PD ISO/TS 12913-3:2019

BSI Standards Publication

Acoustics — Soundscape

Part 3: Data analysis

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National foreword

This Published Document is the UK implementation of ISO/TS 12913-3:2019.

The UK participation in its preparation was entrusted to Technical Committee EH/1/3, Residential and industrial noise.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2019

ISBN 978 0 539 02891 1

ICS 17.140.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 December 2019.

Amendments/corrigenda issued since publication

Date	Text affected

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TECHNICAL SPECIFICATION

ISO/TS 12913-3

First edition
2019-12

Acoustics — Soundscape —

Part 3: Data analysis

Acoustique — Paysage sonore —

Partie 3: Analyse de données

Reference number
ISO/TS 12913-3:2019(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise.*

A list of all parts in the ISO 12913 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The ISO 12913 series on soundscape was developed in order to enable a broad international consensus and to provide a foundation for communication across disciplines and professions with an interest in soundscape. ISO 12913-1 provides the definition of and a conceptual framework for the term 'soundscape'. ISO/TS 12913-2 provides requirements and supporting information on data collection and reporting for soundscape studies, investigations and applications. This document provides guidance on how to analyse data collected in agreement with ISO/TS 12913-2.

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Acoustics — Soundscape —

Part 3: Data analysis

1 Scope

This document provides requirements and supporting information on analysis of data collected in-situ through methods as specified in ISO/TS 12913-2.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12913-1, *Acoustics — Soundscape — Part 1: Definition and conceptual framework*

ISO/TS 12913-2:2018, *Acoustics — Soundscape — Part 2: Data collection and reporting requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12913-1 and ISO/TS 12913-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
confounder
factor influencing the collected responses that is not controlled or systematically considered

EXAMPLE Sequential effect, certain scaling effects like the range effect, or demand characteristics.

4 General

As mentioned in the Introduction of ISO/TS 12913-2:2018, "*The concept of soundscape was adopted to provide a holistic approach to the acoustic environment, beyond noise, and its effect on the quality of life. Soundscape investigations intend to assess all sounds perceived in an environment in all its complexity. To do this, soundscape studies use a variety of data collection methods related to human perception, the acoustic environment and the context. Importantly, the study of soundscape relies primarily upon human perception, and only then turns to physical measurement.*" Data collection is based on this focus and requires a respective analysis (see References [1],[2]).

For the analysis of qualitative and quantitative data through methods specified in ISO/TS 12913-2, methods and tools shall be applied as provided in this document. Given the diversity of the data collected (qualitative and quantitative), corresponding analysis methods could take precedence depending on the needs of the project or the research question, and should be integrated for a holistic understanding of the soundscape. In general, descriptive statistics are used to describe and summarize the collected perceptual data, such as measures of central tendency, measures of dispersion (see Reference [3]).

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For quantitative measures of dependence, inferential statistics using parametric and non-parametric tests shall be applied depending on the respective data. Fulfilment of model assumptions (e.g. normality distribution) shall be carefully assessed, especially in the case of small numbers of participants. If needed, appropriate remedial measures shall be applied. However, as soundscape investigations are intended to be "holistic in covering all auditory sensations as well as all other context variables such as visual stimuli and personal expectations" [ISO/TS 12913-2], the use of statistical analysis methods (e.g. statistical hypothesis testing) is recommended, but may be less important in case of qualitative or explorative methods. For qualitative data, a variety of approaches are available to systematically analyse qualitative data using some kind of step by step coding principles to generalize the observations. In addition, soundwalks are a method for bringing diverse parties together and provide a common basis for communication.

Because of factors that could influence results, a thorough discussion of potential confounders (i.e. bias effects) shall complete the general data analysis. Confounders are, for example, the sequential effect (a previous site influences the assessments of the following site) (see Reference [4]) certain scaling effects, like the range effect (tendency to use full range of a scale independent from stimuli set) (see Reference [5]), or demand characteristics (cues, like the instruction text or the behaviour of the person leading the soundwalk, that signal the research goal and influence assessments) (see Reference [6]).

NOTE Based on the collected data, it is possible to study classification of sites. For the study of classification of sites, different statistical clustering methods are available, which allows for identifying relevant variables for clustering and determining the similarity or dissimilarity of sites.

5 Analysis of quantitative data

The quantitative data obtained by means of questionnaires in soundscape investigations shall be analysed depending on the respective level of measurement (i.e. nominal, ordinal, interval, and ratio). Any correlation analysis shall be chosen in accordance with the level of measurement of the questionnaire data. Inferential statistical tests regarding the level of significance of differences in evaluation between sites and/or correlations shall be carried out and probability values reported. Any chosen method (e.g. measure of central tendency, measure of dispersion, correlation analysis, and statistical hypothesis testing method) shall be reported. For more information, see Annex A (Method A) and Annex B (Method B).

6 Analysis of qualitative data

Data from qualitative interviews shall be transcribed for reporting and further analysis. The style of transcription, whether clean read, verbatim or strict verbatim transcription, depends on the object of the investigation. For the analysis via the Grounded Theory, the clean read transcription style is sufficient. Violations of common rules for conducting interviews (ethical rules, being suggestive, being prejudiced) shall be reported, and the related data excluded from further analysis.

Qualitative data shall be analysed by scientifically proven systematic text analysis methods, such as the Grounded Theory (see Reference [7]), Qualitative Content Analysis (see Reference [8]) or Social Network Analysis as part of mixed-methods design (see Reference [9]). The process of analysis shall follow these methods and be described. For more information, see Annex C.

In addition to established text analysis methods, other methods to gather and analyse qualitative data (such as behavioral mapping, observational analyses, analysis of social interaction, walking patterns; see examples in References [61], [62], [63], [64]) are available and, if determined appropriate in certain cases, shall be applied.

7 Analysis of binaural data

The binaural recordings are the basis for characterizing the acoustic environment at the receiver as the sound from all sound sources modified by the environment [ISO 12913-1]. The measurements and their psychoacoustic analyses enable the determination of the (basic) auditory sensations evoked by

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