MetroLink

Transport Infrastructure Ireland

# Noise Control from Fixed Installations for Metrolink

P01.1

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## MetroLink

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## Contents

# 1. Introduction

This Note sets out the criteria and their application to control operational noise associated with fixed installations designed and installed as part of Metrolink, as described in the EIAR and expanded on, where relevant. It is provided in response to the Inspectorate's questions during the course of Module 1 to provide clarity on the approach for dealing with airborne noise from fixed installations and any special acoustic characteristics, including low frequency noise.

With the exception of public address systems and audible warning systems which are addressed below, the nominated contractor will be required to apply the Metrolink design criterion to the totality of all fixed installations at a single Metrolink development. This means that all the fixed installation noise sources (including mechanical plant and machinery) installed and operated in any location within the Metrolink development will conform to the specific noise source defined by BS 4142:2014 +A1 2019.

The term "fixed installations" is used to describe the following:

- forced ventilation shafts;
- draught relief shafts;
- electrical trackside equipment located along the surface railway / retained cut sections;
- power supply facilities e.g. transformers located at surface locations;
- mechanical ventilation and air conditioning equipment associated with Metrolink buildings including those located at depot buildings, sidings, control rooms, stations and the park and ride facility;
- static external sources of noise located at depots (for example train washes, and stationary trains) but excluding noise from the movement of trains; and
- public address systems and audible warning systems at stations, depots and sidings.

The measures that are available to control the effects of noise from each of these sources are set out below.

## 1.1 Ventilation Shafts

As described in Chapter 4 and 13 of the Metrolink EIAR, tunnel ventilation shafts are located at both ends of each underground station at the following locations:

AZ2: Dublin Airport Station, AZ4: Northwood, Ballymun, Collins Avenue, Griffith Park, Glasnevin, Mater, O'Connell Street, Tara Street, St Stephens Green and Charlemont Stations.

In addition to these shafts, two intermediate ventilation shafts are situated along tunnel sections between Dublin Airport Station and Dardistown Station (Chainage 7+826) and between Collins Avenue Station and Griffith Park Station (Chainage 12+793) at Albert College Park.

The primary mechanism of air exchange between the trains in the tunnels and the atmosphere is via draft relief shaft openings  During day-to-day operations, the tunnel ventilation system design will in the main operate below tunnel air temperatures such that they do not necessitate activation of ventilation fans to drive airflow to the tunnels. Passive draft relief shafts will operate under low flows of the order of 1-3 m/s.

Over Track Exhaust (OTE) systems are in underground stations and their exhaust points are placed over the trackway zone where trains stop. These are used for extraction of heat produced by the trains air conditioning and wheels, and, in case of an emergency, the smoke produced by a fire. OTE tracks are not expected to be operational during all periods, as the air exchange available between the tunnel and atmosphere will be sufficient to maintain track side temperatures.

During warm summer days with high ambient temperatures, the OTE may have to be turned on to extract heat from the stations. Similarly, during less frequent circumstances (not usually expected for GOA4 systems), in the event of congestion in the tunnels one ventilation system may have to be operated to remove heat from the tunnels and ensure train air conditioning systems are not compromised.

It is not expected that these systems will be in use during night-time hours due to lower ambient temperatures and the rationale above. Notwithstanding, operational noise criteria will consider night-time operation to ensure all noise levels are duly considered.

During emergency scenarios, i.e. fire in the tunnel or stations, fans will run at full capacity from each of the shafts.

# 2. Assessment Criteria for Fixed Installations

In accordance with Chapter 13 of the EIAR, BS 4142:2014 +A1 2019 (Method for Rating and Assessing Industrial and Commercial Sound), is the proposed standard for the assessment criterion for fixed installations associated with Metrolink (with the exception of public address systems and audible warning systems).

The criterion is founded upon the difference between the noise from the fixed installations (expressed in terms of the rating level) and the existing background noise (expressed in terms of the $L_{A90,T}$ noise level). The rating level takes account of tonal or impulsive characteristics of mechanical and electrical services plant.

The Metrolink assessment criterion is as follows:

I. Airborne noise arising from fixed installations is not significant if the predicted value, as determined for the worst-affected Noise Sensitive Location (NSL) due to their proximity to the installation, obtained by subtracting the existing background noise level ($L_{A90,T}$) [1] from the rating level of the fixed installations in normal operation is not more than +5 dB, assessed in accordance with BS 4142:2014 +A1 2019.

II. The $L_{A90,T}$ is the A weighted noise level exceeded for 90% of the specified measurement period in the absence of the noise which is the subject of the assessment. The lowest background noise ($L_{A90,T)}$ levels occur at night, so any use and assessment of the operation of the fixed installations at night constitutes the strictest test.

III. BS 4142:2014 +A1 2019 requires that, at night, the reference time interval for determining the specific noise level is 5 minutes, and it is likely that any occasion on which a tunnel forced ventilation shaft fan will run at night will involve continuous noise for a duration of at least 5 minutes. This means that the specific noise level does not need to be corrected for duration. If the noise has distinguishing characteristics, for example, in the case of a tonal characteristic, a further correction is then added depending on the assessment result and the specific noise level becomes the rating level.

IV. The assessment criterion means that for a scenario where fan noise has an audible tone determined using Annex C of BS 4142:2014 +A1 2019, a 6 dB correction is added to the specific noise level. On this basis, the forced ventilation shaft fan sound level alone should be at least 1dB below the background $L_{A90,T}$ noise level without it in operation. A summary of the Annex C approach is included in 3.1**.**

V. The nominated contractor will be required to design and construct fixed installations so that, with additional allowances made for calculation uncertainty, under all reasonably foreseeable circumstances the assessment at the worst-affected residential building, obtained by subtracting the prevailing background[1] noise level ($L_{A90,T}$) from the rating level $L_{Ar,Tr}$ of the fixed installations in normal operation, is not more than +5 dB, determined in accordance with BS 4142: 2014 +A1 2019.

[1] *Defined as that which exists at the time of the detailed design and is agreed with the local authorities.*

VI. While the degree of attenuation required is site dependent, not least because of different levels of background noise at different sites and distances to NSLs, the nominated contractor will be required to design the fixed installations to reduce the noise below the design criterion set out.

## 2.1 Fixed Installations associated with Surface Railway and Stations and Retained Cut Railway and Stations

The nominated contractor will be required to design the fixed installations associated with the surface and retained cut railway and stations in AZ1 and AZ2 (including electrical trackside equipment located along the surface railway, power supply facilities e.g. transformers located along the surface railway and static noise sources associated with Metrolink at surface railway stations, but excluding public address systems and audible warning systems) with the aim of reducing noise so that, with additional allowances made for calculation uncertainty, under all reasonably foreseeable circumstances the assessment at the worst-affected residential buildings, obtained by subtracting the prevailing background noise level ($L_{A90,T}$) [1] from the rating level $L_{Ar,Tr}$ of the fixed installations in normal operation, is not more than $L_{A90,T}$ +5, determined in accordance with BS 4142:2014+ A1 2019.

## 2.2 Application of the Metrolink Design Criterion to the Design of Fixed Installations

The Metrolink design criterion relates to the totality of all fixed installations at a single Metrolink development and the specific noise source defined by BS 4142:2014 +A1 2019 shall mean all the fixed installation noise sources (including mechanical plant and machinery) installed and operated in any location within the Metrolink development. Thus, for example for each underground station, it will apply to the design of the forced ventilation shafts, draught relief shafts and station mechanical ventilation and air conditioning equipment.

When designing all fixed installations other than public address systems and audible warning systems, the nominated contractor will be required to:

- Incorporate the design criterion into contract documents such that it will apply to the design of all the fixed installations that are to be installed and operated in any location within the Metrolink development.
- Translate the design criterion into specific requirements in specifications for the procurement and operation of Metrolink plant, equipment and machinery for fixed installations.
- Determine the relevant $L_{A90,T}$ levels, following updated measurements during the detailed design process.
- Procure, install and commission plant, equipment and machinery, including noise attenuation equipment that meets the specific requirements referred to in bullet point three above.
- Provide details of the measures undertaken to ensure that, under all reasonably foreseeable circumstances, the design process and procurement process for fixed installations is adequate to achieve compliance with the design criterion.

- Before the fixed installation may be operated, satisfactorily complete the standard suite of acceptance tests required for such plant and provide information on those tests to the relevant local authority.

## 2.3 Noise From Public Address Systems and Audible Warning Systems

The nominated contractor will be required to agree appropriate criteria for assessing noise arising from any new public address system and audible warning systems with the relevant local authority, prior to the specification and detailed design of such systems. Such systems shall be designed to meet the agreed noise criteria.

The suggested criteria for the above referenced sources are those set out in Chapter 13 as follows:

- Daytime (07:00hrs to 23:00hrs): 50 dB $L_{Aeq,T}$
- Night-time (23:00 to 07:00hrs): 45 dB $L_{Aeq,T}$

# 3. Tonal and Low Frequency Noise Assessment

The assessment approach for determining the presence of acoustic characteristics of all operational fixed plant items associated with the rail Metrolink rail system are sufficiently contained within the parameters of BS 4142: 2014 +A1 2019. Specifically, the frequency range accounted for in the assessment considers the frequency range between 31.5Hz to 16k Hz which allows for a robust analysis of the nature and types of sources expected. The following methodologies as described in BS 4142: 2014 +A1 2019, are used to determine the presence of tonal characteristics of a noise source and the application of penalty ratings.

## 3.1 One-third octave method – Annex C

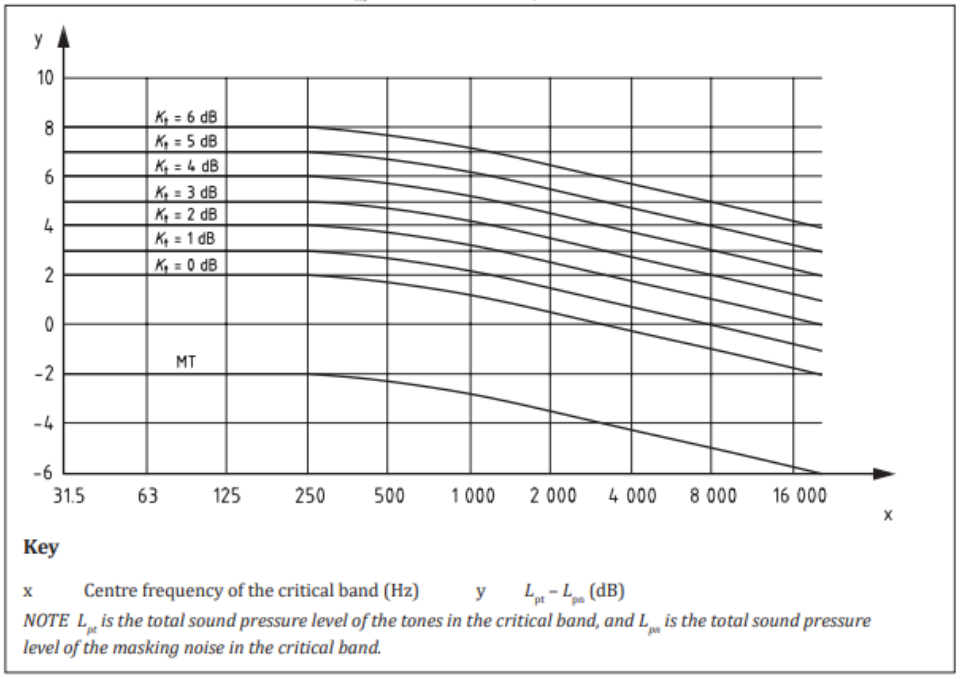
The assessment of tones is set out within Annex C of BS 4142: 2014 +A1 2019 and requires a penalty of 6 dB to the specific noise level if a tone is present. The assessment is undertaken on the basis of the following level differences between adjacent one-third octave bands to identify a tone:

- 15dB in the low frequency one-third octave bands (25 to 125 Hz)
- 8dB in the middle frequency one-third octave bands (160 to 400Hz)
- 5 dB in the high-frequency one-third octave bands (500 to 10 000 Hz)

## 3.2 Reference methods – Annex D

When the one-third octave method is not sufficient, the reference method is used for assessing audibility of tones given in Annex D of BS 4142: 2014 +A1 2019. This approach produces a penalty rating on a sliding scale from 0 to 6 dB. The frequency range used for this assessment applies between 31.5 Hz and 16 000 Hz, thus capturing the expected frequency range of the fixed installations associated with the Metrolink systems.

**Figure D.1** — *Determination of tonal audibility, $\Delta L_{ta}$, and adjustment, $K_T$*




**Key**

x Centre frequency of the critical band (Hz) y $L_{pt} - L_{pn}$ (dB)

*NOTE $L_{pt}$ is the total sound pressure level of the tones in the critical band, and $L_{pn}$ is the total sound pressure level of the masking noise in the critical band.*

## 3.3 Low Frequency Noise

BS 4142: 2014 +A1 2019 notes that this standard is not applicable to the assessment of low frequency noise. The standard (BS 4142), however refers the assessment of low frequency noise to the following documents, referred to as NANR45:

- *Procedure for the assessment of low frequency noise complaints*. Revision 1. London: Department for Environment, Food and Rural Affairs. 2011 (MOORHOUSE, A T, WADDINGTON, D C and ADAMS, M.)
- *Proposed criteria for the assessment of low frequency noise disturbance.* London: Department for Environment, Food and Rural Affairs. 2011. (MOORHOUSE, A T, WADDINGTON, D C and ADAMS, M)

The NANR45 assessment is also referred to within the Irish EPA's guidance document NG4 (Guidance Noise for Noise, Licence Applications, Surveys and Assessments in relation to Scheduled Activities, EPA 2016) for the assessment of low frequency noise.

The above assessment procedures will be included within the schedule of environmental commitments alongside the assessment criteria included within the EIAR and this document to ensure a robust assessment of all potential noise characteristics from fixed installations is considered.

The assessment involves amongst other elements, reference to the following criterion curve which internal noise measurements within a NSL premises are plotted against to determine audibility.

The document notes that if the noise only occurs during the day, then 5dB relaxation may be applied to all third octave bands.

**Table 2 Proposed reference curve**

| Hz | 10 | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dB, Leq | 92 | 87 | 83 | 74 | 64 | 56 | 49 | 43 | 42 | 40 | 38 | 36 | 34 |

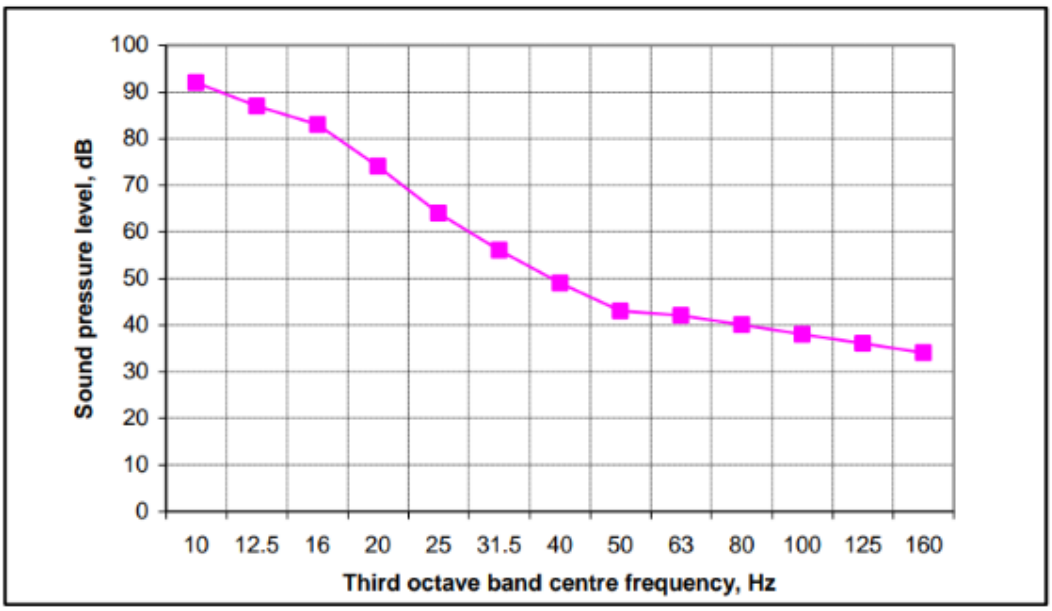



**Figure 1 Criterion curve for assessment of low frequency noise**

# 4. Summary

The assessment approach set out in the EIAR and expanded on in this note will be used for the assessment of noise from fixed installations for the Metrolink Project.

The approach for setting noise limits and evaluating noise source characteristics associated with fixed plant items associated with the rail Metrolink rail system are covered within the parameters of BS 4142: 2014 +A1 2019, BS 8233 and NANR45.