prevent creeping growth of ambient noise in the locus.)

$L_P = L_W - 20 \log r_1 - 8$

$55 = L_W - 20 \log 110 - 8$

$L_W = 103$ dB (A).

Therefore the limit set for the boundary to prevent any increase in noise at the nearest noise sensitive dwelling would be;

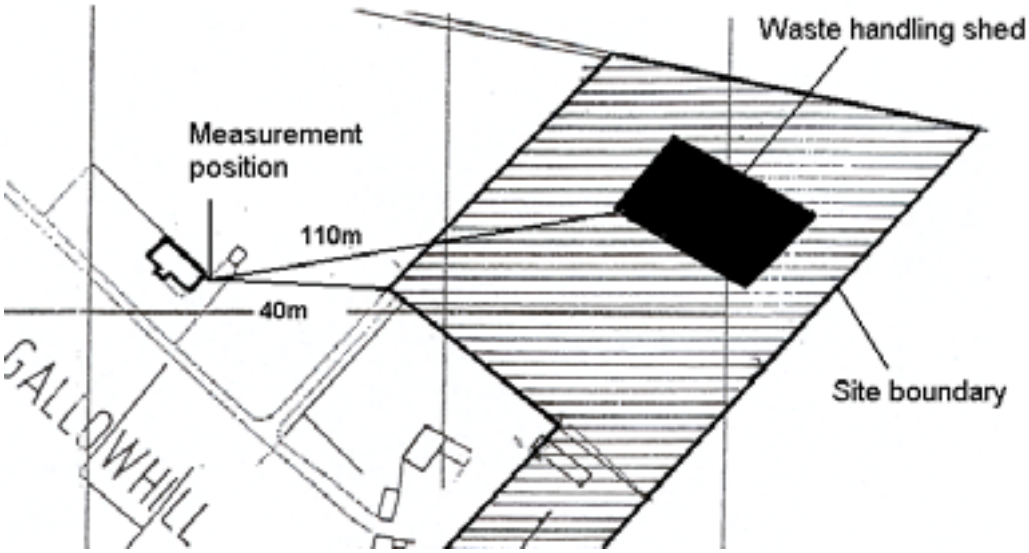
$L_P = L_W - 20 \log r_2 - 8$

$L_P = 103 - 20 \log 40 - 8$

$L_P = 63$ dB (A).

The condition then set was:

In order to protect the amenity of the locality, sound levels arising from waste management activities permitted by this licence shall not exceed 63 dB(A) Leq at any point on the site boundary, delineated in red on the attached docketed plan forming Appendix 1 of this schedule, in accordance with BS 4142 (1997).


Waste handling shed
Measurement position
110m
40m
Site boundary
GALLOWHILL

Legislative Framework for Environmental Noise

Legislative coverage of common (environmental) noise sources

Noise source/type	Enforcing Authority	Relevant Legislation
Construction	Local Authority	Control of Pollution Act 1974 (Sec 60 notices)
Domestic/night noise	Local Authority	Statutory Nuisance - EPA '90, Part III
Dogs/animals (not wild animals)	Local Authority	Statutory Nuisance - EPA '90, Part III
Loudspeakers	Local Authority	Some CoPs relevant
Trade or business	Local Authority	Statutory Nuisance - EPA '90, Part III Noise Abatement Zones designated under COPA (58 designated, 40 no longer operated)
Trade or business	Agency	Processes and activities covered by the Waste Management Licensing regime - 'relevant objectives' of WML Regs 1994. Action can still be taken under EPA '90 Part III if licence conditions are being met but a nuisance still exists
Trade or business	Agency	EPA '90 Part I, Part A (IPC) processes involving the recovery or disposal of waste (to comply with Waste Framework Directive) Part III of EPA '90 (Statutory Nuisance provisions) disabled where action could be taken under pollution control provisions - but this does not apply to noise, fumes or gases which can be regulated under Part I or Part III

Noise source/type	Enforcing Authority	Relevant Legislation
Trade or business	Agency and Local Authority	Integrated Pollution Prevention and Control (PPC Regulations 2000). Activities categorised as Part A. Installations shall be operated in such a way that all preventative measures are taken against pollution, in particular through the application of BAT. Noise and vibration fall within the definitions of 'emissions' and 'pollutants'
Intruder alarms (buildings)	Local Authority	Statutory Nuisance - EPA '90 Part III
Entertainment	Local Authority	Controls via entertainment licensing
Noise output from motor vehicles/motor cycles, aeroplanes, construction plant and machinery	Local Authority	Restrictions imposed by Secretary of State
Airports		Restrictions imposed by S.E.
Noise from public works		S.E. (re. provision of insulation)
Planning	Local Planning Authority	Controls imposed via planning consents. PANs50& 56 give guidance Town & Country Planning (Environmental Impact Assessment) (Scotland) Regulations
Noise at work	Health & Safety Executive	Noise at Work Regulations

Noise/Vibration Management Plan Template

1. Purpose and Ownership

Aim: The aim of this plan is to prevent or minimise noise and vibration emissions and their impact on sensitive receivers by:

(i) identifying the causative factors, location and nature of such emissions

(ii) specifying the actions taken to prevent or minimise releases (BAT)

(iii) identifying foreseeable causes of malfunction or non-operation which could increase the emission and/or the impact on sensitive receivers.

The content of this plan has been agreed between the Operator and the (regulator) on ..... (date).

The plan will be subject to regular review and amended as necessary.

The Operator: (name of organisation)

Relates to the installation/activities at: (address)

Relevant (permit, authorisation number)

Person with overall responsibility (name and job title)

The Operator undertakes to adhere to the agreed plan at all times. Any amendments that are shown to be necessary should be discussed with the (regulator) prior to implementation or to incorporation into the plan.

Signed ..... (for the Operator)

Designation:

Review date

Agreed review date:

Status Log

Detail	Date	Comment
e.g. Draft Plan received	xxxx	further information requested
Plan Agreed	xxxx	
Draft Revision		

The level of detail in the management plan should correspond to the risk of causing annoyance to sensitive receptors.
Where receptors are remote and the risk is therefore low, the information required in Table 2.9.1 below will be minimal, although information relating to noise sources in Table 2.9.2 below will still be required and BAT should be used to reduce noise. Insignificant sources should be "screened out" qualitatively (giving justification) and detailed information need not be given. Scaled maps and site plans should be provided as appropriate to show relative locations of receptors, sources and monitoring points. Significant non-installation sources on site should be identified.

Table 2.9.1 Information relating to environmental impact and existing arrangements for monitoring the impact

Identify and describe each noise sensitive location which is affected	**What is the background and ambient sound level at each receptor identified?**	**Is there a specified monitoring point which relates to the receptor?**	**How often is monitoring undertaken?**	**What is the sound level when the plant/source(s) is operating?**	**Have any sound level limits or other condition(s) been applied?**
State the type of receptor and give an approximation of its extent/size/population, as appropriate. On a large installation different receptors may be affected by different sources.	i.e., when the plant/source is not operating. Background noise level should be expressed as LA90 and the ambient noise level should be expressed as Laeq.	Describe the location or indicate on a plan of the site (relative to source locations and/or receptors). Has this been specified by a Regulator or do they form part of the Operator's own system of performance checks?		Refer to the accompanying notes for a description of the information required.	Conditions/limits imposed which relate to sensitive receptors or to other locations. Include any relevant planning conditions or noise requirements imposed by the Local Authority, including locations and numerical limits and parameters.

Table 2.9.2 Information relating to individual sources and emissions

Provide a brief overview of sources whose impact is insignificant
Further information need NOT be given below for the sources described here.

Identify each significant source of noise and/or vibration	Source reference number	Describe the nature of the noise or vibration	Is there a specified monitoring point?	What is the contribution to overall emission?	Description of actions taken to prevent or minimise emissions	Actions to be taken to meet BAT and timescales
List each source not considered to be insignificant – by process or activity if they can be conveniently sub-divided in this way. Mobile sources should also be identified.	Give each source a reference number (which should correspond to any map or plan supplied)	Provide hours of operation for non-continuous, infrequent or seasonal activities. For noise – where there are any distinctive characteristics associated with a source, such as clatter, whine, hiss, screech, hum, bangs, clicks, thumps or tonal elements, this should be noted.	Have these been specified by a Regulator or do they form part of the Operator's own system of performance checks?	This relates to the relative risk associated with each source in terms of impact at sensitive receptors. Categorise each as high or medium (low risk should have been screened out above) unless supporting numerical data is available.	The Operator should demonstrate that the arrangements in place are BAT for the installation. Indicative BAT requirements and information relating to the determination of BAT can be found in sector-specific guidance or the General Sector Guidance where no sector-specific guidance yet exists,	Identify any proposals for improvement or specific local issues that need to be addressed. An indication of proposed timescales should be included.

Any other relevant information should be given or referenced here

E.g., Non-installation sources

Table 2.9.3 Supplementary information required for complex and/or high risk installations

This is an additional requirement which *should be submitted where requested* by the Regulator. It may also be useful to any Operator who has noise problems or potential to cause noise and/or vibration-related annoyance in assisting to direct or prioritise activities.

Source	**Potential failure scenarios**	**What measures have been put into place to prevent the failure or to reduce the impact?**	**What is the environmental impact/outcome if there is a failure?**	**What actions are taken if this occurs and who is responsible?**
This refers to each source listed in Table 2.9.2	The operator should consider all reasonably foreseeable scenarios that could increase the noise to a level where it could become an issue at sensitive receptors, or could lead to non-compliance with a permit condition. Some of these may be caused by a factor beyond the control of the operator, such as power failure, and for which it is agreed that to provide back-up facilities is not BAT.	The measures put in place would be to prevent or minimize the environmental impact should a failure occur. This may be as simple as ensuring that all doors are shut to contain the noise, doing regular visual inspections, instigating a programme of preventative maintenance, withdrawing machinery from service for maintenance, or possibly shutting down the process or stopping the activity altogether at the other end of the scale. It may also be useful to identify for each scenario (as appropriate), which person is responsible for instigating or approving actions, particularly where this involves shutdown or removal of equipment from service.	This assumes that a failure has occurred and the actions have been taken as specified in the previous column. The likely duration, noise level or increase in noise level (at source or receptor) and any characteristics should be noted. If there is a delay factored into the actions taken (i.e, because it is not possible for some reason to instigate action immediately) before the impact can be minimized, then this should be noted. (Where this might lead to cause for complaint, such a delay must be agreed in advance with the Regulator and a valid justification given – it is not an excuse for a poor response).	This refers to actions such as the requirement to contact the Regulator should an event occur, or internal actions such as reporting requirements, verbal or written, dealing with complaints arising from the incident etc.

Any other relevant information not specifically requested above should be given or referenced here

Maintenance of the logs/records would normally be expected:

- ❑ **Log of processes and checks carried out to minimize noise emission from normal operations**
  This would include planned maintenance, visual inspections and checks.

- ❑ **Log of processes and checks carried out to minimize noise emission from failures and other factors**
  This would include reactive maintenance where required to address increased noise or vibration emissions, replacement of equipment etc.

- ❑ **Log of monitoring and compliance checks undertaken**
  Note: The operational log should normally be completed within 14 days of taking the measurements or actions

All sound level monitoring to be undertaken and reported in accordance with the relevant British Standard.

Generic Noise Survey Specification

Where noise emission is considered to have or is likely to have a significant impact on the environment the following generic specification for a noise survey is suitable to provide either preliminary information in support of an application or ongoing compliance monitoring by the process operator.

Noise measurements shall comply with the following basic conditions:

(i) Be free field measurements, taken between 1.2 to 1.5m above the ground and at least 3.5 m away from reflecting structures such as walls and fences.

(ii) Measurements shall not be made if average wind speed exceeds 5m/s.

(iii) Measurement positions shall be selected to be shielded from extraneous noise.

Where these conditions cannot be complied with they shall be recorded in the site visit log book and the circumstances that prevented the compliance shall be recorded.

Noise shall be measured in accordance with BS7445 and BS4142 where appropriate, at least four positions on the site boundary representative of the total noise arising from the process. At these positions LAp, LAIO, LAeq shall be measured for 60 minute intervals, extraneous noise should be excluded wherever possible. A lesser period of time (minimum 5 minutes) may be used if the noise is steady and not cyclic. The measurements shall be repeated for a number of sampling periods during the permitted hours of operation to determine variability in site noise.

The noise emissions from each individual item of site plant shall be measured, in terms of the LAp, and LAeq at a distance of 10m together with and peak noise levels, wherever feasible. If it is not practicable to measure noise at 10m, noise shall be measured at an alternative distance and the noise level at 10m deduced by calculation and the method used detailed. The operating conditions at the time of measurement shall be noted.

Recording of specific noise frequencies may assist in interpretation of highlighting of specific plant and this could be considered.

If site plant are not available, because for example the site is non operational, then either specific manufacturers data on sound power levels should be included or equivalent data obtained from other sources should be used, e.g. BS5228.

Determination of the background noise (LA90) and pre existing LAeq with no noise from the process activity on the proposed site should be undertaken, preferably at the location(s) of noise sensitive receivers and the site boundary. Monitoring should have been performed to cover all operational or representative weekdays and weekend times as agreed with the Agency.

The report should include the following:

- A general site description including an inventory of noise barriers and the nature of ground cover between any measurement position and the site noise sources and sensitive receivers.

- A list of the noise sensitive areas in the vicinity of the site, identifying amenities parks and open spaces) as well as residential properties and noise sensitive commercial buildings (e.g. schools, hospitals, offices).
- An assessment of the impact of the site on the locality in relation to the background noise including such things as the individual site plant data, a determination of the distance to any noise sensitive receivers and a determination of the levels of noise at the receivers either by measurement or calculation.
- A record of significant site activity including plant movement and comment upon the site activity on the day, the operating conditions and general condition of the site plant/equipment.
- Significant meteorological conditions, particularly the direction of the wind, if any, and the direction of the nearest noise sensitive receiver from the site.
- Comment on other noise sources not part of the permitted operations.

NOISE INSPECTION/SURVEY REPORT

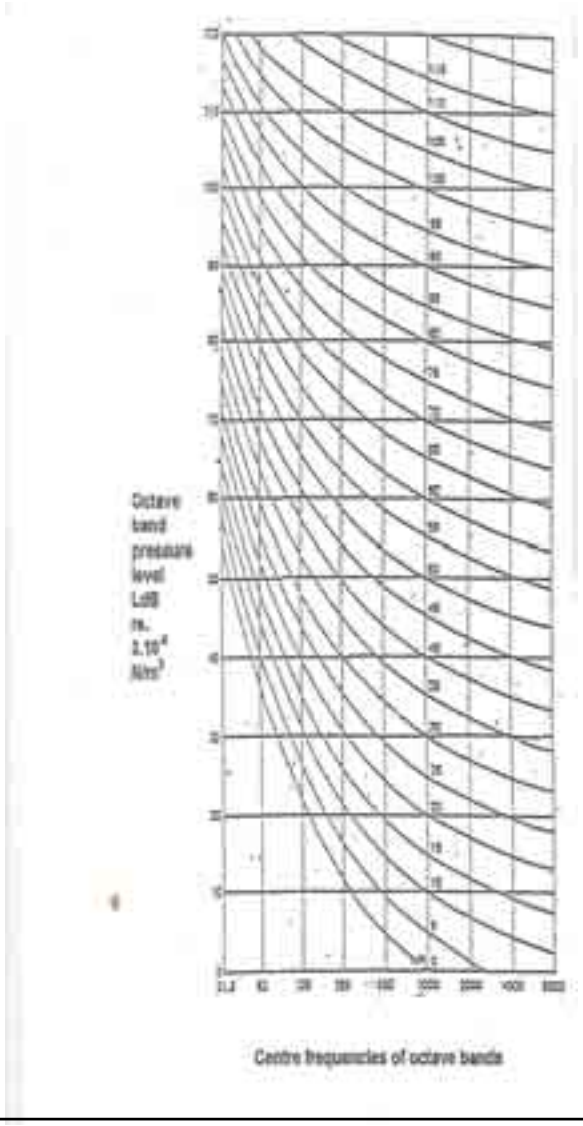
OFFICER:	WITNESS:	
PROCESS ADDRESS:		
		PERMIT NO:
DATE:	TIME START:	TIME STOP:
REASON FOR MONITORING: (COMPLAINT, AUDIT, PROCESS)		
DESCRIPTION OF NOISE SOURCE:		
SUBJECTIVE ASSESSMENT:		
NOISE SOURCE: (A) HOURS OF OPERATION (B) MODE OF OPERATION e.g. Cyclic, Fluctuating		
DESCRIPTION OF PREMISES IN WHICH SOURCE IS LOCATED:		
MEASUREMENT POSITION(S) (SKETCH PLAN OVERLEAF):		
MEASUREMENT EQUIPMENT USED:		
SLM MANUFACTURER:	TYPE:	
SERIAL NO:	CALIBRATION DATE:	
CALIBRATION LEVEL:	BEFORE:	AFTER:
CALIBRATION MANUFACTURER:		
TYPE:	SERIAL NO:	CAL. DATE:
WEATHER CONDITIONS: WIND SPEED/DIRECTION (SEE OVERLEAF)		
RAIN/FOG/MIST/DRY:	TEMPERATURE:	

REFERENCE STANDARD:	BS7445		BS4142		OTHER (SPECIFY BELOW)

SPECIFIC NOISE:		
MEASUREMENT INTERVAL:	REFERENCE INTERVAL:	
MEASURED LEVEL:	SPECIFIC NOISE LEVEL (L_A EQTR):	
CHARACTER CORRECTION:	RATING LEVEL:	
BACKGROUND NOISE LEVEL (L_{90}):	L_{AEQ}:	MEASUREMENT PERIOD:
MEASUREMENT POSITION:		
LEVELS: L_{90}dB(A)		
ASSESSMENT: RATING LEVEL - BACKGROUND LEVEL:		

CONDITION COMPLIANCE:	YES		NO	

FREQUENCY ANALYSIS: YES/NO (IF YES P.T.O.)
OFFICER SIGNATURE:



BEAUFORT SCALE

Beaufort No.	Description of Wind	Wind speed metres per sec.
0	Calm	< 0.3
1	Light air	0.3-1.5
2	Light breeze	1.6-3.3
3	Gentle breeze	3.4-5.4
4	Moderate breeze	5.5-7.9
5	Fresh breeze	8.0-10.7
6	Strong breeze	10.8-13.8
7	Near gale	13.9-17.1
8	Gale	17.2-20.7
9	Strong gale	20.8-24.4
10	Storm	24.5-28.4
11	Violent storm	28.5-32.6
12	Hurricane	> 32.7

APPROPRIATE NR CURVE .....

MEASURED NR CURVE .....

MEASURED LEVELS INDICATED BY .....**X**.....

COMMENTS .....

.....

.....

.....

Sketch Plan of Measurement Position

References

Joint Environment Agency/ Scottish Environment Protection Agency/ Environment and Heritage Service draft Horizontal Guidance for Noise - Parts 1& 2

Consultative document issued by the Scottish Executive and the Scottish Environment Protection Agency titled - The Pollution Prevention and Control(Scotland) Regulations 2000 - A Practical Guide - Issue 1

Planning Advice Note PAN 50

Planning Advice Note PAN 56

BS 7445

BS 5228

BS 4142

Proposal for a European Parliament and Council Directive relating to the Assessment and Management of Environmental Noise - 2000. Working Draft

Circular 10/99 Planning and Noise

Control of Pollution Act 1974

Noise At Work Regulations 1989

Environmental Protection Act 1990

Noise And Statutory Nuisance Act 1993

Environment Act 1995

Noise Act 1996

Pollution Prevention and Control Act 1999

Pollution Prevention and Control (Scotland) Regulations 2000