NOISE DECLARATION OF MACHINERY AND EQUIPMENT IN POLAND

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1. INTRODUCTION

A proposal concerning noise declaration of machinery and equipment according to European requirements, prepared by the Department of Acoustics of the Central Institute for Labour Protection is presented in the paper.

2. GENERAL IDEA

Information on noise emission of machines, required by EEC - directives, is needed by users, buyers, health and safety experts, acoustical planners etc. for purposes of comparison different noise sources, creation of noise data banks etc. Furthermore, information on low noise emission of products is an important argument in trade. In this connection, the Department of Acoustics of Central Institute for Labour Protection has prepared a proposal on which noise declaration of machines in Poland will be based. It is important that noise declaration can be used and compared at the international level. Consequently, the proposal procedure is based on international standards and measurement codes, and in principle follows the procedures for noise declaration in the European Community. Especially the principles for noise declaration are based on the directive on the protection of workers against noise (86/188/EEC [1]) and on the directives relating to machinery (89/392/EEC [2] and 91/368/EEC [3]). Taking into consideration, that sound power level and sound pressure levels at operator's positions are the most important quantities and they should always be declared, noise declaration of machines in Poland must provide the following information:
- equivalent continuous A - weighted sound pressure level at workstations,
- peak C - weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 μPa),
- sound pressure levels in octave bands (for frequency bands centered from 4 to 31,5 Hz) at workstations if there is infrasonic noise,
- sound pressure levels in one - third octave bands (for frequency bands centered from 10 to 100 kHz) at workstations if there is ultrasonic noise,

- A - weighted sound power level emitted by the mechine,
- sound power levels in one-third octave bands in the case of technological ultrasonic devices,
- directivity information and sound power levels in bands but not obligatory except technological ultrasonic devices.

All this information should contain either the actual values or values established on the basis of measurements made on identical machinery. In the case of very large machinery, instead of the sound power level, the equivalent continuous sound pressure levels at specified positions around the machinery may be measured.

All those requirements are compatible with EEC-directives, in some cases they are more rigorous. Almost all above mentioned parameters should be determined according to ISO standards. If there exists no specific noise declaration code for the specific machines, sound power level determination is based on one of the ISO standards 3741÷3747. Also the sound intensity measuring methods (ISO 9614) could be applied to sound power determination.

The sound power levels should be given as declared (stated) values according to European standards EN-27574/1÷4.

The use of stated values in order to describe the sound pressure levels at workstations is problematic. These values depend on environmental factors.

In the case of technological ultrasonic devices, noise testing of them (determining of sound power level) is based on the Polish standard PN-87/N-01320 "Method for determination of acoustic parameters of ultrasonic devices for their attestation" [4] which is shortly summarized below. This method was elaborated upon the experiments which were carried out in the Central Institute for Labour Protection [5] and it is compatible with ISO standards of series 3740. According to the method the measurement should be performed in free field over a reflecting plane which meets the established requirements. The source to be tested shall be installed and mounted with respect to the reflecting plane in position that is representative of normal use. The microphone positions lie on the measurement surface which envelops the source and terminates on the reflecting plane.

The shape of measurement surface is a conformal surface (a rectangular parallelepiped except that the corners are rounded and they are formed by portions of cylinders and spheres). The key microphone positions (17 positions) are shown in figure 1. Quantities to be measured are sound pressure levels in one-third octave bands (for frequency bands centered from 10 to 100 kHz). After the correction for background sound pressure levels calculation of surface sound pressure level (in each one-third octave band) is carried out. Because of the big directivity of the technological ultrasonic devices, the microphone positions are associated with unequal partial areas of measurement surface. Consequently the following equation should be used to obtain the surface sound pressure level in every frequency band, L_p in dB:

$$L_p = \left(10 \lg \frac{1}{S} \sum_{i=1}^{n} S_i \cdot 10^{0,1L_i}\right) - K \quad (1)$$

where:

- L_i is the frequency band sound pressure level resulting from the i-th microphone position, in dB,
- S_i is the partial area associated with the i-th microphone position, in square metres,
- S is the total area of the measurement surface, in square metres (according to figure 1),
- K is the environmental correction, in dB,
- n is the number of microphone positions.

The partial areas S_i of the measurement surface S are calculated using the following equations:

i=1,3;	$S_i=l_2 . l_3$	(2)
i=2,4;	$S_i=l_1 . l_3$	(3)
i=5÷8;	$S_i=0,5 . \pi . d . l_3$	(4)
i=9,11;	$S_i=0,5 . \pi . d . l_2$	(5)
i=10,12;	$S_i=0,5 . \pi . d . l_1$	(6)
i=13÷16;	$S_i=0,5 . \pi . d^2$	(7)
i=17;	$S_i=l_1 . l_2$	(8)

where:

- l_1, l_2, l_3 are the dimensions of the reference box, in metres, (according to figure 1),
- d is the measurement distance, in metres.

The frequency band sound power levels, L_W, in dB, are calculated from the following equation:

$$L_W = L_p + 10 \lg \frac{S}{S_o} + \Delta\alpha \qquad (9)$$

where:

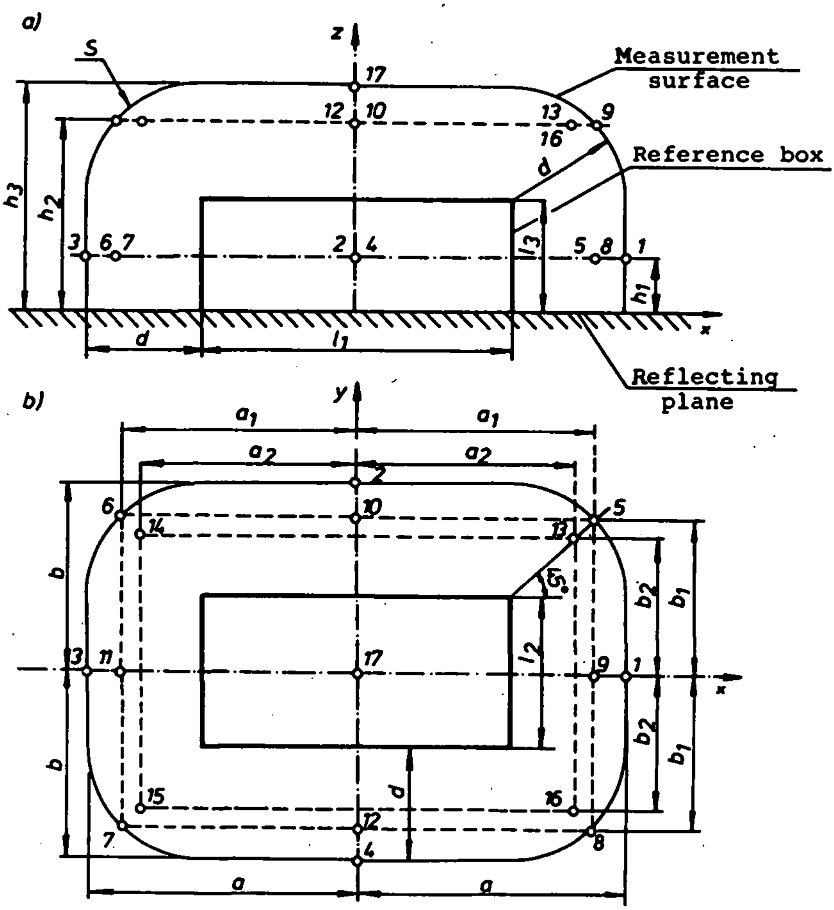
- L_p is the surface sound pressure level, in dB, calculated from the formula (1),
- S is the total area of the measurement surface, in square metres,
- $S_o = 1\ m^2$,
- $\Delta\alpha$ is the atmospheric absorbtion coefficient, in dB (the values of that coefficient for interesting frequency bands are given in discussed standard).

The evaluation of ultrasonic noise occurring at the work stations is also based on the Polish standard PN-86/N-01321 [6]. Limit values of sound pressure level at the work place for one-third octave bands from 10 kHz to 100 kHz and methods for the measurement are determined in this standard.
At this moment it is necessary to harmonize Polish standards with ISO and EN standards and put into execution EEC-directives. The prepared proposal for noise declaration of machinery in Poland is one of the steps to achieve this goal. Furthermore our Institute wants to acquire accreditation for the sound power determination of machines made according to ISO standards.

3. REFERENCES

[1]. Council Directive 86/188/EEC on the protection of workers from risks related to exposure to noise at work.
[2]. Council Directive 89/392/EEC on the approximation of the laws of the Member States relating to machinery.
[3]. Council Directive 91/368/EEC amending Directive 89/392/EEC on the approximation of the laws of the Member States relating to machinery.
[4]. Polish standard PN-87/N-01320 "Method for determination of acoustic parameters of ultrasonic devices for their attestation".

[5]. J.Koton, D.Pleban; "Optimization of methods for determination and evaluation of sound power emitted by ultrasonic devices (in the frequency range from 10 to 100 kHz)", research work of CIOP, 1986, in Polish.
[6]. Polish standard PN-86/N-01321 "Ultrasonic noise. Admissible sound pressure levels at work place and methods for the measurements".



o - key measurement points

Figure 1.Microphone array on the conformal surface.