Noise Impact Assessment

BOC Hydrogen North Tees

BOC Limited

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1.0 Introduction

BOC Limited (BOC) has submitted an application to vary Environmental Permit number EPR/BJ7522IJ to cover the addition of a CO_2 recovery and liquefaction plant at the BOC Hydrogen production facility located on the North Tees complex in Teesside.

The Environment Agency (EA) has issued a Request for Further Information as part of the initial review of the data submitted in support of the Permit Variation application, and the EA has made the following request:

"*You need to submit a risk assessment for noise. This assessment should be structured around:*

- *Identification of residential (and if applicable ecological) receptors potentially affected by noise impacts, identified on a map showing the distances of the receptors from the boundaries of the installation.*
- *Establishing the noise inventory for the new equipment associated to the scope of this variation, such as compressors, cooling towers, etc.*
- *Comparative assessment of new noise sources against the existing, already permitted, noise sources, to establish whether the additional noise sources have a potential to adversely impact any receptors. This would depend on the proximity of the receptors, existing noise levels and additional noise levels. This step might need to consider quantitative information such as sound power level data for the new proposed equipment.*
- *Fully quantitative noise impact assessment to BS 4142 standard, in line with the guidance Noise impact assessments involving calculations or modelling - GOV.UK (www.gov.uk), if warranted according to the results of the previous steps.*
- *Providing a Noise and Vibration Management Plan for the installation, if a BS 4142 noise impact assessment is warranted and this shows potential adverse effects at the receptors. Refer to Noise and vibration management: environmental permits - GOV.UK (www.gov.uk)."*

Based on this correspondence from the EA, it is understood that in the first instance a qualitative Noise Assessment may be acceptable so long as it can be demonstrated that the potential noise impacts are insignificant and as such a detailed quantitative assessment is not warranted.

Based on the requirements of the EA this Report is therefore structured as follows:

- Site Location.
- A summary of relevant Guidance.
- Identification of Noise Sensitive Receptors.
- Variation Noise Source Inventory.
- Comparative Noise Assessment.

Whilst reasonable effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix A.

2.0 Site Location

The North Tees Works is located at North Tees Works, Middlesbrough, TS2 1TT .

The position of the Site, and the proposed location of the new CO_2 recovery and liquefaction plant in the context of the surrounding area can be seen in Figure 1.

Figure 1: Site Location

3.0 Guidance

A summary of the requirements outlined in the EA Guidance document Noise and vibration management: environmental permits (NVM), and the assessment methodology outlined in BS4142:2014+A1:2019 are provided below. As the Site is close to ecological receptors the recommended noise limits presented in AQTAG09 (Air Quality Technical Advisory Group 09) are also provided.

3.1 Noise and Vibration Management: Environmental Permits

The Environment Agency (EA) released the guidance document Noise and vibration management: environmental permits (NVM) in July 2021, replacing the previous guidance presented in Horizontal Guidance for Noise (H3) parts 1 and 2. The NVM details when a noise assessment is required, the competency required to undertake an assessment and how to carry out a noise impact assessment.

The NVM references BS4142:2014+A1:2019 as the appropriate assessment methodology.

The NVM outlines how context should be taken into account in the assessment and notes that "*Whilst context allows you to interpret impact thresholds (to a degree), there are practical limits to the extent of the interpretation. It is unlikely you could adjust the assessment outcome beyond the next band (for example, modifying a BS 4142 outcome of more than 10dB to be less than an 'adverse impact')*."

Determining the outcome of the assessment the following should be considered:

- Weekdays rather than weekends.
- What the sound 'means' – meaningful sound is one that conveys an unpleasant meaning beyond its mere acoustic content, for example noise from an abattoir.
- Time of day.
- The absolute sound level.
- Where the sound occurs.
- New industry or new residences.
- Intrinsic links between the source and receptor, for example the source is the resident's place of work.
- Local attitudes.
- The residual acoustic environment.
- The land use at the receptor (for example, gardens rather than yards).
- The exceedance (traditional BS 4142).
- whatever else might be particular to that individual situation.

Based on the results of the BS4142:2014+A1:2019 assessment the NVM has three distinct requirements as detailed in Table 1.

Table 1: NVM Assessment

NVM Result	BS4142 Descriptor	Next Stage
Unacceptable level of audible or detectable noise	The closest corresponding BS 4142 descriptor is 'significant adverse impact'	You must take further action or you may have to reduce or stop operations. The environment agencies will not issue a permit if you are likely to be operating at this level.
Audible or detectable noise	The closest corresponding BS 4142 descriptor is 'adverse impact'	Your duty is to use appropriate measures to prevent or, where that is not practicable, minimise noise. You are not in breach if you are using appropriate measures. But you will need to rigorously demonstrate that you are using appropriate measures.
No noise, or barely audible or detectable noise	The closest corresponding BS 4142 descriptor is 'low impact or no impact'	Low impact does not mean there is no pollution. However, if you have correctly assessed it as low impact under BS 4142, the environment agencies may decide that taking action to minimise noise is a low priority.

3.2 British Standard 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* is intended to be used to assess the potential adverse impact of sound, of an industrial and/or commercial nature, at nearby noise-sensitive receptor locations within the context of the existing sound environment.

Where the specific sound contains tonality, impulsivity and/or other sound characteristics, penalties should be applied depending on the perceptibility. For tonality, a correction of either 0, 2, 4 or 6dB should be added and for impulsivity, a correction of either 0, 3, 6 or 9dB should be added. If the sound contains specific sound features which are neither tonal nor impulsive, a penalty of 3dB should be added.

In addition, if the sound contains identifiable operational and non-operational periods, that are readily distinguishable against the existing sound environment, a further penalty of 3dB may be applied.

The assessment of impact contained in BS4142:2014+A1:2019 is undertaken by comparing the sound rating level, i.e. the specific sound level of the source plus any penalties, to the measured representative background sound level immediately outside the noise-sensitive receptor location. Consideration is then given to the context of the existing sound environment at the noise-sensitive receptor location to assess the potential impact.

Once an initial estimate of the impact is determined, by subtracting the measured background sound level from the rating sound level, BS4142:2014+A1:2019 states that the following should be considered:

- typically, the greater the difference, the greater the magnitude of the impact;
- a difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and
- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. It is an indication that the specific sound source has a low impact, depending on the context.

BS4142:2014+A1:2019 notes that:

"*Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact*."

BS4142:2014+A1:2019 outlines guidance for the consideration of the context of the potential impact including consideration of the existing residual sound levels, location and/or absolute sound levels.

To account for the acoustic character of proposed sound sources, BS4142:2014+A1:2019 provides the following with respect to the application of penalties to account for "*the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention*".

- **Tonality** – "For sound ranging from not tonal to predominantly tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible and 6dB where it is highly perceptible;
- **Impulsivity** – A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible;
- **Intermittency** – When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied; and
- **Other Sound Characteristics** – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied."

Finally, BS4142:2014+A1:2019 outlines guidance for the consideration of the context of the potential impact, including consideration of the existing residual sound levels, location and/or absolute sound levels.

3.3 AQTAG09 - Guidance on Effects of Industrial Noise on Wildlife

AQTAG09 (Air Quality Technical Advisory Group 09) guidance provides guidance to assist planning and/or licensing officials handling pollution prevention and control applications for industrial installations on relevant noise emissions and relates these to the requirements of the Habitats Regulations.

The Habitats Directive (92/43/EEC) specifies that, where specific noise from industry, measured at the habitat / nest site is below the levels in Table 2, it is considered unlikely that it will have an adverse impact on designated species. Where noise levels are exceeded further, an assessment that is more detailed will be required.

Table 2: Specific Noise Levels at Habitat / Nest Site

Parameter	Noise Level, dB
LAmax,F	80
LAeq,1hr	55

4.0 Identification of Noise Sensitive Receptors

The EA has requested the following is completed:

"*Identification of residential (and if applicable ecological) receptors potentially affected by noise impacts, identified on a map showing the distances of the receptors from the boundaries of the installation*".

An overview of nearest residential and ecological receptors in relation to the Site can be seen below in Figure 2. The coordinates for each receptor can be seen in Table 3.

Figure 2: Nearest Residential and Ecological Receptors

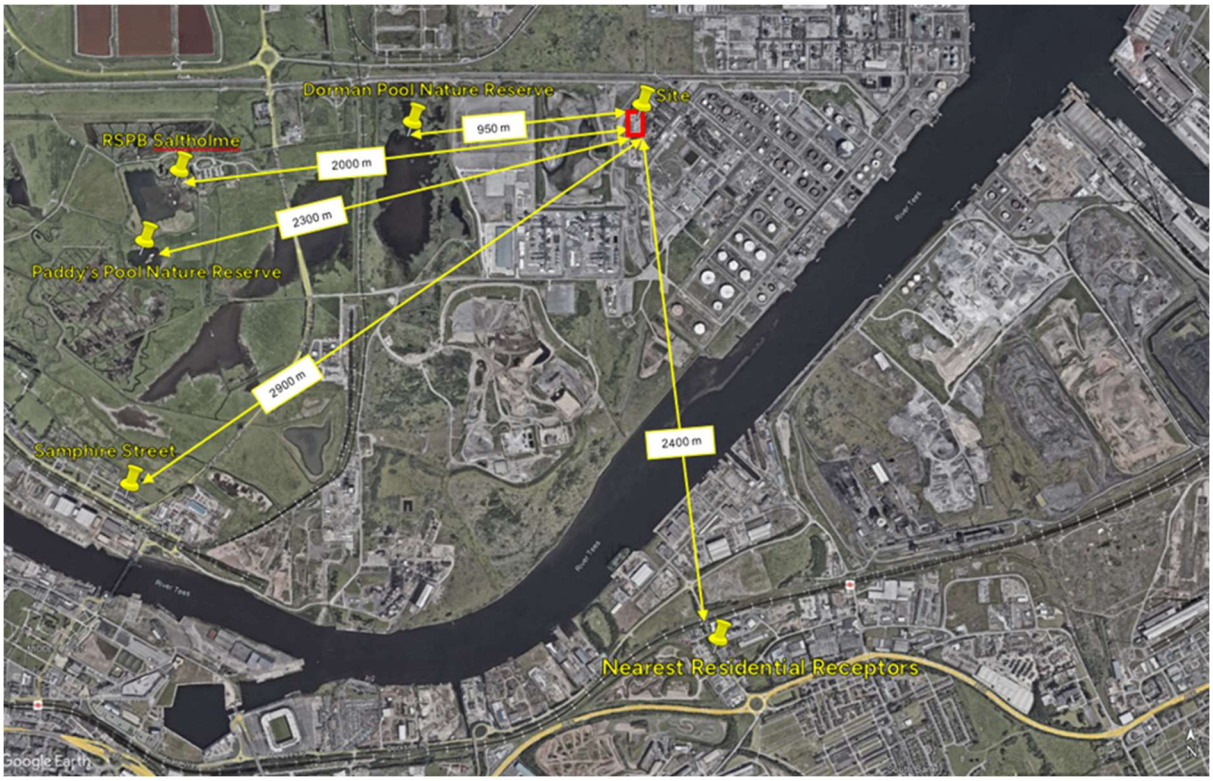

Table 3: Receptor Coordinates

Receptor	Coordinates X	Coordinates Y
Dorman's Pool Nature Reserve	451276	523300
RSPB Saltholme	450196	523185
Paddy's Pool Nature Reserve	450068	522791
Nearest Residential Receptors (King Georges Terrace)	452648	520945
Samphire Street	450000	521680

5.0 Proposed Noise Source Inventory and Sound Levels

To undertake the "*…. Comparative assessment of new noise sources against the existing, already permitted, noise sources*" it is necessary to determine the noise level of the proposed operations.

5.1 Noise Inventory of Proposed CO_2 Recovery and Liquefaction Plant

BOC has produced a noise control concept document[1] which will be used to define the plant design and is included as Appendix G2.

Within the noise control concept document the following is stated:

"***Equipment Noise Limit***

The maximum allowable sound pressure level in 1m distance from any equipment outside buildings, machine house or noise hoods shall not exceed 85 dB(A) (according to Basis of Design, chapter 8.5 "Noise Emission").

When equipment is supplied with gear unit and/or driver, the equipment noise level limits shall be applied to the combined noise level for the equipment, gear unit and/or driver.

High Noise Area Noise Limit

The noise level for high noise areas is between 85 dB(A) and 95 dB(A). There are a few areas where the combined sound pressure level ***inside the plant*** *will be higher than 85 dB(A) at 1m distance. These areas will be signposted as "high noise area". Noise protection equipment which would be necessary to reduce the noise level of this equipment will hinder access for maintenance of the equipment (e.g. enclosures) and therefore will not be foreseen. Furthermore, the daily exposure time of personnel in the high noise area is normally short. At these areas the use of personnel ear protection for short times is required for the advantages of easier access and better maintenance to the equipment*".

5.2 Prediction of Sound Levels from the Proposed CO_2 Recovery and Liquefaction Plant

5.2.1 Noise Calculations

The sound pressure levels generated by the operation of the proposed plant has been predicted in accordance with the prediction framework within ISO 9613-2:1996 Acoustics – *Attenuation of Sound during Propagation Outdoors– Part 2: General Method of Calculation*.

This method of calculation takes into account the distance between the sound sources and the closest receptors, and the amount of attenuation due to atmospheric and ground absorption.

The methodology also assumes downwind propagation, i.e. a wind direction that assists the propagation of sound from the source to the receiver.

At this stage the following assumptions are made:

- The Receptor positions relevant are at sufficient distance from the site such that sound propagation will be assumed as a point source in the far field.

[1] Linde Document Number - &AE-S-PC 1501 (EN) - CO_2 Capture, Concentration, Purification & Liquefaction Plant - BOC North Tees Hydrogen Site - Noise Control Concept.

- A source with a sound power level of 95dB(A) Lw at the site boundary is assumed.

The prediction is based on the following calculations:

- Geometric divergence formula[2] :

  (20 X Log[10] (Distance between source and receptor[3])+8)

- Atmospheric absorption formula[4] :

  (1.9 X Distance between source and receptor) / 1000

- Ground absorption formula[5] :

  4.8 – (2 X 4[6] / Distance between source and receptor) (17 + (300/ Distance between source and receptor))

To account for screening[7] of noise between the Site and the nearest NSR a correction of 5dB(A)[8] has then been applied.

This magnitude of correction assumes that there is partial line of sight between the source and the receptor.

In each equation the distance between source and receptor has been taken from Figure 2.

5.2.2 Results

The predicted specific sound levels at key receptors associated with the operation of the CO_2 recovery and liquefaction plant are presented in Table 4.

Table 4: Predicted Specific Sound Levels

Parameter	Noise Level, dB
Dorman's Pool Nature Reserve	16
RSPB Saltholme	7
Paddy's Pool Nature Reserve	6
Nearest Residential Receptors (King Georges Terrace)	5
Samphire Street	3

[2] IS0 9613-2 Equation 7. Assuming hemispherical radiation.

[3] See Figure 220*log10(plus 10m)

[4] ISO 9613-2 Equation 8. Assumes atmospheric attenuation coefficient of 1.9 (the lowest 500Hz value, used as A-weighted data has been provided).

[5] IS0 9613-2 Equation 10. Assumes soft / porous ground.

[6] This value is the mean height of propagation above ground. 4m has been chosen as the source height and receptor heights are expected to be no higher.

[7] Screening from natural topography between the source and the receiver.

[8] See Page 130 of BS5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

6.0 Comparative Noise Assessment

At this stage it would be typical to assess the CO_2 recovery and liquefaction plant cumulatively with all existing operations at the BOC Hydrogen Plant. However, as the assessment in Section 5 has demonstrated, the specific sound level resultant from the operation of the proposed new plant are predicted to be low at the nearest ecological receptor (16dB(A) at Dorman's Pool Nature Reserve), and 5dB(A) at the nearest residential receptors respectively falling significantly below AQTAG09 levels that would give rise to concern.

It is also understood there have been no noise issues associated with the existing hydrogen plant, and at the magnitudes of impact predicted within this assessment, cumulative noise change is considered unlikely.

On this basis no further assessment is considered to be required given the findings enclosed.

7.0 Conclusion

The assessment undertaken within this report has demonstrated that the proposed addition of a CO_2 recovery and liquefaction plant at the BOC Hydrogen production facility variation would have a Low Noise Impact.

With reference to Table 1, the Low impact does not mean there is no noise emission. However, the EA may decide that taking action to minimise noise is a low priority.

Appendix A Glossary Of Terminology

Noise Impact Assessment

BOC Hydrogen North Tees

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A.1 Glossary of Terminology

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A-1: Sound Levels Commonly Found in the Environment

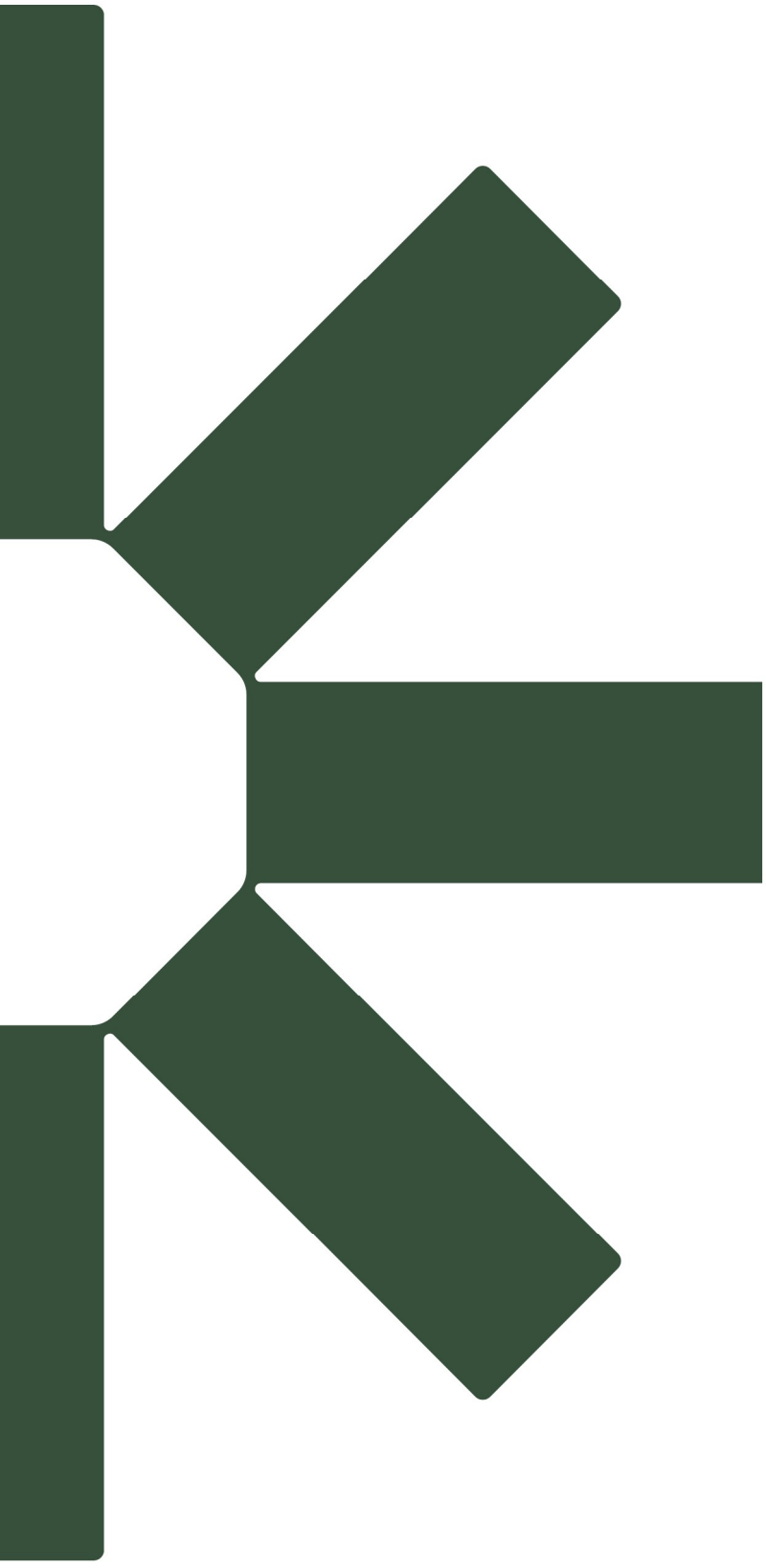
Sound Level	Location
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of Pain

A.2 Acoustic Terminology

Table A-2: Explanation of Acoustic Terminology

Sound Level	Location
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (of 20 µPa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq}, T is defined as the notional steady sound level which, over a stated period T, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
$L_{A10, T}$ & L_{A90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of

Sound Level	Location
	fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{A10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{A90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{A10} index to describe traffic noise.
$L_{Amax(F)}$	$L_{Amax(F)}$ is the maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.



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