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ISO/TC 43/SC 1

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Acoustics — Non-acoustic factors influencing the perception, interpretation and response to environmental sounds —

Part 1: Definition and conceptual framework

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Foreword

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This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*, Working Group WG 68, Non-acoustic factors.

ISO/TS 16755 consists of the following parts, under the general title Acoustics — Non-acoustic factors influencing the perception, interpretation and response to environmental sounds:

— *Part 1: Definition and conceptual framework*

The following parts are proposed following the adoption of Part 1:

— *Data collection and reporting*

— *Data analysis*

— *Interpretation*

ISO/TS 16755 applies to any sound in the acoustic environment ("acoustic environment" is defined in ISO 12913-1:2014 cl.2.2).

A list of all parts in the ISO/TS 16755 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.htmlwww.iso.org/members.html.

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Introduction

This document is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

Many countries already have regulations in place concerning the acceptability of environmental noise exposure, while others are likely to do so in the future. Such regulations often take into account relationships between noise exposure and noise-induced health outcomes, including long-term annoyance and sleep disturbance.

International standards have been developed for the measurements of certain characteristics of environmental sound. Two examples are ISO 1996-1:2016, [1] which contains details specifications about basic quantities and procedures, measurement of sound, and guidance on the application of these data to set noise limits, and ISO 20906:2009, [2] which specifies criteria for unattended monitoring of aircraft sound in the vicinity of airports.

Other standards focus on the effects of sound on humans. Long-term annoyance is an important health effect attributable to environmental noise, both as a health outcome in its own right, but also as a potential risk factor to other clinical health outcomes. [3] ISO/TS 15666:2021 [4] [3] ISO/TS 15666 [4] provides a standardised specification for the assessment of noise annoyance by social and socio-acoustic surveys. This specification has enabled a more robust consolidation of the international evidence on noise annoyance, by ensuring consistency in the definition and measurements of this specific health endpoint [3] [3].

It is generally accepted that human reaction to environmental sound is determined partly by the acoustic characteristics of the physical stimulus, and partly by factors that frame the sound exposure within a broader context. [5-9] [5]to[9] Such factors are often referred to as non-acoustic factors in the noise and health literature.

In recent years there has been a growing interest in the soundscape approach. Whilst the term "soundscape" has seen widespread academic and popular adoption in various fields and applications (including urban, underwater and ecological contexts), [10] [10] the most relevant definition for the purposes of this document is the ISO 12913-1 definition, which places an emphasis on how sound in an environment is experienced by a person and/or people in context. According to ISO 12913-1:2014 assessing soundscape in context includes:

"the interrelationships between person and activity and place, in space and time. The context may influence soundscape through (1) the auditory sensation, (2) the interpretation of the auditory sensation, and (3) the responses to the acoustic environment." [11] *"* [11] *"*

There is clear overlap between the concept of the "context" as discussed in the ISO 12913 series [11-13] [11]to[13] and the term "non-acoustic factors" as used by the noise and health community. Therefore identifying, measuring and assessing non-acoustic factors is an important process of measuring and assessing soundscape in accordance with ISO 12913 series as well as assessing non-acoustic factors in noise and health research [e.g.5,7,8,30,31] [5][7][8][30][31].

Multivariate regression analyses of socio-acoustic surveys suggest that known non-acoustic factors can account for up to one third of the variance observed in noise annoyance reactions. [6,14-17] [6][14]to[17] These results have been further replicated in soundscape studies, with multi-level regression analysis indicating that non-acoustic factors can explain 35 % of the variance in pleasantness perception (i.e. the opposite dimension to annoyance) and 18 % of the variance in eventfulness perception [18] [18].

There is clear evidence that non-acoustic factors offer significant opportunities in a) understanding the drivers of annoyance and soundscape appraisal and b) opening up new possibilities for reducing the health burden attributable to the sound environment. In fact, several projects have already explored how non-acoustic factors can be used to reduce noise annoyance (see for example the ANIMA project [19] [19] for aviation noise and FAMOS [20] [20] project for road traffic noise). Consideration of non-acoustic factors in policy and practice could

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also lead to more equitable health outcomes.[21],[21] In business terminology, non-acoustic factors have the potential to significantly increase the return on investment in noise effects investigation and mitigation and soundscape design.[22],[22] The WHO Environmental Noise Guidelines 2018 also acknowledge the important contribution of non-acoustic factors, and recommend that[23]:[23]:

> *"Future intervention studies … should use measures of moderators and confounders, including repeated measurements of situational and personal variables such as activity interference, potential confounders such as noise sensitivity, coping strategies and a range of other attitudinal variables."*

Despite the key role that non-acoustic factors play in both the health protection (noise control) and health promotion/improvement (good acoustic quality and soundscape design) approaches, to date, there is no standardised specification for the assessment of non-acoustic factors in social surveys and soundscape assessments. For example, the definition and standardisation of non-acoustic factors fall outside scope of ISO/TS 15666:2021. This means that the extent to which non-acoustic factors are investigated in a particular study is limited by the specialist expertise within the study group, and different studies tend to develop project-specific survey instruments.

The aim of this Technical SpecificationISO/TS 16755 series is to help define, measure and interpret specific attributes of the context that help to better understand the human interpretation of, and response to a sound environment. The objective of Part 1 of this seriesdocument is to harmonise the definition and conceptual framework for non-acoustic factors related to noise and soundscape data collection activities, such as via social and socio-acoustic surveys, soundwalks, questionnaires and guided interviews. This definition and conceptual framework form the foundation for data collection, analysis and interpretation covered in subsequent parts of this standard seriesdocument.

ISO/TS 16755 series applies to any sound in the acoustic environment ("acoustic environment" is defined in ISO 12913-1:2014, 2.2).

When these specifications are met, it will be possible to identify, compare and pool survey results across studies in a methodologically robust way, thereby strengthening the evidence base and ultimately leading to a better understanding and application of non-acoustic factors to improve the health and quality of life of citizens across the globe. The data generated by the application of this Technical Specification series will be relevant to practitioners involved in all aspects of spatial planning and environmental public health including policy makers, planners, developers, regulators, researchers and environmental public health practitioners.

This document was developed with valuable input from the International Commission on Biological Effects of Noise (ICBEN) Team 6 - Community response to noise and annoyance.

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