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ACOUSTICAL SPECIFICATION OF NEW EQUIPMENT WITH RESPECT TO NOISE POLICY

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Abstract

Increasingly, the Slovakian and European occupational health and safety legislation requires designers, manufacturers and suppliers of industrial plants and equipment to minimise hazards, such as excessive noise associated with their products, and to provide information about potential hazards. Even so, noise is still often overlooked with the result that the working environment is needlessly noisy. The purpose of this paper is to:

- *provide guidelines for the preparation of noise specifications;*
- *show how to calculate the maximum acceptable noise level for new equipment;*
- *show how to interpret noise information provided by suppliers.*

Key words

noise policy, noise manager, acceptable noise level, noise information

Introduction

A noise policy is a document laying down the general rules the organisation intends to follow in dealing with its noise problems. The most serious of these problems is the presence of hazardous noise (sufficient to cause hearing damage) in working areas. Noise can, of course, cause problems even when it does not pose a threat to hearing (for example, it can

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create difficulties in communication or concentration in office areas or provoke complaints from the organisation's neighbours), but these problems are outside the scope of this paper.

The organisation's noise control goals should be specified, for example, as follows:

- to ensure that no employee's 8-hour average noise exposure level ($L_{Aeq,8h}$) exceeds 90 dB(A) in 2011 and 85 dB(A) by 2013; and
- to ensure that no employee is exposed to impulse noise with a level exceeding 140 dB (lin) Peak.

The noise policy of an organisation also determines the roles and responsibilities of its employees. We will highlight the positions of noise managers and production engineers and give guidelines for improving the acoustical situation within a company by proper noise specification, determination of maximum acceptable noise levels and usage of a supplier's noise information.

Roles and responsibilities of production engineers and noise managers

The respective roles of the production engineer and noise manager will vary from organisation to organisation but typical roles are described below:

Production engineer

The production engineer should:

- establish the need for new equipment;
- question whether a quieter process could be substituted; and
- participate in the ultimate decision to order equipment.

Production engineer in association with noise manager

The production engineer should, in association with the noise manager:

- specify the maximum acceptable noise level;
- participate in the decision to order equipment;
- negotiate with suppliers for additional noise control as necessary;
- where required, arrange for noise measurements for evaluation and acceptance purposes; and
- participate in the decision to formally accept delivery of equipment.

Noise manager

The noise manager should coordinate the implementation of the noise policy program with overall budget planning and with other parts of an organisation's noise management program, especially the plant maintenance and replacement program.

Acoustical specification

It is necessary to specify the maximum acceptable noise level at a specified position (or positions) when the machine is operating under specified operating and acoustical conditions.

Noise level

The basic noise level to specify is the equivalent continuous A weighted sound pressure level ($L_{Aeq,T}$) measured over a complete operating cycle (or the average of several cycles). For the equipment which is likely to emit high-level impulse noise (explosive-powered tools, impact devices such as presses), it may also be necessary to specify a maximum value of linear (unweighted) peak sound pressure level.

Position

The position usually specified for noise measurements is the operator's position. However, for some machines (such as a machine for which there is no fixed operator position or a machine with a built-in operator's enclosure) it may be important to know the noise levels at other points around the machine so that exposure of the operator and the effects on others in the workplace can be properly assessed. In these cases, noise should be measured at the points around the machine at a height of 1.5 metres above the floor and/or access platform(s) and 1.0 metre from the machine itself, ignoring small projections.

Operating conditions

Specification of the operating conditions depends on the nature of the machine and its intended use, and includes such factors as speed, load, tooling, material being processed and feed rate.

Acoustical conditions

The acoustical conditions may be specified in three ways:

- The first option is to specify that the noise of the machine is to be measured under agreed conditions in an environment similar to the proposed installation site. In practice, the manufacturer's or supplier's workplace will often meet this requirement.
- The second option is to specify that the maximum acceptable noise level is not to be exceeded when the machine is installed and operating in the workplace.
- The third option is to specify that the noise of the machine is to be measured in a standard acoustical environment, such as one of those defined in a relevant international standard for machine noise measurement.

Specification of noisy items

While specific items will vary from industry to industry, quiet procedures should apply to all potentially noisy equipment. Even powered hand tools are important because they are a significant source of excessive noise in many workplaces. If the size of the organisation warrants it, consider compiling a specific list of the potentially noisy items in the industry.

Maximum acceptable noise level

Fundamentally the maximum acceptable noise level will be determined by the noise exposure level the organisation sets as its goal for working areas. In order to keep the workplace noise below a certain limit, the noise output of individual pieces of machinery will usually need to be well below that limit.

Flow chart 1 (see Figure 1) outlines a step-by-step procedure for calculating the maximum acceptable noise level for a given installation site. The following comments refer to the lettered points in Flow chart 1.

(a) In Box 1 enter the noise exposure goal [$L_{Aeq,8h}$] that the organisation has set for working areas.

(b) In Box 2 enter the present noise exposure level [$L_{Aeq,8h}$] at what will be the operator position of the new machine, measured when the machine it is to replace is not running.

(c) If the value in Box 1 exceeds the value in Box 2 (which means the present noise in the area is below the goal), use the "Subtracting Decibels Table" on the flow chart to subtract the level in Box 2 from the level in Box 1 and enter the result in Box 4.

(d) For example, if the level in Box 1 is 85 dB(A) and the level in Box 2 is 80 dB(A), by using the "Subtracting Decibels Table" the level to be entered in box 4 is 83 dB(A). If the value in Box 2 exceeds the value in Box 1, the present noise in the area is above the goal, and therefore needs to be reduced. Estimate the level that will exist in the area after feasible engineering controls have been installed and enter it in Box 3.

- (d1) If the value in Box 3 is lower than the value in Box 1 (that is, anticipated engineering controls will reduce the noise in the area below the goal), use the "Subtracting Decibels Table" to subtract the value in Box 3 from the value in Box and enter the result in Box 4. The result is the maximum noise exposure level that can be introduced into the treated noise environment without causing the noise goal to be exceeded.
- (d2) If the value in Box 3 is higher than the value in Box 1 (that is, after the installation of feasible controls the noise in the area will still exceed the goal), reduce the value in Box 3 by 10 dB(A) and enter the result in Box 4. This will ensure that after feasible controls have been introduced, installation of new equipment will have a minimal effect (the increase will be less than 0.5 dB(A)) on the noise exposure level in the area.

(e) Subtract 0, 3 or 5 dB(A) from the value in Box 4, depending on whether 1, 2, or 3 or more machines respectively will be installed either now or in the future, and enter the result in Box 5. This correction allows for the additive effects of noise from adjacent sources.

(f) The value in Box 5 is the maximum level that can be tolerated from an individual machine over its working lifetime.

(g) Since the noise emitted by a machine normally increases with wear and tear, it is desirable to specify for a new machine a somewhat lower limit than the calculated maximum acceptable value. A correction of 2 dB(A) allows a small margin for wear and tear and produces the final result in Box 6.

(h) This is the maximum acceptable noise level to specify for a new machine.

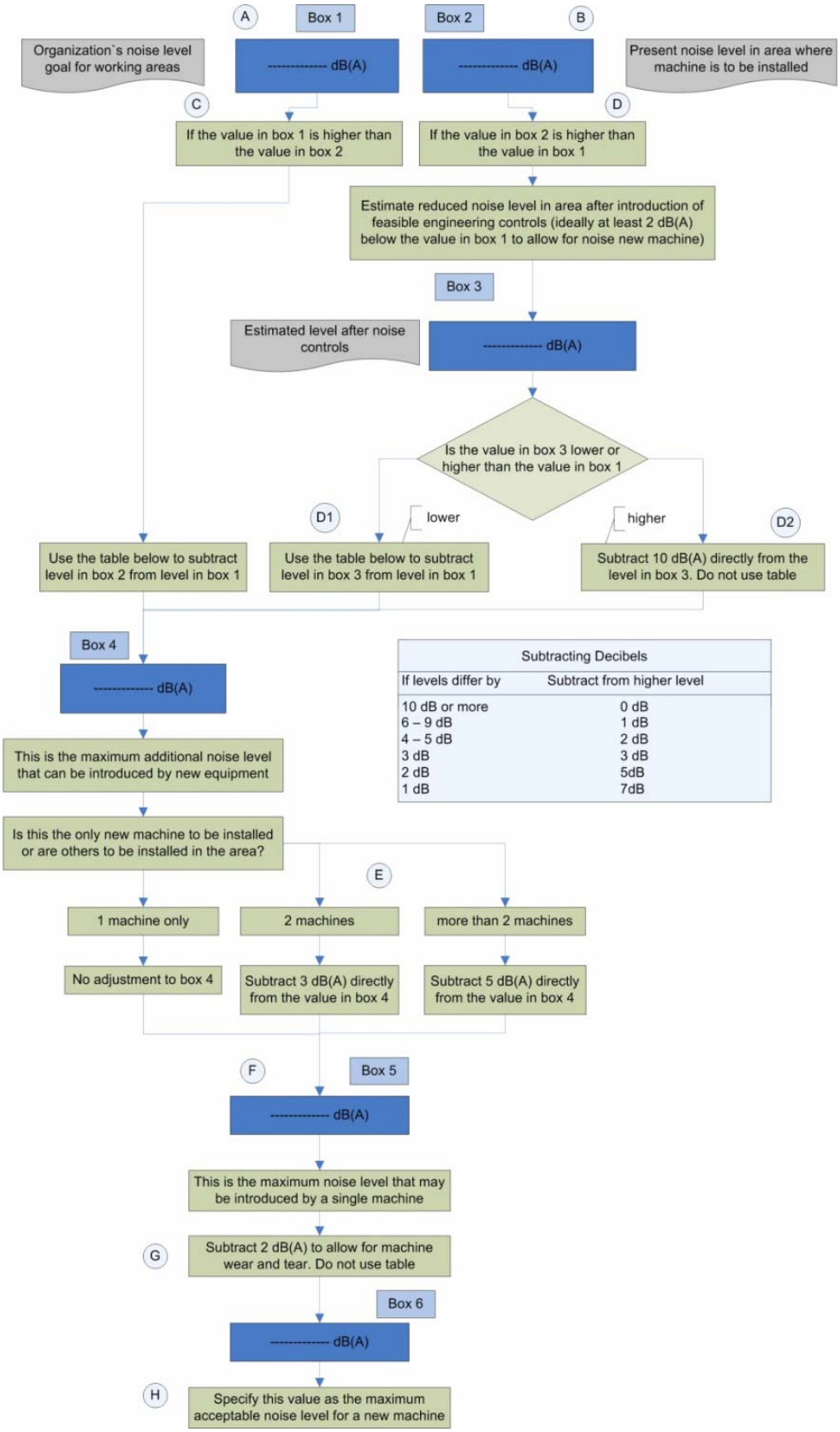

Fig. 1 *Calculation of maximum acceptable noise level for a new machine*

The calculation method in Flow chart 1 ensures that the new machine can be used for up to 8 hours per day without causing the noise exposure goal to be exceeded. If it is certain that the machine will be used for fewer hours every day, higher noise levels, calculated according to the 3 dB rule, could be tolerated without infringing the noise exposure goal. For example, if the machine will never be used for more than 2 hours a day, a maximum acceptable noise level 6 dB(A) higher than the value calculated in Box 6 (for 8 hours) would be tolerable.

Generally, in cases where a machine will be used (or people will be exposed to its noise) for less than 8 hours a day, we should consider specifying a range of acceptable noise levels encompassing its expected actual use and its potential daily use. If the value in Box 6 is 78 dB(A), but the machine will probably never be used for more than 2 hours a day, we should specify 78 dB(A) as the maximum preferred level, thus allowing for increased use/exposure at some time in the future, say as a result of expansion, and 84 dB(A) as the maximum acceptable level.

When comparing noise emission levels quoted by suppliers with the maximum acceptable noise level, we should check the conditions under which the supplier's noise measurements have been obtained. Noise levels appearing in a supplier's data sheet may have been measured under non-representative conditions (for example, a light to medium load on a machine installed in non-reverberant surroundings). At the workplace, it is more likely that the surroundings will be reverberant and that the machine will be run at full load. To allow for these effects, 4 dB(A) should be added to the supplier's noise measurements unless it is clear that they were made under typical working conditions.

Using suppliers' noise information

International standard methods are now available for measuring and describing the noise emission of industrial machines. It is best if suppliers' noise data have been measured according to one of these standards. Measurements made according to other procedures may, however, be acceptable if performed by a competent person according to a clearly defined procedure.

Flow chart 2 (see Fig. 2) presents a method for using supplier's noise information to estimate the amount of noise a given machine will introduce into the workplace:

(a) Enter the supplier's noise measurement result in Box 1.

(b) Refer to the supplier's noise information sheet to determine whether the noise was measured as a sound pressure level or a sound power level.

(c) If measured as a sound pressure level, make no adjustment. However, if supplier's sound pressure level data are for positions at larger distances than the operator's location, seek expert advice.

(d) If measured as a sound power level, subtract 8 dB(A) from the value in Box 1 and enter the result in Box 2.

(e) Refer to the supplier's noise information sheet for a description of the conditions under which the noise measurement was made.

(f) If the test conditions appear to have been representative of typical working conditions (for example, machines are installed in reverberant surroundings, have suffered some wear and tear and are run fully loaded), no adjustment is necessary.

(g) If the test conditions are not representative (for example, the test machine is in new condition and is run on less than full load in non-reverberant surroundings) add a 6 dB(A) correction to the value in Box 2 and enter the result in Box 3. If the test conditions are partially, but not fully, representative of the working conditions, select an appropriate correction between 0 and 6 dB(A).

(h) The value in Box 3 is the estimated noise level the machine will introduce into the area in which it is installed. This value is an estimate and that variations of 5 dB(A) are possible.

(i) The noise introduced by the new machine will combine with the noise already present in the area. To calculate the new noise level in the area, enter the present noise level in the installation area in Box 4, then use the "Adding Decibels Table" to combine the levels in Boxes 3 and 4. For example: if a machine with a noise level of 78 dB(A) is introduced into an area where the existing noise level is 80 dB(A), by using the "Adding Decibels Table" the new noise level in the area will be 82 dB(A).

Lack of supplier information

It may be possible to arrange for noise measurements to be made of the same model of machine already installed elsewhere or of a machine set up in the supplier's workshop. The supplier may be prepared to meet or at least share the cost of having the measurements made since the information would be useful in relation to future product promotion and sales.

Failure to meet noise specifications

As a matter of policy, plant which fails to meet the noise specification should be accepted only with the written approval of a senior manager who should check that:

- efforts have been made to locate alternative suppliers;
- negotiations have been held with tenderers to determine the feasibility of additional noise control work on their products and the availability of noise-reducing accessories;
- the equipment is to be supplied with the maximum affordable amount of noise reduction treatment in order to minimise noise emission in the workplace;
- consideration has been given to the design of the area in which the new equipment is to be installed to ensure that operator exposure levels will be as low as workable.

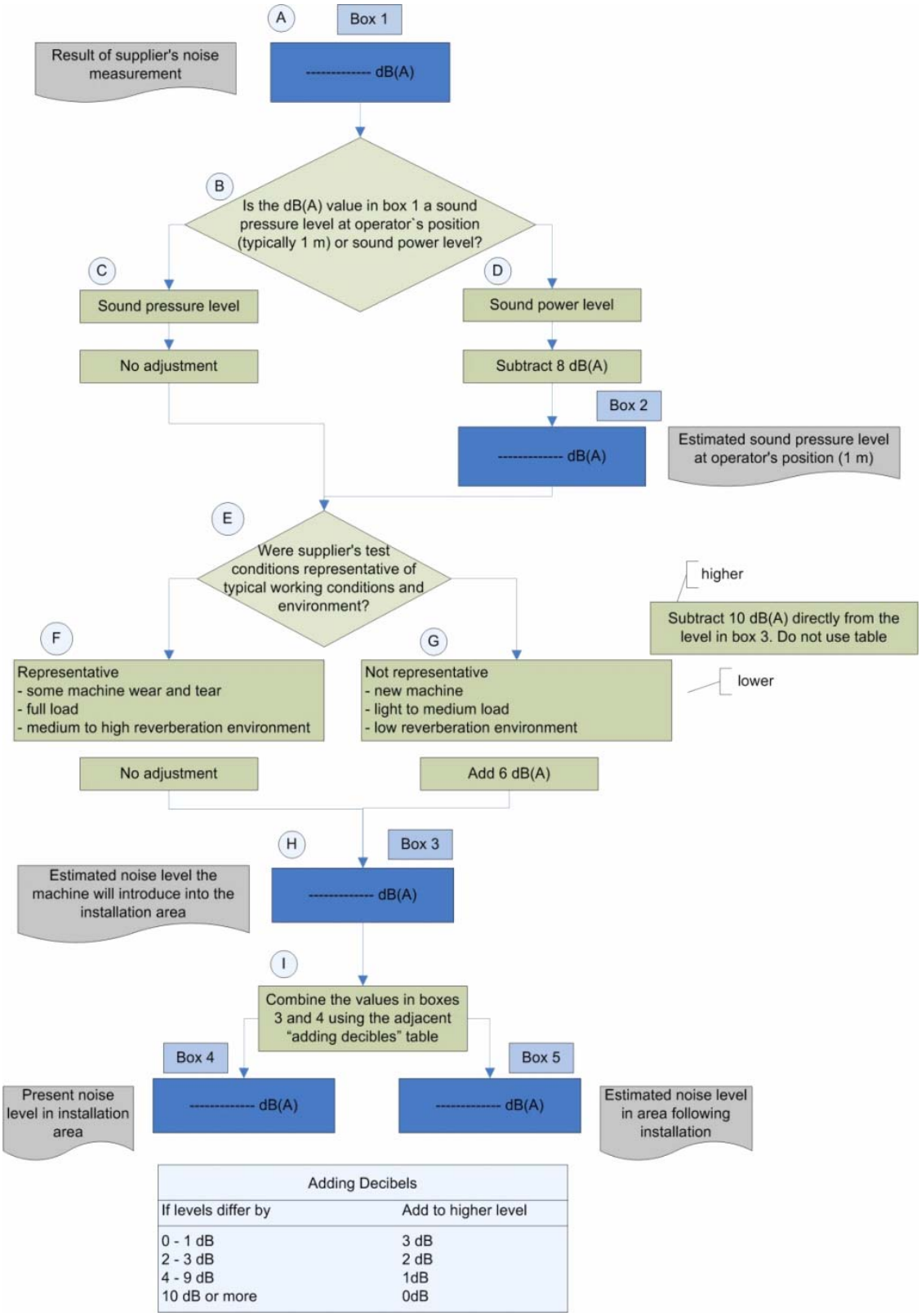

Fig. 2 *Estimation of the amount of noise a given machine will introduce into the workplace*

Conclusion

The relevant noise manager(s) and production/engineering staff should be able to:

- identify which machines or tasks contribute most to the overall noise exposure of operators;
- estimate how much noise reduction is required;
- compare the effectiveness and cost of various treatment options; and
- select the most cost-effective treatment, taking account of significant non-noise factors such as other health and safety considerations and productivity.

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