

Midland Metro

E1.3 Noise Assessment Criteria

E1.3.1 Introduction

Sections 6.4 and 7.4 of the ES summarises the criteria used to assess the potential impacts due to noise from the construction and operation of the tram system. This section describes in greater detail the legislation and guidelines that are referenced.

E1.3.2 Construction Noise and Vibration

Overview

The construction phase of a development is often the period over which any potential noise impact is greatest. There are difficulties in applying the same noise control measures to temporary construction activities as are applied to fixed and permanent installations or operations. The reasons for this are as follows:

- construction work is of a nature whereby noise control measures can be restrictive and could result in unreasonable prolonging of the site works and construction programme;
- work sites are not fixed and change according to the demands of the construction programme;
- work, in the initial stages at least, is conducted out of doors without the benefits of fixed buildings; and
- mobile plant is used which imposes a limit on the scope for noise control measures.

In the UK, no fixed limits apply to the construction site noise. However, advice and guidelines to local planning authorities and developers in the UK can be found in Planning Policy Guidance Note PPG 24 ⁽¹⁾, British Standard BS 5228 ⁽²⁾ and Department of the Environment (DoE) Advisory Leaflet (AL) 72 ⁽³⁾. AL 72 is out of print, but remains as a paper giving guidance on acceptable levels of noise. PPG24 refers to the guidance in BS5228 in respect of construction noise.

DoE Advisory Leaflet AL 72

DoE Advisory Leaflet (AL) 72 gives advice as to maximum levels of construction site noise at residential locations during daytime hours

(0700-1900). Since the criterion of speech interference forms the basis of the recommendations, they can be taken as applicable to commercial buildings. The leaflet states that the noise level outside the nearest occupied room should not exceed:

- 75 dB(A) in urban areas near to main roads in heavy industrial areas; or
- 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise.

These levels are generally taken as being facade L_{Aeq} . AL72 also suggests that in the evening period a level of 10 dB(A) below that during the day may be appropriate. An assessment criterion of 75 dB has therefore been adopted for the purpose of this assessment.

British Standard BS 5228

BS5228 Part 1 does not specify suitable daytime noise levels from construction sites, but lists a number of factors which might affect the acceptability of noise and vibration from construction sites. These factors are:

- site location;
- existing ambient noise levels;
- duration of site operations;
- hours of work;
- attitude to site operator; and
- noise and vibration characteristics of the work.

Although BS 5228 does not propose noise criteria for daytime periods, it suggests that acceptable noise levels in the evening may need to be 10 dB(A) lower than daytime levels. For the purpose of this assessment, the evening has been defined as 1900 to 2300 hours.

BS 5228 also suggests that noise levels at the facades of occupied dwellings may need to be as low as 40 dB L_{Aeq} to avoid sleep disturbance of the occupants. These noise levels imply that windows are open. Thus for closed single glazing a facade level of 55 dB (L_{Aeq}) would result in low risk of sleep disturbance within the building ⁽⁴⁾. However, recent WHO guidance relating to sleep disturbance by noise suggests a guideline facade $L_{Aeq, 8\text{ hour}}$ of 45 dB ⁽⁵⁾. This also assumes that windows may be open at night. For closed single glazing, a facade level of 55 dB (L_{Aeq}) would result in low risk of sleep disturbance within the building.

Noise criteria would apply at 1 m from the facades of neighbouring noise sensitive buildings, including residences, commercial properties. Suggested noise levels are aimed not at providing noise limits for construction activities, but are proposed as criteria for the assessment for the noise impacts associated with the construction programme.

It should also be noted that local authorities have powers under the Control of Pollution Act 1974 to control noise from construction sites. These powers should ensure that the best practicable means (16) are used to reduce or counteract the effects of noise.

The above criteria are summarised below in *Table E1.3*.

Table E1.3 Criteria for Evaluating the Significance of Noise During Construction

Period	Building/Location	Criterion for Assessment L_{Aeq}	Purpose
Day (0700-1900 hours)	Dwellings/Offices (facade)	75 dB	To maintain speech intelligibility
	Schools	65 dB	To maintain speech intelligibility in classrooms
Evening (1900-2300 hours)	Dwellings (facade)	65 dB	To avoid sleep disturbance
Night (2300-0700 hours)	Dwellings (facade)	45 dB (1)	To avoid sleep disturbance
(1) or equal to ambient L_{Aeq} levels if the ambient is higher than 45 dB.			

Reference is also made to ambient noise levels, particularly if night-time levels are already above L_{Aeq} 45 dB.

The noise levels set out in *Table E1.3* are not aimed at providing noise limits for construction activities, but are proposed as criteria for the assessment of the significance of noise impacts associated with the construction programme.

Where predicted noise levels are above the criteria in *Table E1.3* the degree of the impact has been described based a simplified version of the terminology by the Institute of Environmental Management and Assessment and Institute of Acoustics Consultation Draft Guidelines for Noise Impacts Assessment (April 2002), as summarised below in *Table E1.4*.

Table E1.4 Significance of Noise Level Above Impact Assessment Criterion

Amount by Which Noise Criterion is Exceeded dB(A)	Impact
0	None
0 to 3	Slight
3 to 10	Moderate
10 and above	Severe

E1.3.3 Vibration Criteria

Bored piling operations will cause some degree of ground vibration.

Vibration can cause worry and annoyance to the occupants of affected buildings and high levels of vibration can cause damage to buildings. For people within affected buildings, BS 6472 sets out acceptable magnitudes of vibration for both daytime and night-time. It also provides an interpretation for residential buildings of the probability of adverse comment for different levels of exposure to vibration. The measurement scale used for impulsive vibration is one which effectively accumulates the vibration energy received over the daytime or night-time period, Vibration Dose Value (VDV), measured in $m s^{-1.75}$.

In the case of effects on the buildings themselves, including structures and certain types of installation, there are two sources of guidance: BS 5228, Part 4, 1992 provides guidance on damage in relation to vibration from piling; BS 7385, Part 2, 1993 provides guidance on acceptable values of

transient vibration for avoidance of cosmetic damage to buildings. Some useful data is also contained in CIRIA Technical Note 142 (17).

In extreme cases it is possible that sensitive equipment, such as computers, may be adversely affected. In such cases, equipment manufacturers usually provide maximum vibration limits for their equipment.

The threshold of perception for human beings typically falls within the peak particle velocity range of 0.15 mm/s to 3.0 mm/s at frequencies between 8 Hz and 80 Hz. Vibrations above these levels can disturb, startle, cause annoyance or interfere with work activities. At higher levels, the vibration may be described as unpleasant or even painful.

The range of frequencies excited by piling operations in the soil conditions in the UK is generally between 10 Hz and 50 Hz.

In terms of the effect on the structural integrity of buildings, where properties are soundly constructed and in good repair, BS 5228, Part 4, 1992 suggests threshold for minor or cosmetic (ie non-structural) damage at peak particle velocities of 10 mm/s for intermittent vibration and 5 mm/s for continuous vibrations. Below these magnitudes, minor damage is unlikely to occur, although the vibration may be perceptible to the buildings occupants. BS7385, Part 2, 1993 suggests slightly higher levels and gives more specific guidance relating to different types of buildings. The recommended limits are given in *Table E1.5*.

A summary of the criteria for evaluating the significance of vibration during construction is given in *Table E1.5* below.

Table E1.5 Criteria for Evaluating the Significance of Vibration During Construction

Period	Building/Location	Criterion	Purpose
Anytime	Any location	0.1 mm/s rms (a) 0.15 mm/s PPV ^(b)	Limit of perception and to protect sensitive equipment ^(c)
Daytime (0700 - 2300)	Inside dwellings	0.4 m/s ^{1.75} VDV	Annoyance threshold
Night-time (2300 - 0700)	Inside dwellings	0.13 m/s ^{1.75} VDV ^(d)	Annoyance threshold
Anytime	Reinforced or framed buildings	50mm/s PPV (e)	Protection of building structure
Anytime	Un-reinforced or light framed buildings	15mm/s PPV (e)	Protection of building structure
1. Root mean square velocity. 2. PPV denotes peak particle velocity. 3. Equipment manufacturers should be consulted where equipment malfunction has serious consequences. 4. VDV denotes vibration dose value, as given in BS 6472, 1992. (e) From BS 7385 Part 2, 1993.			

E1.3.4 Assumed Construction Plant Inventories

An inventory of construction plant items has been developed in consultation with construction engineers from Babtie Group Ltd. The key noise generating construction plant inventory for each phase of the scheme is provided below.

Table E1.6 Assumed Construction Plant Inventory – Enabling Works

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Tracked excavator	108	1	50	105
Loader	112	1	50	109
Pneumatic breaker	112	1	50	109

Compressor	100	1	80	99
Total				113

Table E1.7 Assumed Construction Plant Inventory – Demolition Works

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Excavator	108	1	50	99
Tipper Lorry	101	1	50	92
Crane	109	1	50	100
Pneumatic breaker	112	1	50	103
Total				106

Table E1.8 Assumed Construction Plant Inventory – Sheet Piling Operations

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Sheet piling rig	120	1	75	119
Tracked crane	99	1	50	95
Pneumatic breaker	100	1	75	99
Total				119

Table E1.9 Assumed Construction Plant Inventory - Bored Piling Operations

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Crane	109	1	100	103
Truck mixer	100	1	100	94
Poker vibrator	102	1	100	96
Piling rig	103	1	85	99
Dozer	112	1	100	106
Total				109

--	--	--	--	--

Table E1.10 Assumed Plant Inventory – Other Bridge Works

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Excavator	108	1	20	93
Tipper truck	101	1	20	86
Dumper	109	1	90	102
Crawler crane	99	1	80	95
Truck mixer	100	1	20	86
Poker vibrators	102	1	80	99
Lorry mounted concrete pump	107	1	20	92
Hand tools	110	1	80	99
Compressor	100	1	50	87
Total				106

Table E1.11 Assumed Plant Inventory – Track-laying and Stop Construction (Concreting)

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Truck mixer	100	1	85	96
Lorry mounted concrete pump	107	1	25	98
Lorry mounted crane	109	1	50	100
Total				103

Table E1.12 Assumed Plant Inventory - Night-time Deck Replacement

Plant Item	Sound Power Level	Number of Plant Items	% on-time	Effective Sound Power Level
Crane	109	1	50	103
Lorries / HGVs	98	1	20	84
Total				103

E1.3.5 Operational Noise

The Design Manual for Roads and Bridges, Volume 11 'Environmental Assessment'

The Department of Transport has a standard procedure for assessing the noise effects of proposals for new trunk roads, set out in its Design Manual for Roads and Bridges (DMRB). In broad terms, a count is made of the number of residential properties undergoing a perceptible increase or decrease in noise level, classified into bands of 3-4, 5-9, 10-14 and 15 or more dB(A). Additionally, the appraisal identifies the number of dwellings that would qualify for noise insulation. The effect on commercial, public and other noise sensitive properties is also identified.

Noise Insulation (Railways and other Guided Transport Systems) Regulations 1996 (SI 1996 No. 428).

These Regulations impose a duty on the operators of railways to offer a package of noise insulation and associated measures for living rooms and bedrooms in dwellings and other residential buildings. They apply to transport systems that require the approval of the Secretary of State under the Transport and Works Act 1992 before being brought into use.

Insulation is mandatory in the case of long-disused systems being re-opened and for new or extended systems, but is discretionary in the case of altered systems. In all cases, the trigger levels for the provision of noise insulation are as follows:

- 68 dB $L_{Aeq, daytime}$ façade (daytime is defined as 0600-2400 hours);
- 63 dB $L_{Aeq, night}$ façade (night is defined as 2400-0600 hours).

Vehicles on the transport system must cause noise levels to increase by at least 1 dB and the new, altered or extended part must contribute at least 1 dB to the total noise.

The assessment is to be made at the facades of residential buildings within 300 metres of the transport system. The Regulations also grant discretionary powers for the provision of insulation against construction noise.

Centro has adopted the provisions of the Noise Insulation (Railways and other Guided Transport Systems) Regulations. In particular:

- The operator will undertake to use all reasonably practicable means of reducing noise levels produced by the Midland Metro at source. Where such measures are ineffective in reducing noise levels below 68 dB $L_{Aeq, (18\text{ hour})}$ or 63 dB $L_{Aeq, (night)}$ (where night is defined as the period 2400-0600), the operator will insulate against noise those rooms of dwellings, schools and hospitals where the levels are exceeded.
- The levels will be measured or predicted at a point one metre in front of the most exposed part of any relevant window or door.
- The offer to insulate will only apply if the noise from Midland Metro will add at least 1 dB(A) to the existing, pre-Metro $L_{Aeq, (18\text{ hour})}$ or $L_{Aeq, (night)}$.
- The predicted noise levels shall be those expected under the noisiest operating conditions anticipated in the 15 year period after commencement of operation.
- Insulation will be offered only to those categories of rooms defined in the Railway Noise Insulation Regulations 1995 for the insulation of property against noise from new roads. The appropriate specification for insulation will apply within the Regulations adopted.

Planning Policy Guidance Note 24

PPG24 ⁽¹⁸⁾ establishes Noise Exposure Categories (NECs) that are applicable when planning new residential developments affected by transport noise or by mixed noise sources. These categories are intended to provide guidance on the levels of acceptable noise for new housing developments that should be taken into account when determining planning permission. The NECs are not intended for use in reverse, ie for assessing noise impacts of new noise sources on existing housing. However, the derivations of these are explained and this background research can be useful when considering absolute criterion for noise impacts.

Noise Exposure Categories

PPG24 does not offer a single set of criteria, but introducing the concept of Noise Exposure Categories (NECs) that provide flexibility to take account of local conditions and the needs of the local community and economy. There are four NECs:

1. Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be considered as desirable.
2. Noise should be taken into account when determining planning applications and, where appropriate, condition imposed to ensure an adequate level of protection against noise.
3. Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
4. Planning permission should generally be refused.

Table E1.11 reproduces the table in PPG 24 that gives the noise levels for each NEC for each source of noise.

Table E1.11 Recommended Noise Exposure Categories for New Dwellings Near Existing Noise Sources.

**Noise levels (a) Corresponding to the Noise Exposure Categories for
New Dwellings $L_{Aeq,T}$ dB**

Noise source	Noise exposure category			
	A	B	C	D
Road traffic	<55	55 - 63	63 - 72	>72
07.00 - 23.00	<45	45 - 57	57 - 66	>66
23.00 - 07.00 ^(b)				
Rail traffic	<55	55 - 66	66 - 74	>74
07.00 - 23.00	<45	45 - 59	59 - 66	>66
23.00 - 07.00 ^(b)				
air traffic ^(c)	<57	57 - 66	66 - 72	>72
07.00 - 23.00	<48	48 - 57	57 - 66	>66
23.00 - 07.00 ^(b)				
Mixed sources ^(d)	<55	55 - 63	63 - 72	>72
07.00 - 23.00	<45	45 - 57	57 - 66	>66
23.00 - 07.00 ^(b)				

(a) Noise Levels: the noise level(s) ($L_{Aeq,T}$) used when deciding the NEC of a site should be representative if typical conditions.

(b) Night-time noise levels (23.00 – 07.00): sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq, 8h}$ (expect where the $L_{Aeq, 8h}$ already puts the site in NEC D).

(c) Aircraft noise: daytime values accord with the contour values adopted by the Department of Transport which relate to levels measured 1.2 m above open ground. For the same amount of energy, contour values can be up to 2 dB(A) higher than those of other sources because of ground reflection effects.

(d) Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The 'mixed source' values are based on the lowest numerical values of the single source limits in the table. The 'mixed source' NECs should only be used where no individual noise source is dominant.

Derivation of Noise Exposure Categories

Annex 2 of PPG24 offers explanations of the how the NEC levels are set for each source of noise. It explains how for road and rail noise there is no recent major research from which to obtain the scale of noise effects. For aircraft noise several major studies have been undertaken by the Department of Operational Research and Analysis (DORA) of National Air Traffic Services. However, for all types of noise source a common rationale separates the NECs, and this provides a useful indication of the magnitude of the noise impact that can be expected in each category.

Boundary of NEC A/B : Taken as the onset of noise impacts taken from World Health Organisation research.

Boundary of NEC B/C : Based on the levels that trigger noise insulation for transportation noise. Hence indicative of the threshold at which the severity of noise impacts become very undesirable.

Boundary of NEC C/D : Taken as the level above which noise insulation becomes insufficient to mitigate noise impacts. Hence indicative of the level at which noise impacts become very severe.

The day/night levels of $L_{Aeq, period}$ 55/45 dB used as the boundary of NEC A and B have been widely adopted as the levels which represent the onset of community noise effects. Whilst levels lower than this are frequently enjoyed in more rural locations, it can be argued that even if noise levels in such areas are increased, provided they remain below these levels a good standard of noise climate will be maintained. However, there are initiatives to preserve quiet and tranquillity where it is of high amenity value.

E1.3.6 The Land Compensation Act 1973

The Land Compensation Act 1973 provides for compensation to be made to owners of property that depreciates in value as a result of direct physical factors (such as noise) arising from the use of public works, such as railways.

[About Centro](#) | [Contact Us](#) | [Links](#) | [How to Find Us](#)
Copyright © 2002 Centro. All rights reserved.