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Static Noise Testing Protocol for National Hot Rod Oval Racing

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Professional Credentials – John Edward Grant

I. I am John Edward Grant, Acoustics and Environmental Consultant. I have provided an independent consultancy service since 1991, and in a professional capacity have presented expert evidence to Public Inquiries, Ombudsman Investigators, Planning Appeals and Courts.

II. From 1982 to date I have been employed in local authority service, engaged in a wide range of environmental pollution work incorporating noise and vibration - control, rating, assessment, investigation and enforcement; impact assessment of town and country planning development(s); statutory/public nuisances; air quality; contaminated land; and regulation of industrial processes, commercial operations, entertainment and sporting/leisure activities.

III. I held the position of Principal Pollution Control Officer within a metropolitan authority for 11 years, heading a team of specialists working in the field of environmental noise, air pollution and land contamination, throughout which I had Lead Officer responsibility in respect of noise and vibration.

IV. I am concurrently employed as Scientific Manager by Walsall Metropolitan Borough Council, heading a team of noise and air quality specialist officers, and as an Associate Lecturer at the University of Derby.

V. I possess the following academic qualifications, professional memberships and recognitions:

Master of Science Degree	- Acoustics, Noise and Vibration Control
Master of Science Degree	- Environmental Pollution Control (*Distn.*)
Institute of Acoustics Diploma	- Acoustics and Noise Control
University Certificate	- Environmental Noise
Royal Society of Health Diploma	- Air Pollution Control
University Certificate	- Air Pollution Control (*Distn.*)

Institute of Acoustics	- Corporate Grade (Member)
Institution of Environmental Sciences	- Corporate Grade (Member)
Royal Society of Health	- Corporate Grade (Fellow)
Chartered Environmentalist	

VI. I am the Noise Technical Co-ordinator for the Midland Joint Advisory Council for Environmental Protection (MJAC), a position I have held since 1997. Within the MJAC I additionally hold the position of Chair to the Noise Committee, and have previously been Secretary to the Vibration Working Group, Secretary to the Clay Target Shooting Noise Working Group. On behalf of the MJAC I served as a Member of The Chartered Institute of Environmental Health Technical Working Group on Clay Target Shooting Noise.

VII. In 1999 I became a Committee Member for the Institute of Acoustics Midlands Branch, a position I presently retain. As of 2008, I became a Committee Member for the Institute of Acoustics Education Committee.

VIII. From 2002 to date I have been employed as an Associate Lecturer in Acoustics, Noise and Vibration at the University of Derby in association with the Institute of Acoustics' Diploma in Acoustics and Noise Control. Between 1992 and 2002 I was a Sessional Lecturer in Environmental Noise at Matthew Boulton College, Birmingham. I have additionally undertaken Sessional Lecturing relating to air pollution at Masters Degree level, and for the NEBOSH Certificate in Environmental Management.

IX. I am certified as a Competent Person for the purposes of the Noise at Work Regulations.

X. Advice, recommendations, or conclusions contained in this report are offered without bias or prejudice. I understand that it is my duty to any court or hearing to help in an impartial manner with all matters relevant to my areas of expertise.

XI. I confirm that insofar as the facts stated in my report are within my own knowledge I have made clear which they are and I believe them to be true, and that the opinions I have expressed represent my true and complete professional opinion.

XII. Compliance with any recommendations or advice contained herein cannot confer immunity from statutory or civil (legal) proceedings, neither can it offer any form of guarantee of a successful appeal against such legal action.

XIII. Where any works, steps or measures are applied as a consequence of this Report, adherence is required to all pertinent legal and safety requirements and consultation with all appropriate regulatory bodies must be undertaken.

1.0 Introduction

1.1 At the request of the Oval Racing Council International (ORCi), this report has been prepared as part of a remit to address environmental noise associated with the use of oval racing circuits. It forms an addition to the first element of a three part strategy that comprises :

i. Preparation of a static noise testing protocol on behalf of the ORCi in respect of Formula 1 Stock Cars that can subsequently be used as a basis for noise testing procedures in regard to other classes of oval circuit racing.

ii. Preparation of environmental noise impact criteria.

iii. A preliminary review of the National Society for Clean Air (NSCA) 1996 'Code of Practice for the Control of Noise from Oval Racing Circuits'.

1.2 Key to the approach when controlling noise in this context is to ensure the best practicable means are employed, which is a defence afforded against statutory nuisance action to a trade or business activity.

1.3 To facilitate development of a static noise test protocol, 31 National Hot Rod (NHR) cars have undergone noise testing conducted at a race event held in March 2009.

1.4 Whilst NHR cars compete to a defined set of rules and regulations (including a standard silencer specification), and to all intents and purposes there is a great similarity between vehicles, certain anomalies were nonetheless apparent. The main point of concern rested with car design and the accessibility of exhaust silencers.

1.5 Whilst silencers are all broadly positioned in the same location, determination of the exhaust reference point (see Figure 1) was in certain instances compounded by rear under tray designs.

1.6 Additionally, some vehicles were fitted with functioning tachometers, whereas others have no such instruments; these are an integral feature of the proposed noise testing protocol.

2.0 Approach to Noise Testing Procedures

2.1 Static noise testing in motor sports normally entails application of a maximum noise limit at a specified distance from, and angle to, the line of an exhaust/silencer. This approach is typified for example, in events governed by the UK's Motor Sports Association (MSA). The MSA produces a Competitors' Yearbook (the 'blue book') which is currently in its 52nd Edition.

2.2 The MSA Yearbook contains a wealth of information relating to rules and regulations that govern a variety of motor sport events and competitions, and for those regulated by the MSA it is stated that an essential part of pre-event scrutineering should be a sound test.

2.3 The Yearbook does not incorporate stock car / oval racing, banger racing, or 'drifting', but it does contain sections devoted to rallying, karting, hill climbs, sprints and drag racing. Using karting as an example, in dealing with noise, it is a mandatory requirement that all karts have effective exhaust and induction muffling to comply with prescribed sound level regulations set out by the MSA (and whilst silencing is not mandatory for all vehicles/classes of racing, it is strongly recommended). Responsibility rests with the competitor to comply with sound regulations, and during competition any competitor loosing a silencer during a race is excluded.

2.4 The standard MSA sound test involves measurements taken at 0.5 m from the end of the exhaust pipe with the microphone at an angle of 45^o with the exhaust outlet, at a height of 0.5 to 1.0 m above the ground. Where more than one exhaust is present, the test is to be repeated for each exhaust and the highest reading used as the test result.

2.5 In circumstances where the exhaust outlet is not immediately accessible, the test may be conducted at 2.0 m from the centre line of the vehicle at 90^o to the centre line with the microphone 1.2 m above the ground.

2.6 Measurements should be made outdoors with no large (sound) reflecting objects or structures within 3.0 m (in the 0.5 m distance test) or within 10.0 m (in the 2.0 m distance test).

2.7 Background or ambient noise levels should be at least 10.0 dB(A) below the measured levels.

2.8 Cars are run at two thirds or three quarters maximum r.p.m.

British and International Standard Noise Test for Stationary Vehicles

2.9 Standards have been available for noise testing of road vehicles for a number of years, and for static purposes are currently exemplified by BS ISO 5130: 2007 'Acoustics – Measurements of sound pressure level emitted by stationary road vehicles'.

2.10 BS ISO 5130 has been developed for use in the engineering evaluation of the sound pressure level performance of road vehicles in the vicinity of exhaust systems, with the intention of offering a method to vehicles in use. It also serves to determine variations in the exhaust sound pressure level that can result from wear, maladjustment or modification of particular components (when the defect does not appear by visual inspection), and the partial or complete removal of devices that otherwise reduce certain sound pressure levels.

2.11 The scope of BS ISO 5130 includes a test procedure, environment and instrumentation for measuring exterior sound pressure levels from road vehicles under stationary conditions, and is designed to meet the requirements of simplicity as far as they are consistent with the reproducibility of results under the operating conditions of the vehicle.

2.12 Although not intended to be directly applicable to motorsport activities, distinct aspects of the standard are helpful in designing a noise testing protocol for NHRs and Stockcars to ensure consistency and technical robustness. Where considered appropriate, elements of BS ISO 5130 have consequently been utilised or adapted for the purpose of this report, along with technical criteria from other standards and guidance.

Continued

2.13 It is clear that a 0.5 m test relative to exhausts is not feasible for the current compliment of National Hot Rods raced in the UK, since on competitors' cars exhausts and silencers cannot readily be seen or accessed, and a distance of 0.5 m allied to a 45^{o} angle relative to the exhaust outlet cannot be achieved owing to bodywork and chassis obstructions.

2.14 A 2.0 m distance test procedure was therefore standardised for a default position in relation to the exhaust outlet, at a height above ground level of not greater than 1.0 m and not less than 0.5 m. Maximum noise measurements were conducted with the microphone aligned towards the exhaust termination point and in the direction of exhaust gas flow.

3.0 NHR Noise Testing Protocol

Test Site

i. All noise tests shall be conducted outdoors with vehicles positioned on level concrete, dense asphalt or a similar hard material flat surface free from snow, grass, loose soil, or other sound absorbing material. The test site dimensions shall ideally be a rectangular area that is not less than the dimensions of the vehicle under test and shall extend sufficiently to include microphone positions.

Note: As a guide, a test area of 4.0 m x 8.0 m minimum will be sufficient

ii. The test site shall be in an open space free from large sound reflecting surfaces, for example parked vehicles, buildings, billboards, trees, shrubbery, parallel walls within a 3.0 m radius of the microphone location and any point. Where available, test sites free from large sound reflecting surfaces within a 10.0 m radius of the microphone shall be used.

Meteorological Conditions

iii. It is preferable that noise tests are carried out where –

Wind speed or wind gusts do not exceed 5 ms^{-1}
No heavy rain or snow is present
Air temperatures are above 3^{o}c

Engine Speed

iv. The vehicle under test shall be run at not less than 5,000 rpm ± 300 rpm. The engine speed shall be gradually increased from idle to the target engine speed and held constant for at least 1 second whilst noise tests are carried out. The throttle control shall then be rapidly released and the engine speed returned to idle.

v. All vehicles undergoing a noise test shall preferably be fitted with a calibrated tachometer the accuracy of which can be independently verified.

Vehicle Preparation

vi. All engine covers shall be in place.

vii. Prior to testing, the vehicle's engine shall be brought to its normal operating temperature.

viii. The vehicle shall be in neutral gear position.

ix. The clutch shall be engaged.

x. The vehicle under test shall have a clear indication in yellow on a chassis member or bodywork on each side and to the rear delineating the alignment of the exhaust reference point.

xi. All vehicles undergoing a noise test shall have readily visible timing marks.

Microphone Position

xii. Noise test level measurements shall be conducted at a distance 2.0 m (± 0.1 m) from the exhaust reference point at a height above ground level not less than 0.5 m and not greater than 1.0 m.

xiii. Measurement microphones shall be placed facing towards the exhaust outlet axis in the direction of exhaust gas flow, in line with the position of the exhaust outlet end point.

Underlying (Background) Noise

xiv. Readings on sound measuring instrumentation produced by underlying ambient noise (including vehicles not undergoing testing) and wind shall be at least 10 dB(A) below the A-weighted sound pressure level to be measured.

Noise Test Levels

xv. The maximum noise level, expressed as $L_{AF\ Max}$, dB, shall be determined to provide three values for each vehicle that are within 2 dB of each other.

xvi. Each individual value shall be mathematically rounded to the first significant figure before the decimal place (e.g. 92.4 shall be rounded to 92; 92.5 shall be rounded to 93; 92.7 shall be rounded to 93).

xvii. For each set of three values, the arithmetic average shall be determined, mathematically rounded to the first significant figure before the decimal place. This shall then be reported as $L_{AF\ Max\ (Rep)}$, dB , given by

$$L_{AF\ Max\ (Rep)} = \frac{L_{AF\ Max,\ 1} + L_{AF\ Max,\ 2} + L_{AF\ Max,\ 3}}{3}$$

xviii. The test result for a vehicle shall be given as the highest value of $L_{AF\ Max\ (Rep)}$, dB, rounded to the first significant figure before the decimal place.

Maximum Permitted Noise Levels

As of 1st July 2009 :	L_{AF} 104 dB
As of 1st January 2010 :	L_{AF} 100 dB
As of 1st January 2012 :	L_{AF} 98 dB (*Proposal under review)*

Sound Measuring Instrumentation – Required Specifications

xix. Sound measurement instrumentation used for the purpose of determining test levels shall conform to either British Standard BS 3539: 1986 *Specification for Sound level meters for the measurement of noise emitted by motor vehicles*; or British Standard BS 60651: 1994 *Specification for sound level meters (Type 1)*; or British Standard BS 61672-1: 2003 *Electroacoustics - Sound Level Meters – Part 1: Specifications (Class 1)*.

Calibration and Use of Sound Measuring Instruments

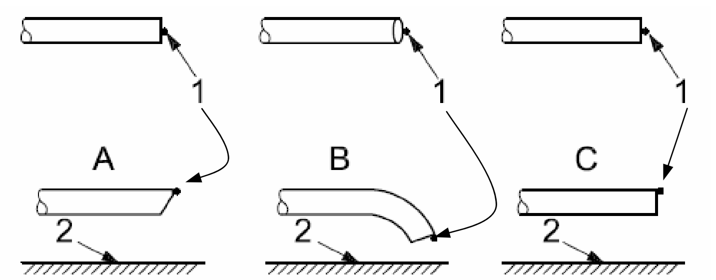
xx. All sound measuring instrumentation shall be calibrated before and after use at a test location in accordance with manufacturers instructions. Test levels shall be deemed valid only if calibration levels are within 0.3 dB.

xxi. Sound calibration devices shall comply with British Standard BS 7189: 1989 *Specification for sound calibrators*; or British Standard BS 60942:1998 *Electroacoustics – Sound calibrators*; or British Standard BS 60942: 2003 *Electroacoustics – Sound calibrators*.

xxii. The acoustic performance of sound measuring instrumentation, inclusive of the microphone and sound calibrator as a set, shall be subject to a traceable verification check by an appropriately accredited laboratory at intervals of not more than 2 years. Where an annual verification is not carried out, the acoustic performance of the set shall otherwise be determined by comparison with instrumentation that has undergone verification with a period of not more than 12 months. Certificates and statements to this effect shall be available during any noise test.

xxiii. A windshield complying with instrument manufacturer's specifications and requirements shall be used at all times during noise tests.

Figure 1 Exhaust Reference Points

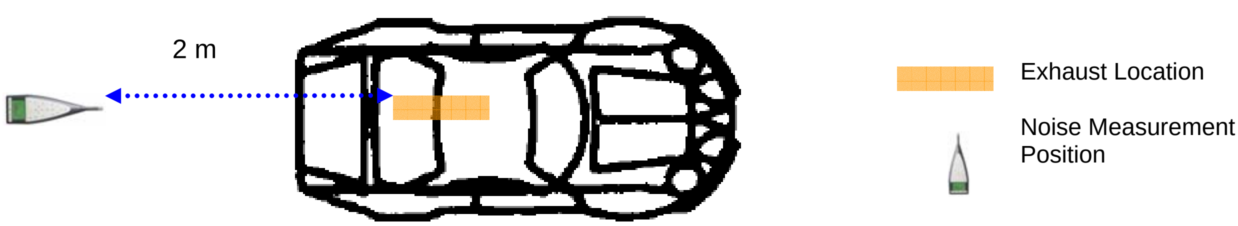


Key

1. Exhaust reference position
2. Test surface

A. Mitred tail pipe
B. Bent down tail pipe
C. Straight tail pipe

Figure 2 Noise Measurement Position - Schematic



4.0 Motor Sport and Noise Control

4.1 As with any engineering noise control programme, the regimen for reducing environmental noise is threefold, classically embodying :

- control of noise at source;
- control of noise in respect of the transmission path;
- reduction of noise at the receptor.

4.2 Attention should initially be paid to noise attenuation at source, which in some cases will incorporate basic design principles, materials, and available engineering technology. For the purpose of examining motor sport noise involving 4 wheeled vehicles it is useful to draw a parallel with road vehicle noise and how this is mitigated.

4.3 A road vehicle such as a car or lorry can be analysed in terms of distinct noise components, which take priority under differing conditions. Essentially these are dealt with as:

i. exhaust noise
ii. induction noise
iii. tyre / road surface noise
iv. transmission noise (gearbox / axle)
v. aerodynamic noise (body)
vi. engine ancillary components
vii. Bodywork components (sound insulation and absorption)

Noise at Source

4.4 The key noise control issue at source rests with appropriate silencing of engine exhaust gas emissions. In the context of motor sport however, certain conflicts can arise through a desire to achieve more engine power, which can be liberated by presenting fewer restrictions to the outflow of exhaust gases (and intake air through the induction mechanism). This can be limited by the greater amount of exhaust silencing that is present by virtue of impeding direct and efficient gas flow to atmosphere. Overall it is well established that in the search for greater power, a competitive preference understandably rests with minimal silencing and attendant increased noise levels, producing the dominant acoustic signature.

4.5 Exhaust silencing is therefore a major component in attaining effective noise control. Many motor sport activities have now evolved limitations on the levels of permitted exhaust noise, which competitors may produce within a given competitive class, and as technology or environmental constraints become more onerous, in-turn noise levels can become increasingly stringent subject to available technology.

4.6 In motor sport, transmission noise and engine ancillary component noise is usually of little significance, neither is aerodynamic noise created by air flow over bodywork once certain speeds are reached. Tyre noise however, can in some instances be problematic and is variable according to the road surface properties, vehicles in use, speed, driver skill, and in the case of some classes of motor sport, the actual characteristics of the event.

4.7 Turning to induction noise, this can have the potential to be problematic and is largely dependent on the type of vehicle and whether or not silenced (i.e. filtered) induction systems are in use. In practically all situations it is nonetheless expected that exhaust and tyre noise will render this of lesser concern.

4.8 National Hot Rods have significant scope for noise reduction by use of improved exhaust silencing given the specifications of the racing class and the design and configuration of vehicles.

Noise Transmission

4.9 This aspect concerns transmission of sound within the environment from the noise source to the noise receiver, which is influenced by a number of inter-related meteorological conditions including wind direction, wind speed, temperature, humidity and cloud cover. Additional to this are topographical features, which can serve to reduce noise transmission for example by screening effects (hills and embankments) or via acoustic absorption where ground cover is soft (grass and cropland).

4.10 Use of purposely constructed noise barriers is a well accepted noise control practice, and its principles are explored in a separate supplementary technical document to this report. To summarise, acoustics barriers can in normal situations provide a limited degree of noise control, and should be placed either as close to the noise source or as close to the noise receptor as possible to achieve maximum effect. Barriers can take the form of a wide variety of construction formats and materials, or simply comprise earth berms graded according to soil stability or retained by engineering methods.

4.11 Noise barriers should not automatically be treated as a universal panacea to resolving noise problems, as there are distinct practicable limits on the benefits that can be accrued.

4.12 There is however, a secondary, psychological element to factor into some schemes, as in some scenarios they offer a sight barrier; the adage ‘out of sight, out of mind’ is periodically used in architectural circles to help accommodate neighbouring non-conforming uses and albeit visual amenity may be improved or changed through this approach, there may be fundamental engineering noise benefits that underlie a given design.

Noise at Receptors

4.13 Here the remedial noise control treatment rests with preventing noise ingress to a building or site, and so can take the form of an acoustic barrier, or appropriate sound insulation to a building, or when dealing with a noise-at-work matter the provision of hearing defenders to susceptible individuals.

4.14 Of the three approaches to noise control listed above, this is normally the last option to be considered.

Noise Control at Oval Circuits

4.15 The confined land-take afforded by short oval circuits in general renders them more amenable to noise control through the use of acoustic barriers, particularly if only a single or two elevations need to be addressed.

4.16 Motor racing circuits are located in both rural and more populated areas, and invariably introduce a range noise producing into the local noise climate. In approaching noise control at a venue it is thus important to have appropriate regard to its relative setting.

4.17 Further consideration of noise control issues is provided in the (former) National Society for Clean Air's (NSCA) Code of Practice for the Control of Noise from Oval Motor Racing Circuits.

Appendix 1

Informative on Basic Sound and Noise Concepts

A1.1 Sound consists of pressure fluctuations through an elastic medium, such as air or water, travelling in the manner of a longitudinal wave motion. It thus constitutes a form of mechanical energy, the perceived magnitude of which is known as loudness.

A1.2 Loudness is a function of both the intensity of sound waves (that is, the sound energy passing through a notional area of one square metre per second) and the frequency, which is defined as the number of sound waves occurring or passing a temporal point per second (expressed as Hertz, H_z).

Decibels, dB

A1.3 For convenience, the magnitude of sound is measured and described most commonly by use of the decibel scale, dB, as an expression of the sound pressure level, L_p. This scale is logarithmic and is obtained by comparing the actual sound pressure (or sound intensity) against a standardised reference value. For practical purposes zero decibels can be treated as the threshold of hearing, with the onset of physical pain arising at a sound pressure level of around 120 dB or more.

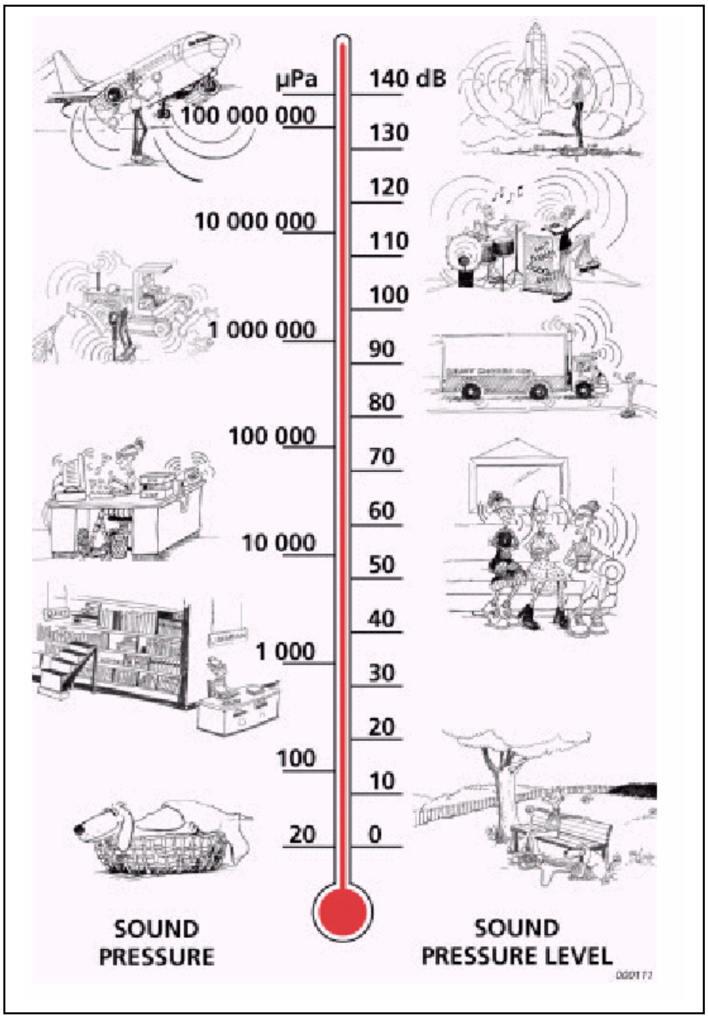
A1.4 The logarithmic function of the decibel scale means that the sound pressure levels of two or more sounds cannot be added together in a simple linear fashion to obtain a sum total. To illustrate this, if 50 dB is added to 50 dB the total is 53 dB. Furthermore, if one sound has a greater magnitude than another by 10 dB or more, when adding them together the lower level sound can for practical circumstances be ignored; therefore, 50 dB added to 60 dB yields a rounded total of 60 dB.

A1.5 Where the sound pressure level of a sound is increased by 10 dB, the human ear typically perceives this as a doubling of subjective loudness (‘twice as loud’); conversely, where a sound is reduced by 10 dB, the perception is one of a halving of loudness. A further 10 dB increase (providing 20 dB in total) results in a quadrupling of perceived loudness.

Sound Pressure and Intensity

A1.6 An increase in sound pressure level by a margin of $^{+}$3 dB is caused by a doubling in acoustic energy (or intensity); if this margin is $^{+}$10 dB the required energy (or intensity) increase is tenfold. A doubling of acoustic pressure however, results in a $^{+}$6 dB increase in sound pressure level, illustrating acoustic intensity is not directly proportional to acoustic pressure.

Figure A 2.1 : The Decibel Scale (Courtesey Bruel & Kjaer)

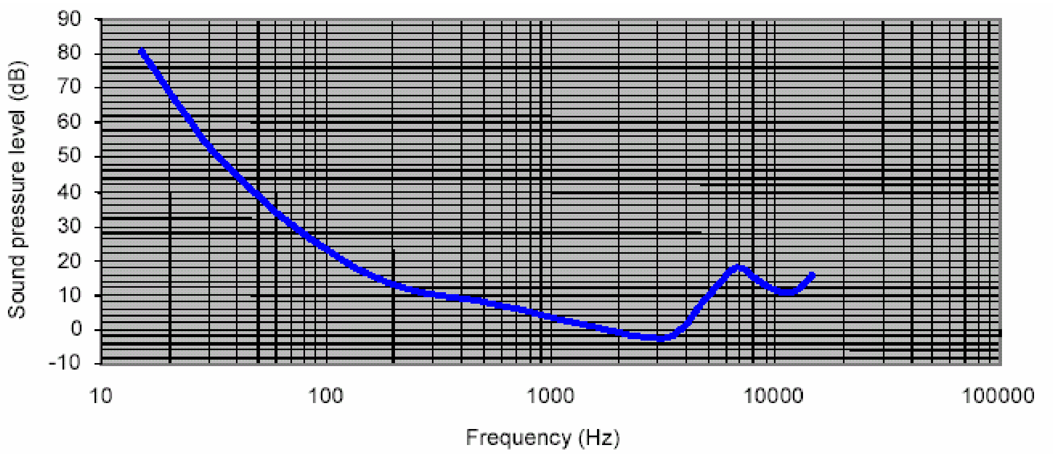


Decibels, dB(A)

A1.7 The human ear functions in a logarithmic manner, as well as being discriminatory to sounds of varying frequency (or pitch). Basically the ear is not as acutely sensitive to low frequency sounds, which may be described as ‘rumbles’ or ‘hums’, whereas mid and higher frequencies are more readily heard and may have a propensity to cause greater annoyance or adverse response. [In this instance, take for example a high-pitched whistle, or the sound of fingernails drawn across the face of a black board compared to distant road traffic].

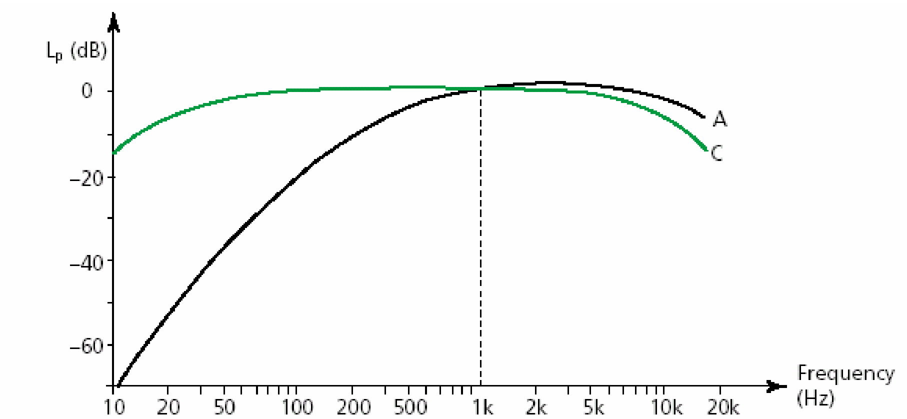
A1.8 To reflect this auditory performance the decibel scale is modified by application of a frequency weighting (A-weighting) to replicate the variable, non-linear response of the ear to both frequency and loudness of sound. Many forms of measured or predicted values of noise are hence regularly expressed as decibels A-weighted, or dB(A).

Figure A 2.2 : Human Hearing Threshold of Audibility



A1.9 The dB(A) unit of measurement is now used almost exclusively to predict human response to a wide variety of sound sources both in the United Kingdom and throughout the World. This applies in relation to railways, aircraft, roads, motor sports, music concerts, minerals workings, shooting, model aircraft, occupational noise exposure and industrial/commercial plant or machinery amongst others.

Figure A 2.3 : A and C Frequency Weightings



Effects of Noise

A1.10 When sound is undesired by the recipient it becomes *noise*. Noise can disturb work, rest, sleep and communication, as well as causing damage to hearing and evoking psychological, physiological and possibly even pathological reactions.

A1.11 The complex and variable interactions of noise with other environmental factors does not easily provide for a straightforward analysis of adverse effects, though in summary researchers have identified the following primary categories for study:

- Interference with speech communication
- Hearing loss and impairment
- Disturbance of sleep
- Stress
- Annoyance and disturbance
- Distraction
- Mental health

A1.12 Health-based guidelines on community noise can serve as the basis for deriving noise standards within a framework of noise management. Key issues of noise management will normally include setting noise emission standards for existing and planned sources, noise prediction and noise exposure assessment.

Appendix 2

Glossary of General Acoustic Terms

A-Weighting	an electronic frequency weighting network which selectively adds and subtracts from measured sound so as to replicate the response of the human ear.
Ambient Noise	totally encompassing sound in a given situation or environment at a given time. This is normally composed of sound from many sources near and far and described by the metric $L_{Aeq,\,T}$, dB.
Background Noise Level	often taken to be represented by the noise index $L_{A90,\,T}$, dB, being the level of sound remaining in the absence of a particular noise source in the absence of a specific noise (BS 4142: 1997 *Method for Rating industrial noise affecting mixed residential and industrial areas,* clause 3.10).
Broad-band	with reference to sound and noise at acoustic frequencies, a signal containing energy over a wide frequency range with the absence of any significant discrete tones or narrow bands.
Day-time	in guidance and legislation typically taken to be 7.00 am to 11.00 p.m.
Decibel, dB	a unit of sound level derived from the logarithm of the ratio between the value of a quantity, such as sound pressure or sound intensity, and a corresponding reference value. The threshold of normal hearing is in the region of 0 dB, and the threshold of auditory pain lies between 120 and 140 dB. A change of ±1 dB is often only perceptible under controlled conditions.
dB(A)	sound levels measured in such a fashion that the frequency weighting ‘A’ is used (A-weighting), which differentiates

between sounds of different frequency (pitch) in a similar way to that of the human ear. Sound measurements in dB(A) broadly agree with people's assessment of loudness. A change of ±3 dB(A) is often quoted as the minimum perceptible under normal environmental conditions, and a change of ±10 dB(A) approximately corresponds to a halving or doubling of subjective loudness. dB(A) is now the standard unit of measurement for assessing human response to noise.

dB(A)F / L_{AF} — A-weighted sound level measurements performed using the F (formerly known as 'Fast') time weighting.

dB(A)S / L_{AS} — A-weighted sound level measurements performed using the S (formerly known as 'Slow') time weighting.

Free Field — an environment in which there are no sound reflective surfaces of importance.

Impact Noise — (see impulse noise).

Impulse Noise — a noise consisting of one or more bursts of sound energy each of duration (typically) less than approximately 1 second.

Insertion Loss — relative reduction in noise (or sound) level at a designated position brought about by use, fitment or insertion of a particular component or device.

Frequency, H_z — of sound. The number of complete sound waves passing a given point in unit time of 1 second; expressed in Hertz, H_z.

$L_{Amax, S}$ / $L_{AS max}$ — the A-weighted maximum r.m.s. sound pressure level, dB, occurring at a given time (sometimes referred to as the instantaneous noise level) using S time weighting.

$L_{Amax, F}$ / $L_{AF max}$	the A-weighted maximum r.m.s. sound pressure level, dB, occurring at a given time (sometimes referred to as the instantaneous noise level) using F time weighting.
$L_{A10, T}$, dB	the A-weighted level of sound or noise exceeded for 10% of a specified measurement period, $_T$.
$L_{A90, T}$, dB	the A-weighted level of sound or noise exceeded for 90% of a specified measurement period, $_T$. In British Standard BS 4142: 1997 '*Method for rating industrial noise affecting mixed residential and industrial areas*', this constitutes the '*background noise level*'.
$L_{Aeq, T}$, dB	the Equivalent Continuous A-weighted Sound (or Noise) Level. This is the sound level of a notional steady sound having the same A-weighted acoustic energy as a fluctuating sound over a specified measurement period, $_T$.
Low Frequency	sound(s); sound usually below a frequency of 150 H_z.
Mid-Frequency	sound(s); sound over a frequency range 150 H_z up to approximately 800 to 1 KH_z.
Night-time	in guidance and legislation taken to be 11.00 p.m. to 7.00 a.m.
Noise	a term used to describe sound that is undesired by the recipient, or sound which intrudes, disturbs or annoys.
Noise Sensitive Premises	premises likely to be adversely affected by an increase in noise levels. Normally taken to include residential properties, places of worship, offices, hospitals, nursing homes schools and colleges and surrounding grounds. This can include parkland and certain public open spaces.

Continued

Octave	logarithmic frequency interval between two sounds whose fundamental frequency ratio is two.
Point Source	an idealised concept of an acoustic source which radiates spherical sound waves.
Residual Noise	the (ambient) noise remaining at a given position in a given situation, expressed by the metric $L_{Aeq,\ T}$, when the specific noise is suppressed to a degree such that it does not contribute to the ambient noise $L_{Aeq,\ T}$, dB.
Residual Noise Level	the Equivalent Continuous A-weighted Sound Pressure Level, expressed by the metric $L_{Aeq,\ T}$, dB, of the Residual Noise.
Specific Noise	noise from a particular source, e.g. noise from a source under investigation (specific noise source) when assessing the likelihood of complaints (e.g. using British Standard BS 4142: 1997 '*Method for rating industrial noise affecting mixed residential and industrial areas*', this constitutes the '*background noise level*'.
Specific Noise Level	Equivalent Continuous A-weighted Sound Pressure Level, expressed by the metric $L_{Aeq,\ Tr}$, dB, at an assessment position produce by a specific noise over a reference period, $_T$, (in accordance with British Standard BS 4142: 1997 '*Method for rating industrial noise affecting mixed residential and industrial areas*', this constitutes the '*background noise level*'.
Tone	a sound/noise having significant acoustic energy at a given frequency. (A pure tone is a sound at a single frequency, producing a sinusoidal wave form).