Gym Acoustics Guidance Workshop

Launch of a new ProPG

29 March 2023

Collaboration between

ANC | ACOUSTICS & NOISE CONSULTANTS

Institute of Acoustics
Sound • Noise • Vibration

Chartered Institute of Environmental Health

Introduction

Presented by

Peter Rogers BSc(Hons) MSc CEng FIOA FRSA MIOL

Managing Director at Sustainable Acoustics,

> 30 years experience in industry (incl. 5 years in Local Authority)

Sebastian Woodhams BSc(Hons) MSc MIOA

Acoustic Engineering Lead at QinetiQ, 10 years in industry

Why?

- Until this guidance there was no defined method of acoustically testing gyms in the UK.
- Nor was there a defined criteria to assess the performance of gyms.
- But a number of consultants had built up knowledge and expertise in the area, based on broadly similar approaches. Bringing that together needed the ANC!
- Differences in testing methods between consultants do not help justifying a credible way forward. Standardizing was suggested in a paper at Euronoise, Crete 2018.
- Local authorities also need to be able to determine if a site has been robustly tested, and how to assess complaints, assess planning applications and protect the public.

Aim: Provide a framework for all disciplines to follow to create consistency in the industry

Who are the working group?

Consultants

Peter Rogers
Sustainable Acoustics Ltd, Chair

David Chapman
Edinburgh Napier University & Robin MacKenzie Partnership

Martin McNulty
Hoare Lea

James Stokes
RBA Acoustics Ltd

Matthew Sugden
Clarke Saunders Associates

Sebastian Woodhams
QinetiQ (formerly Sustainable Acoustics Ltd), Secretary

Local Authorities

Chris Hurst
Three Spires Acoustics (formerly London Boroughs of Richmond upon Thames & Merton)

Anthony Robinson
Westminster City Council

CIEH Expert Panel on Pollution

Suppliers

James Bligh
Pliteq Inc

Adam Fox
Mason-UK

Wesley Highton
CMS Danskin Acoustics Ltd

Our schedule for today

Session 1

David Chapman & Anthony Robinson

- Criteria & good practice
- Planning conditions
- Legislative framework
- Brief Q&A

Session 2

James Stokes & Martin McNulty

- Good practice in testing
- Method 1 testing
- Method 2 testing
- Vibration
- Prediction methodology
- Brief Q&A

Session 3

Adam Fox & James Bligh

- Specification of mitigation
- Brief Q&A

Session 4

Q&A with all presenters

Good Luck!

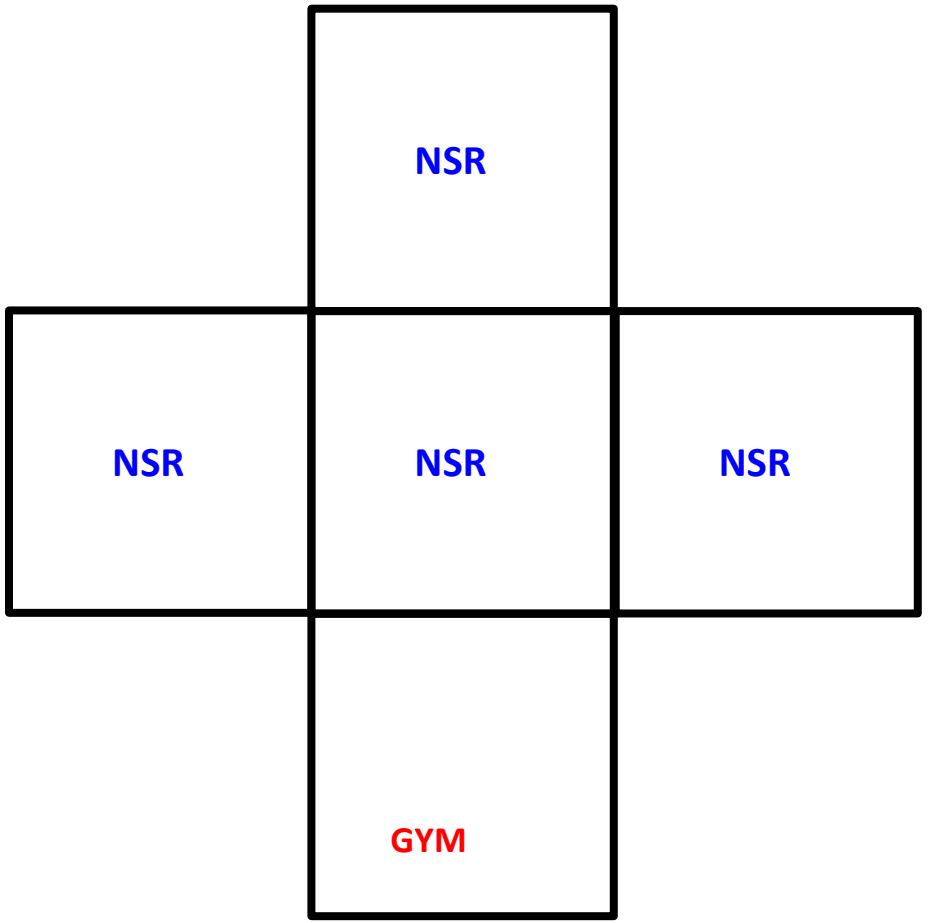
1.1 CRITERIA & GOOD PRACTICE

Presented by

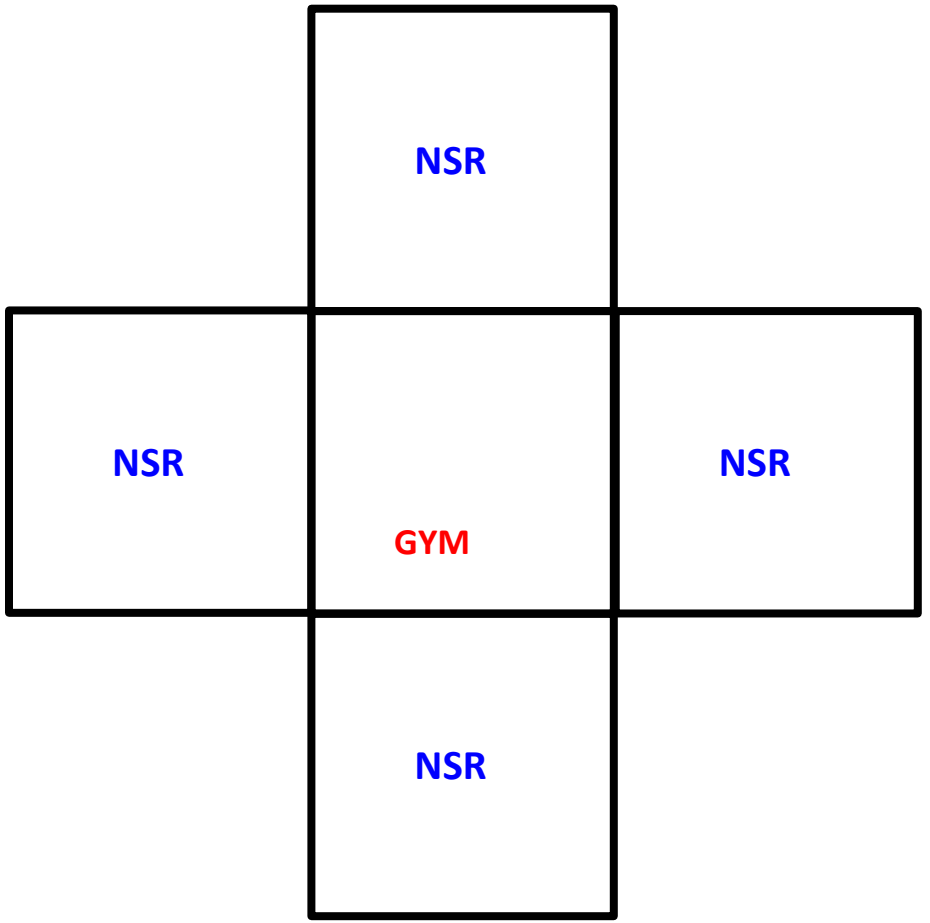
David Chapman BEng(Hons), MIOA

Principal Consultant at RMP/Edinburgh Napier University

Location of proposed gym vs noise sensitive receivers



Location of proposed gym vs noise sensitive receivers



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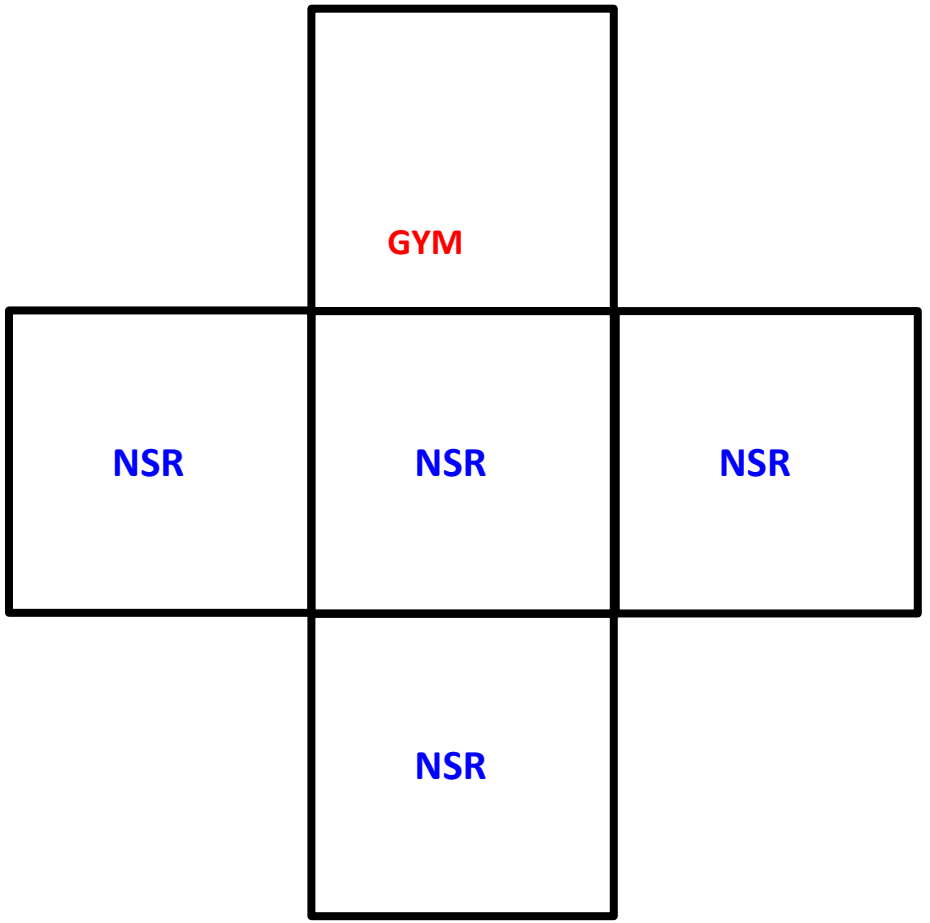

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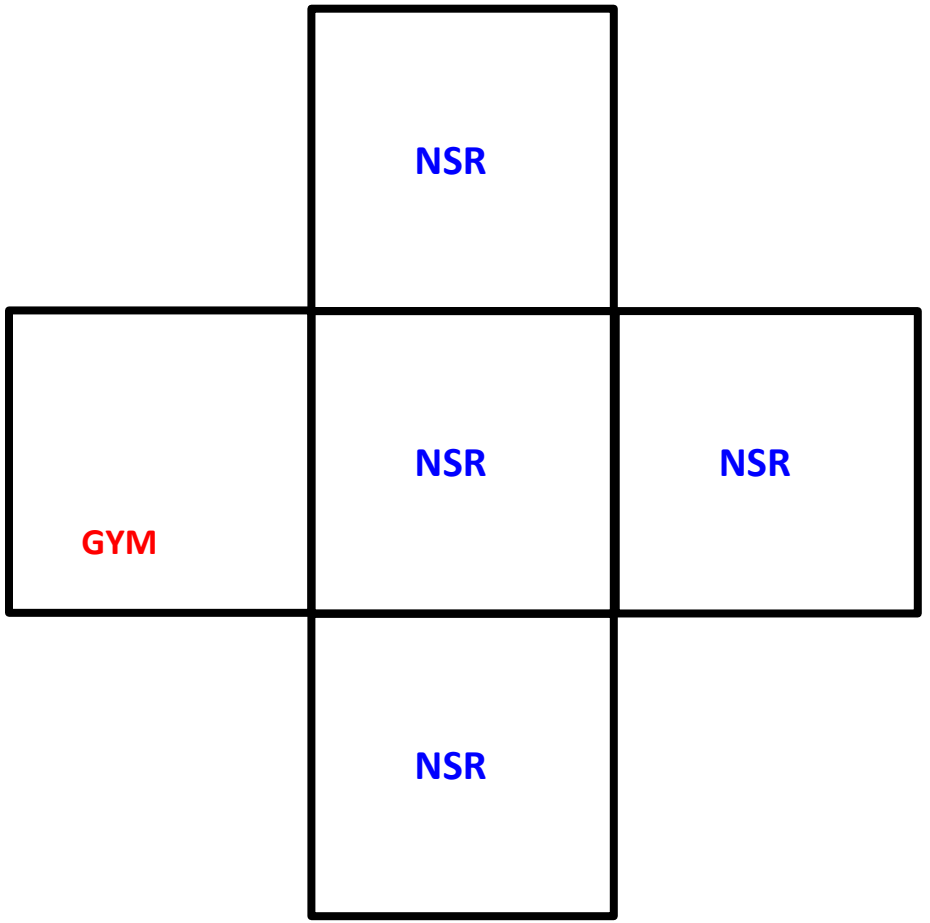

Current Guidelines – Not Gym specific

Table 1: Reference Assessment Threshold Ranges for Airborne Noise from current guidance or standards

BS8233	Living Room /Bedroom (Day, 16 hours)	35-40 dB $L_{Aeq,T}$
	Bedroom (Night, 8 hours)	30-35 dB $L_{Aeq,T}$
	Lift noise in Bedroom (Night, 8 hours)	25 dB $L_{Amax,F}$
Noise Rating NR *(Parameter not Specified)*	Living Room /Bedroom (Day, 16 hours)	20-30
	Bedroom (Night, 8 hours)	15-20
LFNR	Living Room /Bedroom (Day, 16 hours)	25-30
	Bedroom (Night, 8 hours)	20-25
NANR45	Living Room /Bedroom (Day, 16 hours)	Above 1/3 Octave above LF criterion curve thresholds by more than 5dB in any 1/3 Octave band
	Bedroom (Night, 8 hours)	Above 1/3 Octave above LF criterion curve threshold in any 1/3 octave band
BS4142 Relative Type Approach	Living Room /Bedroom (Day, 16 hours)	Internal $L_{ArTr} - L_{A90,T}$ = 0 to +5
	Bedroom (Night, 8 hours)	Internal $L_{ArTr} - L_{A90,T}$ = -5 to 0
WHO Guidelines for Community Noise (1999)	Bedrooms (Night, 8 hrs)	Internally: $L_{Amax,F}$ 45 dB
European WHO Environmental Night Noise (2009)	Bedrooms (Night, 8 hrs, yearly)	Externally: L_{night} 45 dB to 50 dB (interim)
	Bedrooms	Internally: $L_{Amax,F}$ 35 dB

Relevant Noise & Vibration Assessment Standards and Guidelines

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Noise R (Parameter no	Living Room /Bedroom (Day, 16 hours)	2
	Bedroom (Night, 8 hours)	2
LFNR	Room /Bedroom 16 hours)	25-30
	(N	20-25
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ERRATUM (ERRATA)

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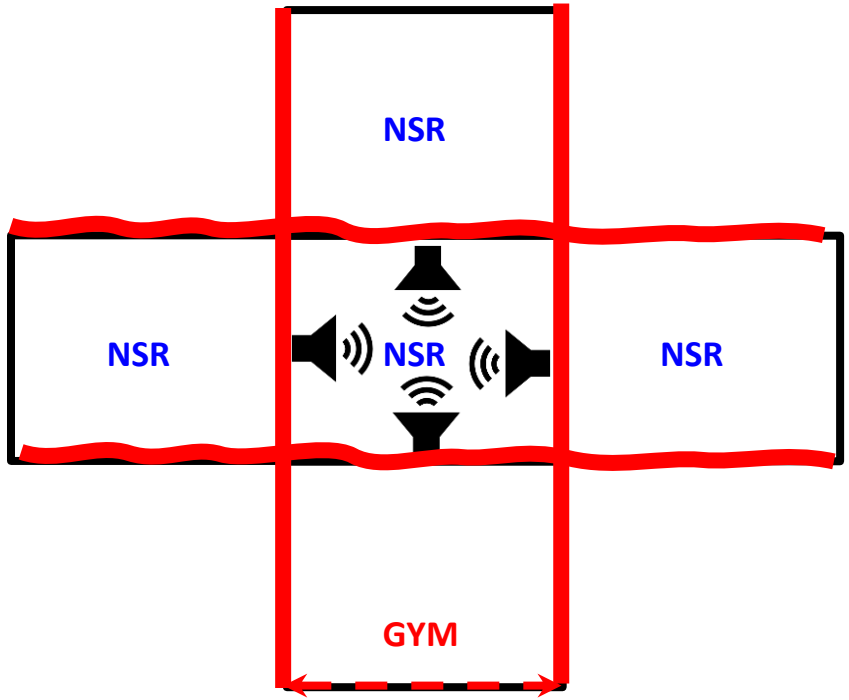
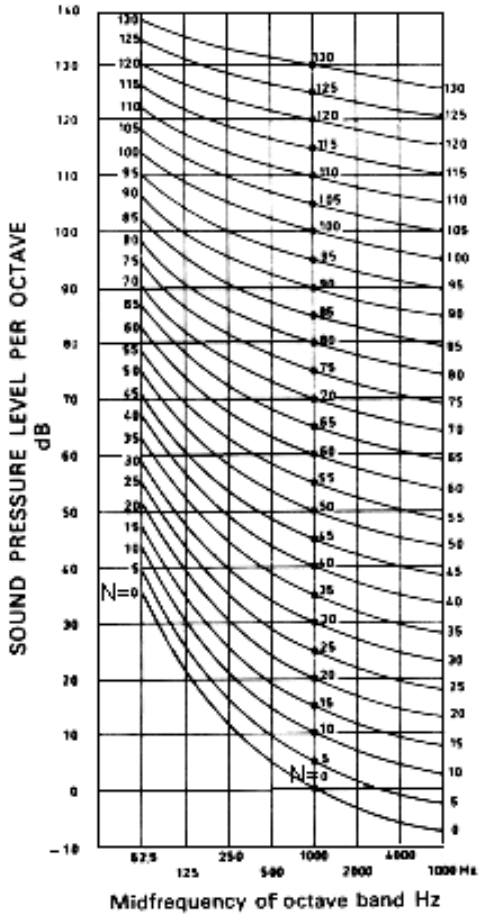
STRUCTURE-BORNE NOISE???



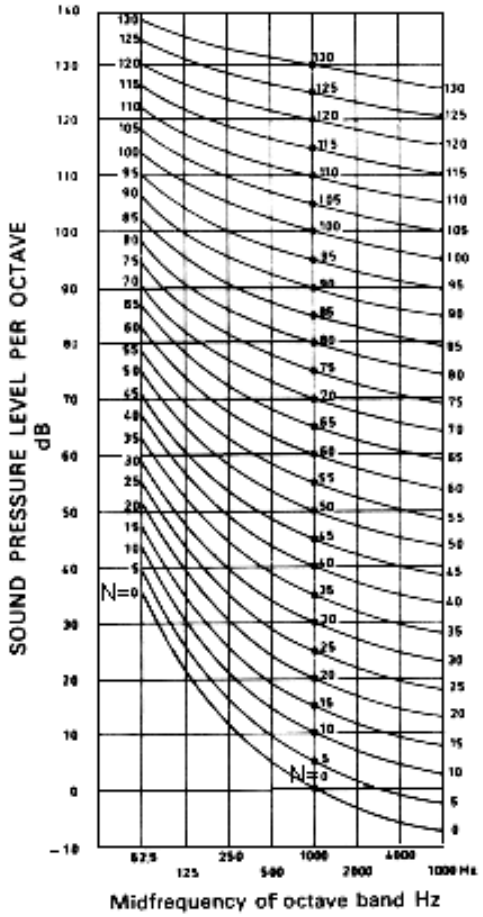
Relevant Noise & Vibration Assessment Standards and Guidelines

Noise Rating (**NR**) Curves, proposed by Kosten & van Os (1962)

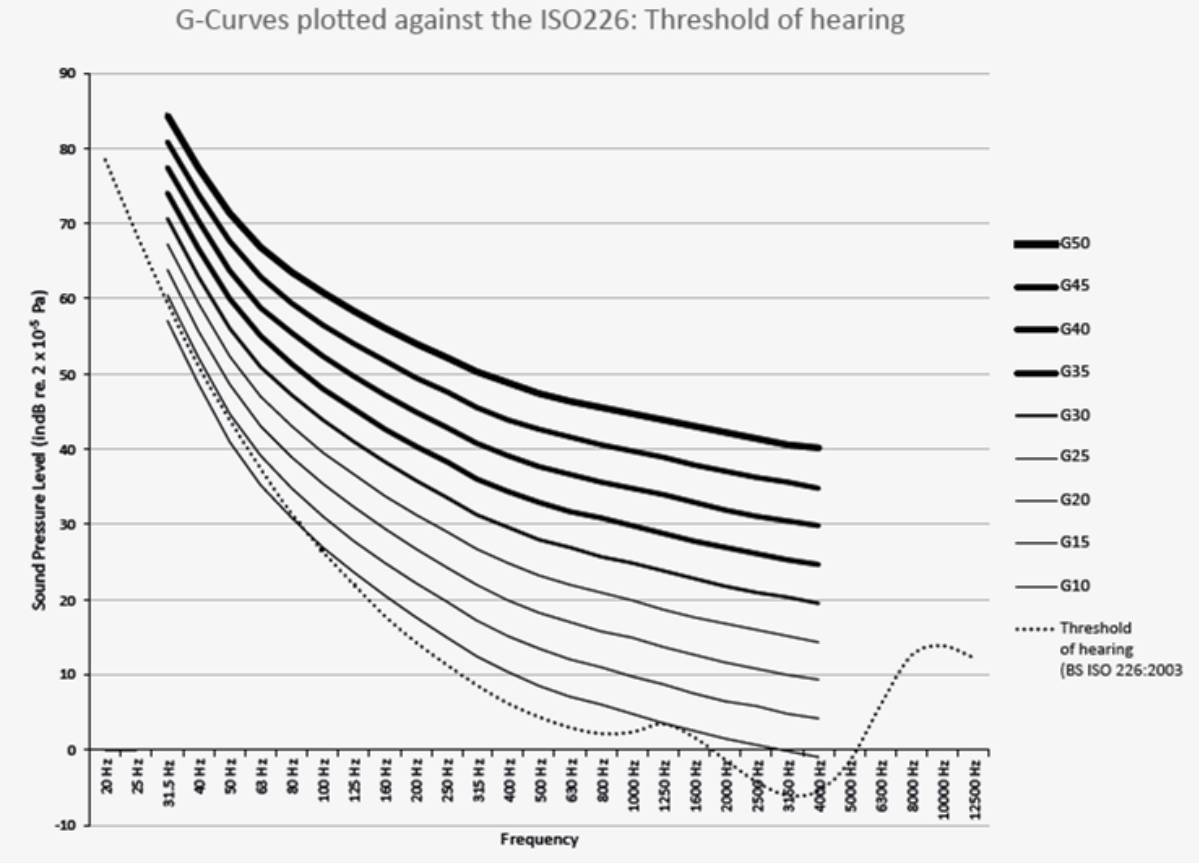


Relevant Noise & Vibration Assessment Standards and Guidelines

Resolution not good enough for gym noise and NSR mitigation solutions

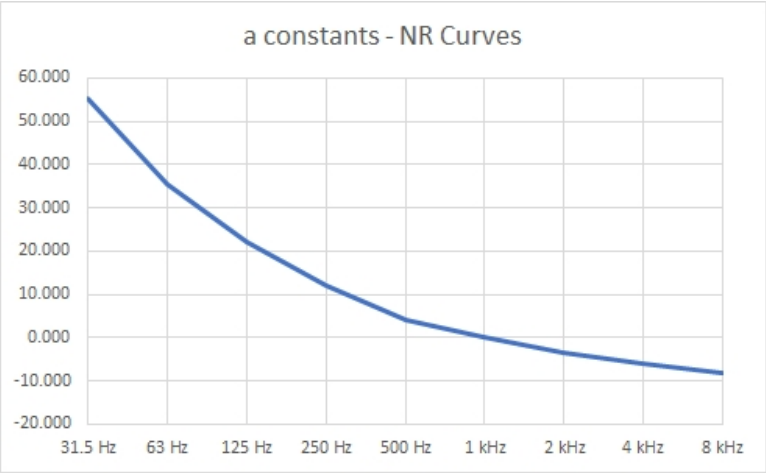


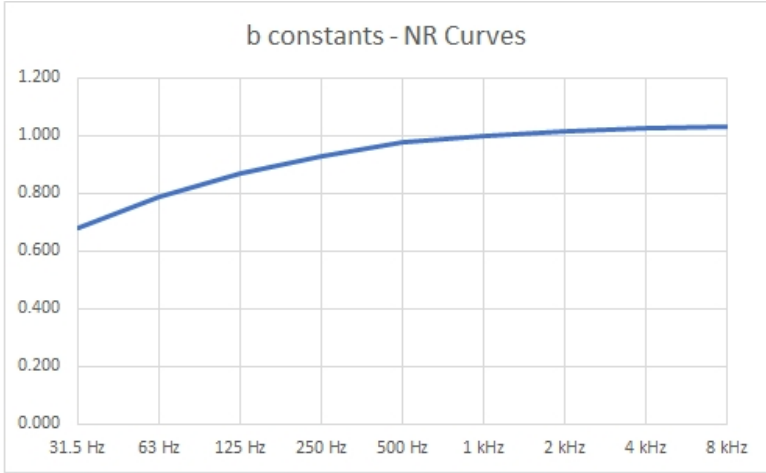
Introducing…G-Curves!

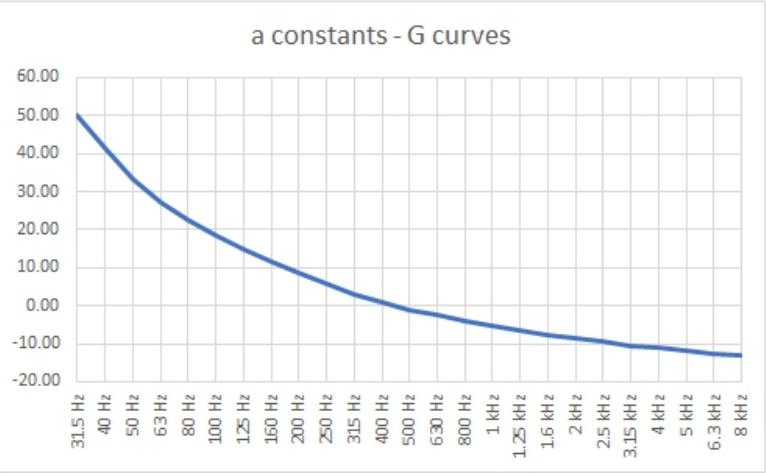


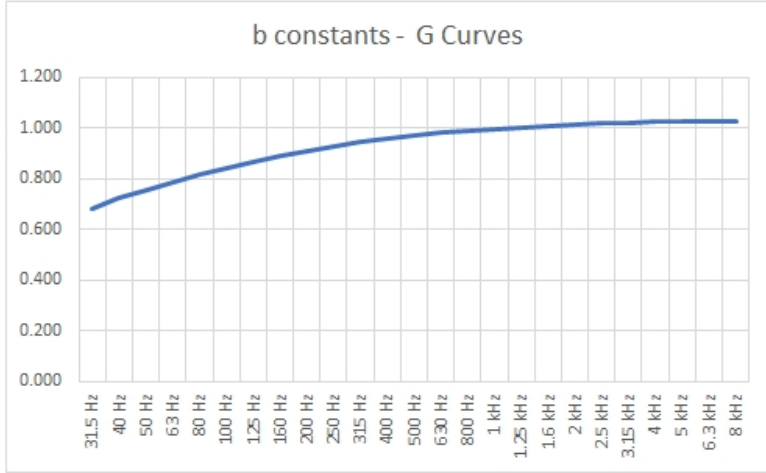
Guidance on Noise Criteria

G-Curve Confidence









Suggested Guidance

Table 2: Guidance Internal Sound Target Criteria for Gym Activity – Residential & Other Areas

Receptor type	**Guide Criteria** (for third octave band values plots against the stated G curve - see Figure 2)	
	Airborne Sound (e.g., music) $L_{eq,T}$ (31.5Hz to 8kHz)	Heavy Impact Sound $L_{max,F}$ (31.5Hz to 8kHz)
Commercial Offices	G25-G35	G35-G45
Retail Areas	G30-G45	G35-G50
Residential Areas	G15-G25 (day) G10-G20 (night)	G20-G25 (day) G15-G20 (night)

Guidance on Noise Criteria

Read the **Notes!**

Table 2 Notes:

1. *The Working Group generally found in their experience that levels below the upper values tended to avoid significantly adverse impacts (SOAEL) occurring and higher levels than these should generally be avoided, but this is highly dependent on context. The background and ambient noise levels at any given site can fluctuate (e.g., a building in an urban setting adjacent to busy infrastructure versus a building shielded from external adverse noise intrusions and/or quieter location). This variation will also cause a subjective variance in relation to the perceived noise impact, both during the design phase and the completed development and the SQA should be cognisant of which target criteria would be most appropriate to their Gym scheme.*
2. *In rooms with low background noise levels (below ~20 dB $L_{A90,5minutes}$), the criteria should be carefully considered and fully justified. It has been noted that the subjective impression of low frequency noise could still cause issues of disturbance, despite meeting the above target ranges. Therefore, it is recommended that resulting heavy impact noise levels at frequencies 80Hz and below, do not exceed a level of 20dB above the existing background noise dB $L_{A90,5minutes}$ within commercial and retail adjacencies (without source/Gym related activities). Where good sound insulation and closed windows results in very low background sound levels this can result in the loss of masking sound making intruding low frequency sound from Gyms more prominent and so potentially more likely to cause disturbance*
3. *For heavy impact noise at least 1/3 octave bands analysis is desirable over the audible range from 31.5Hz, although measuring down to 20Hz is desirable to cover the audible range and may assist in identifying outlying peaks of energy.*
4. *For music noise, particular care should be given to controlling noise in the low frequency region, in the range 31.5Hz to 200Hz and $L_{max,F}$, L_1, L_{10} may also be used as parameters as a substitution for $L_{eq,T}$.*

1. Upper values ~SOAEL depending on <u>context</u>
2. At and below~ 20 dB $L_{A90,5mins}$ **be careful!** For commercial/retail, recommended limiting heavy impact noise to 20 dB above background inside NSR at frequencies ≤80 Hz
3. Heavy impact noise, measure minimum 31.5 Hz, desirable down to 20 Hz
4. For music noise, critical frequencies 31.5 Hz to 200 Hz. Acceptable to substitute parameters such as $L_{max,f}$, L_1 and L_{10}

Guidance on Noise Criteria

How do G-Curves (loosely) compare to NR?

20	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	1/1 NR (32.5-8kHz)	1/1 NR* (32.5-250Hz)	1/3 G (32.5-8kHz)	1/3 G* (32.5-315Hz)
65	62	58	62	60	62	57	57	62	59	56	61	58	57	56	53	48	43	39	40	37	36	37	35	34	33	32	57	56	60	60
66	72	74	81	88	85	91	95	94	95	98	98	100	99	103	102	95	95	91	86	79	76	70	68	65	64	61	104	98	107	102
54	56	54	55	58	62	53	48	54	52	49	48	46	44	40	36	37	31	28	27	25	19	15	15	15	16	13	43	43	45	45
67	71	66	67	64	64	56	52	55	51	49	49	44	47	44	39	36	31	28	24	18	14	14	13	12	11	10	46	44	48	47
73	74	77	75	69	64	72	66	66	63	52	58	59	53	48	40	40	45	37	29	27	28	25	31	33	23	15	55	55	61	61
62	59	56	53	51	54	50	45	49	44	42	48	41	34	32	29	30	31	28	30	33	31	33	35	34	33	32	44	40	45	45
69	71	71	71	68	67	59	51	55	49	50	56	51	47	48	45	39	36	30	27	22	19	16	14	15	12	11	49	49	54	54
71	70	67	62	58	57	53	46	51	49	45	52	45	44	46	40	34	32	29	27	24	18	16	14	13	10	10	45	45	50	50
55	57	57	57	52	53	54	53	49	43	41	37	35	38	39	35	33	34	34	30	23	17	16	13	13	11	9	39	37	41	40
63	58	54	56	58	61	54	51	57	56	58	59	59	64	62	61	60	61	59	58	55	53	49	44	39	31	22	65	56	67	60
86	85	90	89	76	75	72	79	69	65	60	56	53	50	44	44	43	40	40	38	38	39	35	31	31	29	27	66	66	72	72
64	66	73	67	66	61	53	60	58	62	64	64	66	64	64	67	69	68	69	69	69	67	68	63	56	48	36	76	62	77	66
71	67	74	68	66	59	52	60	57	62	63	66	66	64	65	65	65	62	62	61	59	56	57	51	43	36	26	68	62	70	67
81	86	83	83	87	91	91	97	91	91	86	85	86	82	84	75	66	65	61	61	57	55	57	55	55	56	54	88	88	92	92
84	83	73	66	61	62	61	58	51	52	47	43	46	40	40	35	33	32	32	31	28	21	21	17	14	14	12	43	43	47	47
74	68	61	63	58	59	55	61	55	57	52	51	55	53	58	55	55	55	50	42	36	34	34	28	24	22	20	59	49	61	55

Discussion on Vibration Criteria

When is vibration no longer an issue?

Discussion on Vibration Criteria

On the Rare Occasion

Table 3: Guidance Internal Vibration Target Criteria for Gym Activity – Residential & Other Areas

Receptor type	**Guide Criteria** (see Figure 3) **Tactile Vibration** (point of entry to the body) **Acceleration** (mm/s^2)		
Commercial Offices	rms 20mm/s^2 W_g	Peak 40mm/s^2 W_g	base curve multiplier of 4 (ref. BS 6472:1992)
Retail Areas	rms 20mm/s^2 W_b	Peak 60mm/s^2 W_b	base curve multiplier of 4 (ref. BS 6472:1992)
Residential Areas	rms 7mm/s^2 W_b	Peak 21mm/s^2 W_b	base curve multiplier of 1.4 (ref. BS 6472:1992)

Table 3 Notes:

1. *When measuring vibration, a similar approach down to at least 6Hz is recommended;*
2. *For facilities that are particularly sensitive (like scientific facilities) a specific methodology might be appropriate*

Relevant Vibration Guidance

1. BS 6472 Part 1: 1992 and 2008
2. BS 6841: 1987
3. HTM/SHTM 08-01
4. Specialised Equipment (VC curves)
5. Floor response factors

1.2 LEGISLATIVE FRAMEWORK & PLANNING CONDITIONS

Presented by

Anthony Robinson BSc (Hons), AMIOA

Senior Practitioner (Noise), Westminster City Council

15 years in Local Authority EH specialising in Acoustics and Noise Control
(incl. 9 years at London Borough of Hounslow and 6 years at Westminster City Council)

Legislative Framework

Three branches:

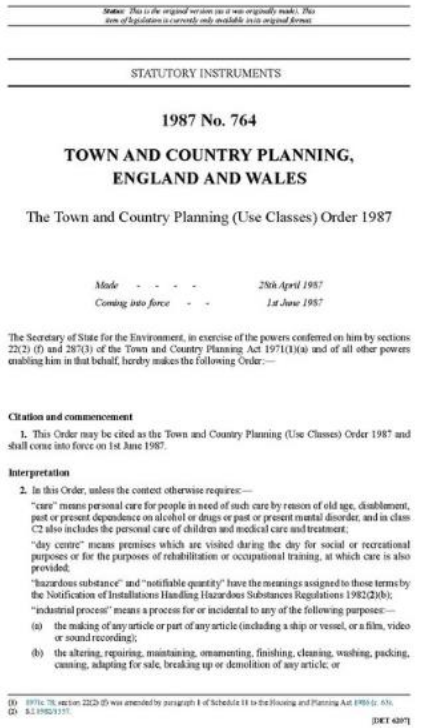
Building Control, Development Control (Planning) & Statutory Nuisance

Building Regulations 2015
Approved Document E: Resistance to the passage of sound

National Planning Policy Framework (NPPF) 2021
Affirms NPSE as a material consideration in decisions on planning applications. Under review (Feb 2023).

Noise Policy Statement for England (NPSE) 2010

Agent of Change (**NPPF) 2018** two example scenarios in section 2.1



Status: This is the original version (as it was originally made). This item of legislation is currently only available in its original format.

STATUTORY INSTRUMENTS

1987 No. 764

TOWN AND COUNTRY PLANNING, ENGLAND AND WALES

The Town and Country Planning (Use Classes) Order 1987

Made - - - - 28th April 1987
Coming into force - - 1st June 1987

The Secretary of State for the Environment, in exercise of the powers conferred on him by sections 22(2) (f) and 287(3) of the Town and Country Planning Act 1971(1)(a) and of all other powers enabling him in that behalf, hereby makes the following Order:—

Citation and commencement

1. This Order may be cited as the Town and Country Planning (Use Classes) Order 1987 and shall come into force on 1st June 1987.

Interpretation

2. In this Order, unless the context otherwise requires:—

"care" means personal care for people in need of such care by reason of old age, disablement, past or present dependence on alcohol or drugs or past or present mental disorder, and in class C2 also includes the personal care of children and medical care and treatment;

"day centre" means premises which are visited during the day for social or recreational purposes or for the purposes of rehabilitation or occupational training, at which care is also provided;

"hazardous substance" and "notifiable quantity" have the meanings assigned to those terms by the Notification of Installations Handling Hazardous Substances Regulations 1982(2)(b);

"industrial process" means a process for or incidental to any of the following purposes:—

(a) the making of any article or part of any article (including a ship or vessel, or a film, video or sound recording);

(b) the altering, repairing, maintaining, ornamenting, finishing, cleaning, washing, packing, canning, adapting for sale, breaking up or demolition of any article; or

(1) 1971c. 78; section 22(2) (f) was amended by paragraph 1 of Schedule 11 to the Housing and Planning Act 1986 (c. 63).
(2) S.I. 1982/1357.

[OCT 6207]

Planning Use Classes

The Town and Country Planning (Use Classes) Order 1987 (as amended) defines uses of land and buildings into 'Use Classes'. Amended by The General Permitted Development Order 2020 which introduced Use class E, MA, ZA etc.

Gymnasiums, Indoor Sports and Recreation were in a category of their own. 'Use Class D2 - Commercial, Business and Service.' **Now in broad 'Use Class E - Commercial, Business and Service'**

Use Class D no longer exists.

All existing 'Use Class D' buildings are **now 'Use Class E'.**

Use Class E & Re-use / Conversions

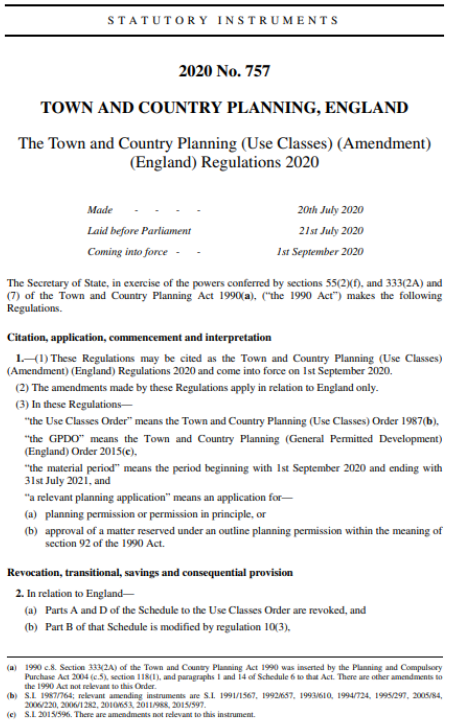
Implications of changes to the use class order are significant for proposals involving new Gyms.

Mixed-use lightweight structures that may have been suitable for office uses may not be acceptable for use as a Gym.

Increased emphasis on re-use / conversion of existing buildings. Concerns about embodied carbon in construction and the case for a retrofit-first approach being pushed.

In most cases Use Class E allows this change (Office to Gym) as permitted development **without** being subject to planning conditions.

Following technical guidance on acceptable standards for adjoining residential spaces is absolutely vital to avoid future problems.



STATUTORY INSTRUMENTS

2020 No. 757

TOWN AND COUNTRY PLANNING, ENGLAND

The Town and Country Planning (Use Classes) (Amendment) (England) Regulations 2020

Made - - - - 20th July 2020
Laid before Parliament 21st July 2020
Coming into force - - 1st September 2020

The Secretary of State, in exercise of the powers conferred by sections 55(2)(f), and 333(2A) and (7) of the Town and Country Planning Act 1990(a), ("the 1990 Act") makes the following Regulations.

Citation, application, commencement and interpretation

1.—(1) These Regulations may be cited as the Town and Country Planning (Use Classes) (Amendment) (England) Regulations 2020 and come into force on 1st September 2020.

(2) The amendments made by these Regulations apply in relation to England only.

(3) In these Regulations—

"the Use Classes Order" means the Town and Country Planning (Use Classes) Order 1987(b),

"the GPDO" means the Town and Country Planning (General Permitted Development) (England) Order 2015(c),

"the material period" means the period beginning with 1st September 2020 and ending with 31st July 2021, and

"a relevant planning application" means an application for—

(a) planning permission or permission in principle, or

(b) approval of a matter reserved under an outline planning permission within the meaning of section 92 of the 1990 Act.

Revocation, transitional, savings and consequential provision

2. In relation to England—

(a) Parts A and D of the Schedule to the Use Classes Order are revoked, and

(b) Part B of that Schedule is modified by regulation 10(3),

(a) 1990 c.8. Section 333(2A) of the Town and Country Planning Act 1990 was inserted by the Planning and Compulsory Purchase Act 2004 (c.5), section 118(1), and paragraphs 1 and 14 of Schedule 6 to that Act. There are other amendments to the 1990 Act not relevant to this Order.
(b) S.I. 1987/764; relevant amending instruments are S.I. 1991/1567, 1992/657, 1993/610, 1994/724, 1995/297, 2005/84, 2006/220, 2006/1282, 2010/653, 2011/988, 2015/597.
(c) S.I. 2015/596. There are amendments not relevant to this instrument.

Noise Policy Statement for England 2010 (NPSE)

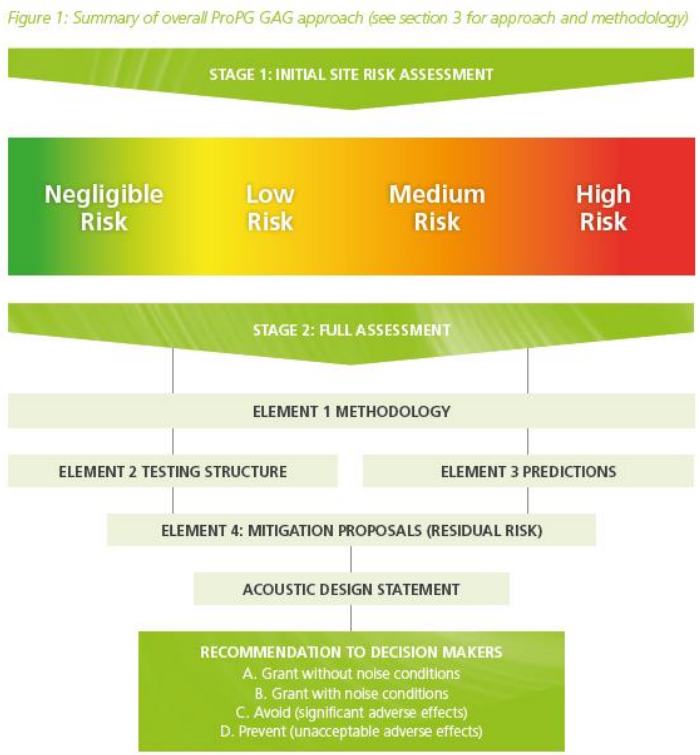
Included some new concepts in assessing noise impacts and uses established concepts from toxicology:

***NOEL** – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level there is no detectable effect on health and quality of life due to the noise.*

***LOAEL** – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.*

***SOAEL** – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.*

*LOAEL or SOAEL is likely to be different for different noise sources, for different receptors and at different times of the day, and needs to be defined for the given situation, with regard for context to become meaningful.



Existing Criteria & Evidence

The Gym Working Group examined criteria used by consultants and real world planning conditions used by Local Authorities in London, North West England and Scotland.
[Examples in Appendix B.8.]

Example Criteria at Westminster City Council

Fixed NR criteria since 2006 and 63 Hz and 125 Hz limits. [Noise council,1995].

Very low number of adverse comments where criteria < NR20 Leq is complied with.

Table 2: Design criteria for residential habitable space

Typical use	Noise Criteria	Noise Parameter
Music and entertainment (e.g. restaurants, clubs, pubs)	10 dB below measured/assessed background in adjoining residential habitable space	L_{eq} & L_{Fmax} in 63 Hz and 125 Hz octave bands
	Fixed criteria	Day: NR30 L_{eq}, NR35 L_{Fmax} Night: NR25 L_{eq}, NR30 L_{Fmax}
Gym facilities and other similar uses	10 dB below measured/assessed background in adjoining residential habitable spaces	Leq & LFmax in 63 Hz and 125 Hz octave bands
	Fixed criteria[2]	Day: NR20 Leq (Airborne noise), NR25 LFmax (Impact noise) Night: NR15 L_{eq} (Airborne noise), NR20 L_{Fmax} ([Impact noise)

Existing Criteria & Evidence

Four London and three Scottish Environmental Health departments use **NR15 to NR25 night-time** and similar criteria during the day time (**up to NR30**).

Other councils in England use the **63Hz and 125Hz criteria of 47 dB and 41 dB** (Noise Council's Code of Practice (1995)) which equates to NR15 at 63 Hz and NR22 at 125 Hz for all types of development that include music noise.

One other English City Council uses **NR20** criteria for the **63 Hz and 125 Hz** frequencies.

Use of the NR curves by Local Authorities has been demonstrated to avoid complaints and therefore prevent further strain on LA resources.

These metrics compare well with existing design targets used across the Gym sector.

ProPG GAG Criteria

The criteria are proposed as guidance only and are formed from experience of the authors and contributors, developed from a low level of public response from the historic use of NR-curve based targets.

In the experience of the group **the lower values in table 2** represent the lowest observed adverse effect level (**LOAEL**) .

Table 2 provides a guide for those setting criteria, whilst being mindful of the locality and context. Context is very important and should influence the final criteria.

Detailed guidance and notes are provided to accompany Table 2.

Target criteria below the upper thresholds tend to avoid significant adverse impacts (**SOAEL**) occurring.

Table 2: Guidance Internal Sound Target Criteria for Gym Activity – Residential & Other Areas

Receptor type	**Guide Criteria** (for third octave band values plots against the stated G curve - see Figure 2)	
	Airborne Sound (e.g., music) $L_{eq,T}$ (31.5Hz to 8kHz)	Heavy Impact Sound $L_{max,F}$ (31.5Hz to 8kHz)
Commercial Offices	G25-G35	G35-G45
Retail Areas	G30-G45	G35-G50
Residential Areas	G15-G25 (day) G10-G20 (night)	G20-G25 (day) G15-G20 (night)

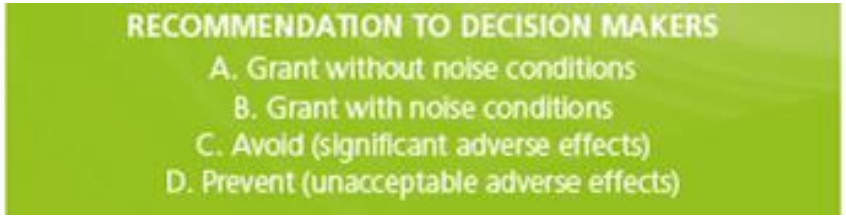
NPSE / ProPG Approach

A. Grant without noise conditions (e.g. low risk new build with high building fabric specification)

B. Grant with noise conditions (e.g. conversion, re-use, new build which just meets criteria)

C. Avoid (Significant adverse effects)
Recommendation for decision makers is to recommend refusal to avoid significant adverse effects, unless it can be adequately mitigated.

D. Prevent (unacceptable adverse effects)
Recommendation for refusal would be in order to "prevent" unacceptable adverse effects due to noise.



Appendix Section A.5 provides “Advice for Local Authorities” which provides Local Authorities with a reliable, supporting technical basis for determining the suitability of an application.

Planning Conditions

*Table B4: Airborne and Impact Noise Limits within residential (*using lower values from Table 2)*

Operational Hours	Target Level
X to Y (assuming 07:00 to 23:00)	**Airborne Noise** Health and fitness activity noise shall be no greater than curve G15 as an $L_{eq,5minutes}$*, in accordance with ProPG:GAG2022 methodology in any structurally adjoining habitable areas of residential properties located above or adjoining the health and fitness studio or Gym.
	Impact Noise (Airborne & Structure-borne) Health and fitness activity noise shall be no greater than G20 $L_{Max,5minutes}$*, in accordance with ProPG:GAG2022 methodology in any structurally adjoining habitable areas of residential properties located above or adjoining the health and fitness studio or Gym.

REASON: *To protect the amenity and quality of life of occupiers of nearby properties from noise and vibration disturbance.*

Example Model Conditions

Table B4 presents example LOAEL criteria and condition wording which includes:

*"Full details of the noise control scheme shall be submitted to the LPA prior to commencement and approved, which shall include a **Noise Management Plan** and submitted to and approved by the LPA prior to the first use of the health and fitness studio or Gym."*

Further Advice for the Local Authority

The Guidance advocates a proactive approach and includes:

- **Complaint Investigation and Management** providing a framework for investigating complaints.
- **Noise Management Plan** guidance
- **Advice for Local Authorities** on avoiding significant adverse effects, including recommendations for post occupancy feedback
- **Example planning condition wording** used by other Local Authorities.

Aims & Future Development

The key aim of this guidance is to result in **a more consistent approach in support of the delivery of sustainable development** and to assist the successful location of Gyms near to noise sensitive adjacencies, where it is appropriate and to identify where it is not.

The framework of this guidance is intended to **help determine the risk of adverse impacts** from noise being high enough that they reach a significant or unacceptable level. Where that impact cannot be reduced through mitigation the application should be recommended for refusal, in line with planning policy.

LPAs should encourage developers to obtain post occupancy feedback from new residents on acoustic design issues for all new residential development that is permitted in circumstances where there is a potential risk of significant adverse effects arising from noise and that the **lessons learned from such surveys should inform future good practice**, **including local and national plan-making and decision-taking activities.**

The group aim to review and amended the guidance in 2024.