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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

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R 131

EXPRESSION OF THE PHYSICAL AND SUBJECTIVE MAGNITUDES OF SOUND OR NOISE

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BRIEF HISTORY

The ISO Recommendation R 131, *Expression of the Physical and Subjective Magnitudes of Sound or Noise*, was drawn up by Technical Committee ISO/TC 43, *Acoustics*, the Secretariat of which is held by the British Standards Institution (B.S.I.).

The study of the principles contained in this ISO Recommendation had already commenced in 1937, during a conference held under the aegis of the former International Federation of the National Standards Associations (ISA), but that work was interrupted by the war.

During its first meeting, held in London, in October 1953, Technical Committee ISO/TC 43 decided to reactivate this study. The work of the Technical Committee was continued at the meetings which followed, held in Berne, in September 1955 and in Paris, in January 1957. A draft proposal developed during this latter meeting was submitted by correspondence to all the members of the Technical Committee and was adopted as a Draft ISO Recommendation.

On 17 January 1958, the Draft ISO Recommendation (No. 201) was distributed to all the ISO Member Bodies and was approved, subject to some modifications, by the following Member Bodies:

Australia	Hungary	Portugal
Austria	India	Romania
Burma	Italy	Spain
Czechoslovakia	Japan	Sweden
Denmark	Mexico	Switzerland
Finland	Netherlands	United Kingdom
France	New Zealand	U.S.A.
Germany	Poland	U.S.S.R.

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in September 1959, to accept it as an ISO RECOMMENDATION.

EXPRESSION OF THE PHYSICAL AND SUBJECTIVE MAGNITUDES OF SOUND OR NOISE

1. EXPRESSION OF THE PHYSICAL MAGNITUDE OF SOUND OR NOISE

1.1 It is recommended that data on the physical magnitude of sound or noise should be expressed by a statement of the sound pressure level (see clause 1.2) or in terms of the sound intensity level or sound power level.

1.2 **The sound pressure level** of a sound or noise is expressed as

$$20 \log_{10} \frac{p}{p_o} \text{ in decibels, dB}$$

where p = measured sound pressure, and

p_o = reference sound pressure, expressed in the same units as p.

It is recommended that, for sound in air, the following value be universally adopted as the reference pressure:

2×10^{-4} dyn/cm² (r.m.s.) *
or 2×10^{-5} N/m² (r.m.s.) *

NOTE. It should be noted that, when measurements are made in terms of the sound pressure level, an expression in terms of the sound intensity level or sound power level can only be derived if the sound field concerned is of an appropriate and well defined type.

2. EXPRESSION OF THE SUBJECTIVE MAGNITUDE OF SOUND OR NOISE LOUDNESS LEVEL — THE PHON

2.1 **The phon** is a dimensionless unit, used to express the loudness level of a given sound or noise (see clause 2.2).

2.2 **The loudness level** of a sound or noise is expressed as n phons, when it is judged by normal observers to be equally loud to a pure tone of frequency 1 000 Hz (c/s) consisting of a plane progressive sound wave, coming from directly in front of the observer, the sound pressure level of which is n dB above the standard reference pressure of 2×10^{-4} dyn/cm² (or 2×10^{-5} N/m²) r.m.s.*

NOTE. The measurement conditions should be described.

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* r.m.s. = root mean square.

3. ALTERNATIVE EXPRESSION OF THE SUBJECTIVE MAGNITUDE OF SOUND OR NOISE LOUDNESS SCALE—THE SONE

3.1 The loudness level of any sound may be expressed uniquely in phons in accordance with the procedure defining the phon scale (see clause 2.2). Owing, however, to the arbitrary definition of this scale, loudness level values, in phons, do not immediately convey the magnitude of the loudness sensation, but have to be interpreted by the user on the basis of his experience of previously heard sounds to which phon values have been attached.

The purpose of the sone scale is to provide a numerical designation of the loudness of sounds or noises that is proportional to the subjective magnitude as estimated by normal observers.

This ISO Recommendation specifies a function relating the loudness, in sones, of a steady sound or noise to its loudness level, in phons. The relation specified is an approximation to the laboratory data sufficiently accurate for expressing loudness in engineering applications. It does not necessarily represent the degree of accuracy required for research purposes.

3.2 **Specification.** The relation between the loudness in sones S of any sound and its loudness level in phons P is given by

$$S = 2^{\frac{P-40}{10}}$$

The relation between S and P is given in the Table.

An approximate equivalent of the relation is given by

$$\log_{10} S = 0.03\ (P-40).$$

NOTES

1. The specified relation defines the value of the sone (unit of loudness) as the loudness of a sound whose loudness level is 40 phons.

2. A twofold change in loudness corresponds to an interval of 10 phons.

3. Experimental confirmation of this relation exists over the range 20 to 120 phons, and its use outside this range should be recognized as an extrapolation.