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NOISE CONTROL BY ENCLOSURES - INFORMATION ON THE STATE-OF-THE-ART IN TECHNICAL GUIDELINES AND STANDARDS

U J Kurze

Müller-BBM, Robert-Koch-Str 11, D-82152 Planegg, near Munich, Germany

1. INTRODUCTION

Technical guidelines and standards on noise control by enclosures provide information on the acoustical and operational requirements which are to be agreed upon between the supplier or manufacturer and the user of enclosures designed for noise control. Complete enclosures around a machine with a fraction of less than 10 % of the surface area open and unmuffled are the main subject of a new guideline to be prepared by ISO/TC43. Enclosures for noise protection of operators (cabins) require additional consideration, depending on their structural connection with machines.

2. RECENT STANDARDS FOR NOISE CONTROL ELEMENTS

In the wake of the European machine safety regulations [1], several standards have been prepared by ISO/TC43/SC1/WG36 concerning measurement procedures for various types of noise control elements including silencers, acoustic enclosures and indoor noise barriers. WG44 of the same subcommittee added a draft standard entitled " Acoustics - Guidelines for noise control by silencers" [2]. It lists specification, selection and design considerations, describes types of silencers, general principles and operational considerations, gives typical performance characteristics, explains measurement techniques, specifies the information to be provided by the user and the manufacturer and gives numerous examples in an informative annex. Based on this experience and on the long tradition of German VDI guidelines [3], which have been found useful for referring to the state-of-the-art and are regularly reviewed, another international guideline is presently drafted on acoustic enclosures.

3. OUTLINE OF THE GUIDELINE

After the introduction, scope and normative references, the section "Definitions" will be used to distinguish between free-standing machine enclosures, integrated enclosures attached to machines, and cabins for the protection of human beings from noise. Furthermore, essential acoustical performance data will be explained including the insertion loss D_W and the related single number value $D_{W,w}$ which is called the weighted sound power insulation, the panel transmission loss R, the sound pressure insulation D_p and the related single number values D_{pA} or D_{pAe} resulting from A-weighting of the actual sound spectrum or of an estimated sound spectrum, respectively.

Under General Principles and Operational Considerations, the need for clear identification of the sound source to be muffled by the enclosure, and for consideration of auxilliary devices for removing the heat from the enclosure or for air conditioning of cabins will be described. In addition, a block diagram similar to the one shown in Fig. 1 will be presented to indicate the various sound propagation paths and potential means for controlling the air-borne and structure-borne sound inside the enclosure, in the enclosure wall, and along the flanking paths. Estimates will be given for the relations between the transmission loss R_1 on path 1 and the leak ratio θ, $R_1 \cong -10$ lg (θ) dB, and between the insertion loss, the absorption coefficient α of the lining, and the transmission loss, $D_W \approx R_1 + 10$ lg (α) dB. The significance of the other propagation paths will be discussed.

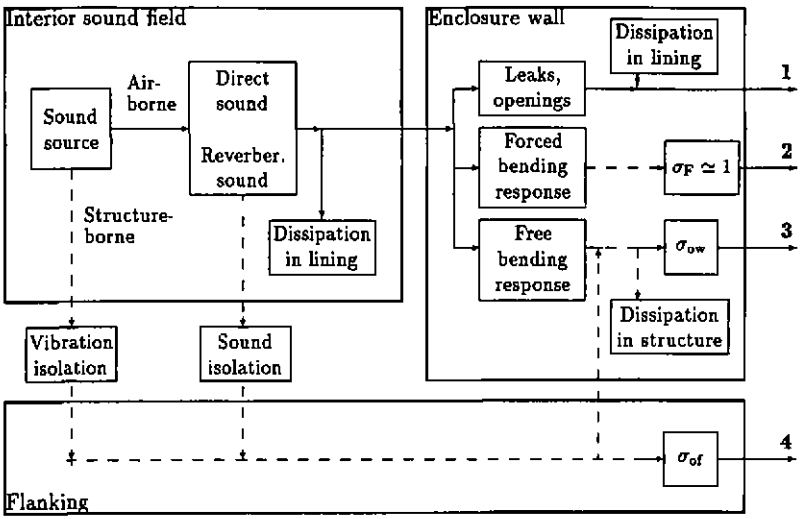

Figure 1: Block diagram of sound propagation paths

Basic rules for efficient noise control by enclosures will be summarized:

- Select an enclosure which is matched to the particular task of housing a machine or protecting a workplace under general operating criteria, including availability of space, safety aspects, material flow etc. Acoustical considerations come in second.

- Generally, the acoustic performance of enclosure panels is sufficient in terms of absorption and transmission loss if common materials are used, e.g., 1,5 mm steel sheet metal with 50 mm mineral wool and 30 % open perforated plate on the inside, see Fig. 2, or 6 mm thick glass panes. Special requirements for enhanced low-frequency insertion loss, protective covers on the mineral wool, use of particular shapes and materials for the impervious surface and the absorbing material etc. need detailed investigations.

- Devote full attention to leaks and openings. Avoid leaks between panels by making use of special single or double sealing constructions, depending on the acoustic requirements. If the panels are often disassembled, make sure that the sealing constructions can be used repeatedly. Where leaks are unavoidable, as in sliding doors, use absorbing linings or slot silencers. Keep all openings as small as possible and equip them with silencers.

- To avoid flanking transmission of structure-borne sound, use resilient elements for mounting the sound source on the floor and panels of the enclosure on the sound source.

- Use coating of panels with damping material for increasing the panel weight and the attenuation of free bending waves, if necessary for special applications.

Particular requirements will be described in detail for machine enclosures, depending on the size of the machine, for integrated enclosures, including stationary machines and vehicles, and for cabins used for general control and supervision, for operators of stationary machines, and for vehicle mounted cabins.

Field experience will provide the basis for the description of acoustic requirements in planning and verification of noise control. In addition to the measurement procedures standardized in ISO 11546 Part 2 [4], situations of high background noise will be addressed which require vibration measurements instead of sound pressure measurements.

Similarly important is the description of non-acoustic requirements including safety, access, cooling and ventilation, durability, handling of materials etc.

Information to be provided by the user and the manufacturer will be put together at the end of the main body of the normative guideline. The relevant literature and examples for constructions will be given in informative annexes.

References

[1] EC Directives 86/188, 89/391, 91/368, 93/44.

[2] ISO/DIS 14163, Acoustics - Guidelines for noise control by silencers (1996).

[3] VDI 2711, Noise control by enclosures (in German), (1978)

[4] ISO 11546-2:1993 Acoustics - Determination of in situ sound insulation performance of enclosures (for acceptance/verification purposes).

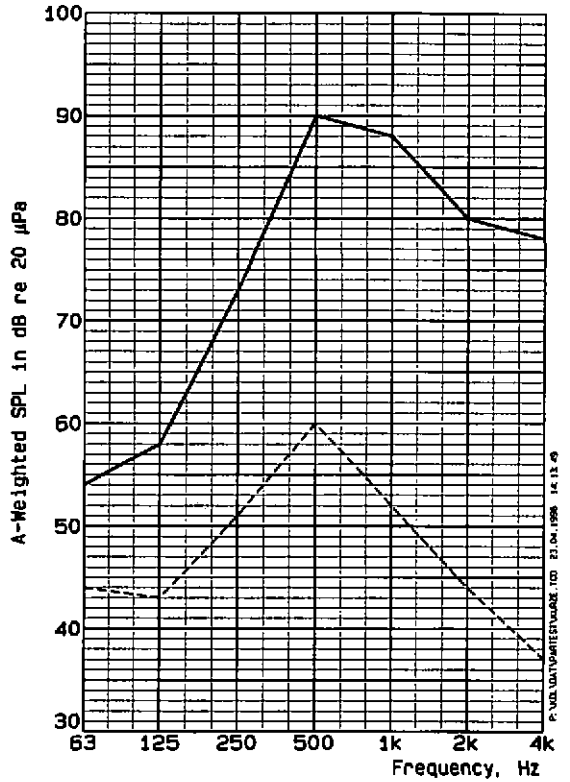

Figure 2: Examples of A-weighted octave-band spectra of sound pressure level for sound source without enclosure (—) and with a typical enclosure without leakage (- - -).