

Pickleball and Padel Noise Assessment Methodology Review

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Abstract

In 2023, ISO/TC43/SC1/WG45 on the assessment of environmental noise (ISO 1996) was approached regarding whether pickleball noise had come to the attention of WG45, then on how pickleball and padel are dealt with around the world, and a request for international guidance on how to assess it.

Pickleball and padel are growing in popularity. There are claims that pickleball and padel are more intrusive than other sports, due to their acoustic signatures. There is a clear need to develop assessment methodology for these emerging sports with their unique and unfamiliar acoustic signatures. Existing standardized assessment methodology and dose-response studies are both limited, creating noise assessment challenges. There is an immediate need for sharing information and experience globally to help develop assessment methodology.

ISO/TC43/SC1/WG45 has initiated work to gather information and decided to publish findings on existing methodology as soon as possible, and to encourage funded international research in this area.

This paper describes the background for and the status of our work to collect existing practice on assessment of padel and pickleball outdoors, and the group's plans to initiate work to identify dose-response relationships and appropriate metrics, including the use of Rating Level as defined in ISO 1996.

Keywords: *impulse, standards, environmental noise, noise control*

1. Introduction

In late 2023, the convenor of ISO/TC 43/SC 1/WG45 on the assessment of environmental noise (the ISO 1996

series) was approached by people in USA initially regarding whether pickleball noise had come to our attention, due to our work on ISO standards on impulsive environmental noise. This developed into a request on how pickleball and the related padel sport are dealt with in other countries and the need for international guidance on how to assess it.

Pickleball and padel differ with regards to the balls and equipment used, the size of the courts and their enclosures, and rules, but are, initially, for this study, treated as one.

Both sports are growing in popularity. They are relatively easily learned and not physically strenuous. This and the fact that existing tennis courts can be converted into a larger number of pickleball/padel courts in the same physical area drive growth. There are claims that there is a strong difference in the intrusiveness of padel/pickleball compared to other sports, due to their acoustic signatures.



Figure 1. Outdoor padel court.

It became clear to WG45, that there is a need for assessment methodology to be developed as these are similar emerging sports with unique and unfamiliar acoustic profiles. This limited existing standardized assessment methodology and limited dose-response studies creates noise assessment challenges. So in

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January 2026, WG45 agreed to gather information on the topic and for an appointed subgroup to present a paper at an imminent international conference to uncover existing and in-development methodology, and to encourage funded international research in this area. After publication of this paper, WG45 will consider further action.

The paper is intended to share expertise on padel/pickleball noise assessment to help development of assessment methodology by collecting existing national practice, reporting but not recommending metrics, possible graduation of adjustments and/or classification. It was intended to identify research needs such as dose-response studies and data acquisition



requirements to enable these.

Figure 2. Pickleball paddle and different balls (Source: wikipedia).

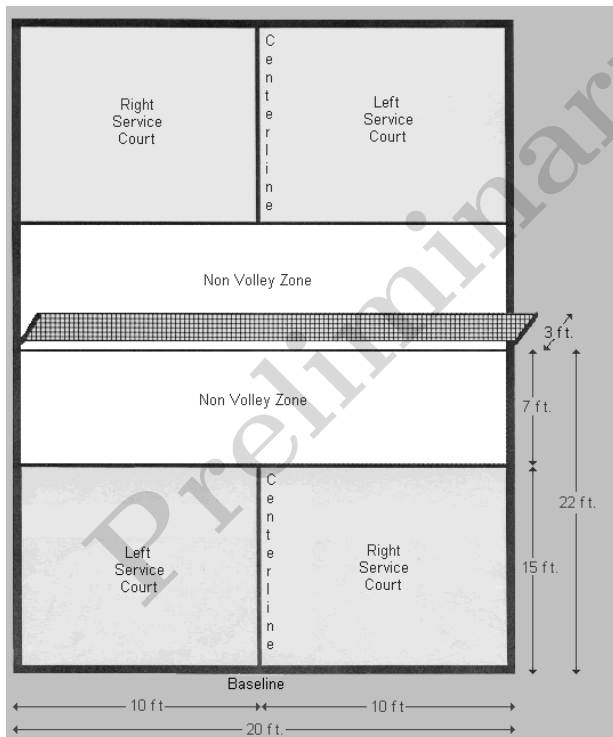


Figure 3. Pickleball court dimensions (Source: wikipedia). Note: padel courts are slightly larger.

2. Existing Practice Study

Methodology

With the help of WG45 members, 13 selected countries were identified and investigated by contacting national experts to provide the status of national methods, descriptions of them and reference documents. In addition, as ISO standard generic methodologies exist to assess pickleball and padel, how padel/pickleball would be assessed using the ISO 1996 series and associated standards was also investigated. All methods were then assessed regarding a range of standardized criteria.

3. Existing Practice Assessment

Criteria

The assessment covered:

- Geographic area: ie which country is covered
- Publisher: Identification of the publishing standardization organization
- Identification: a unique, commonly used identification of the method
- Title: Title of method
- Year: Publication date
- Reference/Source: a reference where available, or the source of information
- Category: whether the method is a Law, a Rule, a Guideline, or Other
- Application: whether the method is specific to padel/pickleball, part of methodology to assess noise from sport, or more generic
- Metrics: which parameters. If possible, what assessment duration and any level limit(s)
- Method: Basis of the analysis
- Is the method based on dose-response?: Yes/no/unknown/undefined
- Other: Which language, any other salient information
- Summary: A brief summary of the method

In addition, any additional description of the method and its background made available to the authors was appended. This paper summarizes the main findings. A full report will be delivered to WG45 for further discussion.

4. Existing ISO Methodology

The following ISO standards are applicable for assessment of padel/pickleball noise: the 1996 series on the description, measurement and assessment of environmental noise including the ISO/TS 20065 objective method for assessing the audibility of tones and ISO PAS 1996-3 for categorization of impulsive sounds [1], [2], [3], [4]. These provide general guidelines for good practice of environmental noise assessment, deferring responsibility for setting noise limits to cognizant authorities while recommending that limit values should vary depending on time-of day/week, and on land use. The standards are currently either under revision or intended to be so.

5. Results of Review of Existing Practice

The following countries were investigated:

- Australia
- Canada
- China
- Denmark
- France
- Germany
- Korea
- Japan
- Netherlands
- Norway
- Spain
- Switzerland
- United Kingdom
- United States of America

The following countries have a method to assess padel/pickleball, either specifically or as part of methodology to assess noise from sport:

- Netherlands (specific), guideline [5]
- Germany (sport), law [6]
- Denmark (sport), guideline [7]

Table 1. Summary of existing practice study. Key: NL: Netherlands, DE: Germany, DK: Denmark, FR: France, NO: Norway, CH: Switzerland

Geographic area	NL	DE	DK	FR	NO	CH	ISO
Year	2023	1991	2025	2018	2006	2017	2022
Category	Guideline	Law	Guideline	Guideline	Guideline	Guideline	Standard
Application	Specific	Sport	Sport	Sport	Sport	Sport	Generic
Metric	Etmaalwaarde, L_{pFAmax}	L_R	L_{Aeq} , L_R	Emergence	L_{pAmax}	L_R	L_R
Method	Etmaalwaarde (highest $L_{eq,day}$, $L_{eq,evening} +5$ dB, $L_{eq,night} +10$ dB) and L_{pFAmax} for planning	Rating level including impulse and tone adjustments	Subjective assessment with analysis	NF S 31-010: Emergence compared with residual noise level. No impulse or tone adjustments	Maximum A-weighted level	Rating level including impulse and tone adjustments	Rating level including impulse and tone adjustments
Dose response?	Indirectly	No	No	No	No	No	No

The majority are guidelines, with only Germany having a legal basis. The only national method specific to either sport is in the Netherlands, for padel. The methods in other countries are for all sports. Rating Level, L_R , is widely used but the methods differ in how this is calculated. However other parameters are also used, with 2 countries using maximum levels, L_{pAmax} . None of the methods are directly based on dose-response relationships, although at least the one in the Netherlands has an indirect link as it is based on a dose-response relationship for industrial noise. Future study is recommended to determine how the assessment methods and limits in each country for padel/pickleball compared to those for noise from industry.

- France (sport), guideline [8]
- Norway (sport), guideline [9]
- Switzerland (sport), guideline [10]

In addition, existing ISO standard generic methodologies can be applied to assess padel/pickleball.

The following countries investigated have no national method or guideline to assess padel/pickleball, although for some, regional or local guidance exists but is typically limited and generic:

- Australia [11]
- Canada [12]
- China [13]
- Korea [14]
- Japan [15]
- Spain [16]
- United Kingdom [17]
- United States of America [18]

The 6 national methods and the ISO method are summarized in Table 1 below.

Note that the above assessments, particularly regarding whether the method is based on dose-response relationships, are based on assessments done in cooperation with method experts, and are not necessarily aligned.

6. Dose Response Relationship Study

A noise dose response relationship describes the correlation between the magnitude of noise exposure and the resulting human response, typically annoyance. There is currently very little published dose response research specifically addressing padel/pickleball noise, and no established pickleball specific dose response relationship is available. However, the noise produced

by the contact between the ball and paddle exhibits several acoustic characteristics such as impulsivity which is known to increase annoyance [1].

The dose response relationship for impulsive noise sources differs significantly from that of continuous environmental noise sources such as transportation noise where dose response relationships, largely based on time averaged sound levels, are well established. As impulsive sounds are often judged to be more annoying than continuous sounds having the same or similar energy equivalent sound level, the use of equivalent energy metrics such as the equivalent sound level (L_{eq}) and day-evening-night level (L_{DEN}) may underestimate the perceived impact of such sources.

In the absence of a validated pickleball specific dose response relationship, research has been conducted to investigate the annoyance and health impacts experienced by individuals living near outdoor pickleball facilities. A survey-based study [19] documented several annoyance and health related impacts associated with pickleball noise, including stress, anxiety, sleep disturbance, the perception of “phantom pops” and reduced enjoyment of residential property. This demonstrates the need for the development of a standardized dose response relationship relating pickleball noise exposure to the percentage of highly annoyed individuals within an exposed population. The development of such a relationship would require a scientifically rigorous study including the following:

- Collection of long term noise exposure data at sensitive receptor locations;
- Characterization of relevant acoustic descriptors, including impulsiveness, maximum sound level, tonality, spectral content, frequency of occurrence;
- Administration of standardized annoyance surveys to exposed populations;
- Development of logistic regression models to estimate the probability of annoyance and establish an exposure response relationship between padel and/or pickleball noise and annoyance

The development of a quantitative dose response relationship will support objective impact assessment and potential regulatory applications.

7. Data Gathering

The limited data sets that are currently available provide a diversity of characterizations. Additional data sets are needed for complete and comprehensive characterization. Similarly, long term noise exposure data sets are needed to develop a dose-response relationship.

To develop the characterization, data sets are needed where the padel/pickleball noise does not include reflections, reverberance and the noise of other sources. Such datasets would be sound pressure level measurements, with A-weighted frequency and F time weighting, sampled with time intervals in the range of 10 ms to 25 ms, inclusive. The dataset will provide

additional value if it includes FFT or 1/3 octave band frequency data. An alternative data set would be an audio recording of 12 kHz or higher sampling rate, made with a linear response microphone (e.g., a Class 1 sound level meter). The audio recording must be provided with calibration. The data set, whether a measurement or audio recording, must be accompanied by a diagram showing the measurement location(s) and distance(s) from the back and/or side of the court.

A different type of data set is needed for the long-term noise dose response. The data set would be equivalent sound pressure level measurements (L_{Aeq}), including frequency data (FFT or 1/3 octave band) over a specified period. It is most helpful if the dataset provides supporting audio or indicates when the pickleball/padel is being played and when it is not. The data set must be accompanied by a diagram showing obstacles and reflective surfaces, the measurement location(s) and distance(s) from the back and/or side of the court.

The initial approach proposed is to determine a parameter for the time period when pickleball is actually being played. To enable this to be in line with the ISO 1996 strategy, this parameter could be a Rating Level. In other words the L_{Aeq} with an adjustment for impulsivity, perhaps determined by identification of the source, and/or for tonality, perhaps based on determination of the audibility at the receiver location. This could require:

- $L_{Aeq, 1s}$ logged data
- L_{AFp} logged at 10-25 ms intervals for impulsive sound detection according to ISO PAS 1996-3
- For tonality, objective assessment in some resolution, sound recordings, or objective assessment, either using 1/3-octave survey-grade assessments according to ISO 1996-2, or FFT-based engineering assessments according to ISO TS 20065.

The resulting metrics could then be determined for exposure intervals of 1-30 minutes.

Sound recording of selected representative data, both specific and residual, could be used to determine impulsivity and tonality through later analysis, as well as other metrics. Sound recording may also be useful for source identification using AI.

8. Future Work

The authors intend to provide a full report, including all details, to WG45 for further discussion and potential action.

A more in-depth study to determine how the assessment methods and limits in each country for padel/pickleball compare to those for noise from industry is recommended. In addition, further review of the assessments, particularly regarding whether the method is based on dose-response relationships, is recommended to better align them and thus achieve a more homogeneous result.

Research to develop a quantitative padel/pickleball dose response relationship is encouraged in order to

support objective impact assessment and regulatory applications.

Further work to refine what measurement data and sound recordings are required or desirable is also encouraged.

WG45 will review the results of the investigations summarised in this paper and consider further action.

9. Conclusions

The paper is intended to share expertise on pickleball and padel to help development of assessment methodology by collecting existing national practice, reporting but not recommending metrics, possible graduation of adjustments and/or classification. It was intended to identify research needs including data acquisition requirements to enable dose-response studies.

The paper provides an overview and comparison of currently existing national assessment methodology, and on how existing ISO standard generic methodologies can be applied to assess padel/pickleball noise.

Thoughts on how to develop a quantitative padel/pickleball dose-response relationship, and on what data should be gathered to support this, are presented

Further research is encouraged in order to provide further insight and to support the development of objective impact assessment and regulations based on human dose-response, including whether both sports can be dealt with in the same manner or differently.

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References

- [1] International Organization for Standardization, ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures
- [2] International Organization for Standardization, ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise. Part 2: Determination of sound pressure levels
- [3] International Organization for Standardization, ISO/PAS 1996-3:2022 Acoustics — Description, measurement and assessment of environmental noise. Part 3: Objective method for the measurement of prominence of impulsive sounds and for adjustment of LAeq
- [4] International Organization for Standardization, ISO/TS 20065:2022 Acoustics — Objective method for assessing the audibility of tones in noise — Engineering method
- [5] KNLTB (Dutch national tennis and padel association), Handreiking Padel en Geluid, 2023 (in Dutch), https://nsg.nl/nl/handreiking_padel_en_geluid?noredirect=1 (accessed 15 May 2026)
- [6] Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN), 18. BImSchV, Sportanlagenlärmschutzverordnung (Sports Facility Noise Control Act), 1991 (in German), https://www.gesetze-im-internet.de/bimschv_18/BJNR015880991.html (accessed 7th May 2026)
- [7] Miljøstyrelsen (Danish EPA), "Vejledning fra Miljøstyrelsen Støj fra idrætsanlæg, vejledning 81", 2025 (in Danish), <https://referencelaboratoriet.dk/regler-og-vejledninger/oversigt-over-regler-og-vejledninger/2025/stoej-fra-idraetsanlaeg>, (accessed 5 May 2026)
- [8] AFNOR, "Acoustique - Caractérisation et mesure des bruits de l'environnement - Application de la norme NF S 31-010 aux stands de tirs : mesure de contrôle et mesure associée à une étude prévisionnelle", NF S31 160, 2018, (in French) <https://www.boutique.afnor.org/fr-fr/norme/nf-s31160/acoustique-caracterisation-et-mesure-des-bruits-de-lenvironnement-applica/fa177655/81926> (accessed 6 May 2026)
- [9] Helse- og omsorgsdepartementet, "Støyvurdering ved etablering av nærmiljøanlegg", 2006 (in Norwegian), <https://www.regjeringen.no/globalassets/upload/kkd/idrett/302579-stoyveileder.pdf> (accessed May 2026)
- [10] Bundesamt für Umwelt (BAFU), "Ermittlung und Beurteilung von Sportlärm" (in German), Umwelt-Vollzug Nr 1704, Bern, Switzerland, 2017
- [11] correspondence with Colin Tickell and Peter Teague, (ISO TC43 SC1 WG45 members, March 2026)
- [12] correspondence with Peter VanDelden (ISO TC43 SC1 WG45 member, May 2026)
- [13] correspondence with Yu Wuzhou (TC43 SC1 WG45 member, May 2026)
- [14] correspondence with Jinhoi Gu (ISO TC43 SC1 WG45 member, May 2026)
- [15] correspondence with Takatoshi Yokota (ISO TC43 SC1 WG45 member, May 2026)
- [16] correspondence with Maria Jesus Ballesteros (ISO TC43 SC1 WG45 member, May 2026)



- [17] correspondence with Simon Shilton (TC43 SC1 WG45 member, April 2026) and Adam Walker (April 2026)
- [18] correspondence with Ken Kaliski and Bob Hellweg (ISO TC43 SC1 WG45 members, 2024 to January 2026), Rob Mastroianni (February 2026) and Charlie Leahy (2023)
- [19] Acoustical Society of America, “A Survey of the Community Impact of Pickleball Noise: A pilot study”, K. Romito, J. Bank, *Proceedings of Meetings on Acoustics*, Volume 60, paper 040001, 2026

Preliminary document

