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Toolbox noise and provisions in metal working industry

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861 ABSTRACT

Employees in metal working industry are often exposed to high noise levels. Noise limits regarding occupational noise are in general related to the daily dose of workers. In this type of industry the daily dose is hard to obtain by measurements due to the great variety in activities and equipment. To enable firms to determine the daily dose of workers a specific toolbox has been developed. Based on an estimate of activities and their duration this toolbox derives the daily dose and highlights the most dominant sound sources and activities. In the toolbox also the effect of room acoustics and the contributions due to activities of co-workers are taken into account. If noise limits are exceeded, the toolbox provides specific measures for each activity to reduce the noise levels, giving detailed information about the amount of reduction of the daily dose to be expected. Also the effect of organisational and room acoustical measures are described, including the expected reductions. The toolbox is part of a program issued by the government and branch organisations that also deals with other occupational aspects.

1 INTRODUCTION

High noise levels in metal working industry form a real threat to hearing abilities of workers. Legislation aims at reducing the risk of hearing damage. However, providing relevant information to employers and health coaches is considered as an equally important part in achieving this goal. This information should give insight in the scale of the noise problem in the own company as well as feasible sound reducing measures and their effect. By order of branch organisations and in co-operation with a software firm a web based digital tool has been developed by which this information is made available in an easy way.

2 LEGISLATION ON LIMITS TO OCCUPATIONAL NOISE

Noise at Work Directive 2003/10/EC [1] lays down minimum requirements for the protection of workers from risks to their health and safety arising or likely to arise from exposure to noise and in particular the risk to hearing. The Directive was formally adopted in November 2002 which allowed members of the European Union three years to bring in the new Directive as Legislation. The Member States are to comply with this Directive before 15 February 2006. However, there may have an additional period of five years from 15 February 2006 with regard to limit values for personnel on board seagoing vessels. And, for the music and entertainment sectors, member states have a maximum transitional period of two years

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from 15 February 2006 (i.e. five years in total) to comply with this Directive, provided that, in the meantime, the levels of protection already achieved are maintained.

In The Netherlands the new regulations were introduced in February 2006, and repeal the existing Noise at Work Regulations.

For the purposes of the Directive, the physical parameters used as risk predictors are defined as follows:

(a) peak sound pressure (p_{peak}): maximum value of the "C"-frequency weighted instantaneous noise pressure;
(b) daily noise exposure level ($L_{EX,8h}$) (dB(A) re. 20 µPa): time-weighted average of the noise exposure levels for a nominal eight-hour working day as defined by international standard ISO 1999: 1990, point 3.6 [2]. It covers all noises present at work, including impulsive noise;
(c) weekly noise exposure level ($L_{EX,8h}$): time-weighted average of the daily noise exposure levels for a nominal week of five eight-hour working days as defined by international standard ISO 1999: 1990, point 3.6 (note 2).

In the Directive, the following limit and action values are defined:

(a) exposure limit values: $L_{EX,8h}$ = 87 dB(A) and p_{peak} = 200 Pa respectively;
(b) upper exposure action values: $L_{EX,8h}$ = 85 dB(A) and p_{peak} = 140 Pa respectively;
(c) lower exposure action values: $L_{EX,8h}$ = 80 dB(A) and p_{peak} = 112 Pa respectively.

By this the 1st and 2nd Action Levels in former European regulations have been reduced by 5 dB(A) to 80 dB(A) and 85 dB(A) respectively. A Maximum Exposure Level Limit of 87 dB(A) and 140 dB(C) peak at the ear has been introduced which includes the effect of any hearing protection.

3 SPECIFIC APPLICATION IN DUTCH SITUATION

Besides legislation regarding limits and regulations about different subjects, in the Dutch legislation so-called Labour policy regulations are introduced. If a firm complies with these regulations, the Labour Inspectorate will approve of the situation. If the firm does not comply but has applied alternative measures, it has to prove that the same level of protection is achieved. If they are not able to prove that, they can expect to be fined.

Since some time these Labour policy regulations are subject to criticism, since they are too rigid and do not take into account the feasibility of measures in specific situations.

Moreover, it is felt that legislation alone is not sufficient to reduce the risk of harmful noise. Co-operation and agreement between employers and employees about the practicable ways to reduce the noise is expected to provide a more effective way to achieve real results. The Dutch government stimulates the making of so-called Labour Circumstance Catalogues for different branches of industry. Each Catalogue does not only concern noise but also other topics that are considered to be relevant for the specific branch. In the Catalogue branches define measures which are generally accepted as feasible and can be considered as state of the art.

The changed Labour Circumstance Law came into force by the first of January 2007. Starting from that date branches have 3 years to make a Catalogue. If the branch succeeds in that, the Labour policy regulations are no longer valid for that specific branch. The Labour Inspectorate will mainly assess the firm according to the mutual agreed measures in the Catalogue.

At this moment five pilots concerning the development of a Catalogue are supported by the Government. Experience with this will be useful for other initiatives in this field.

An important part of the introduction of the Catalogue concerns the specific ways by which the information is shared to the interested parties. Living in a digital era the use of internet provides a useful instrument of communication.

4 DIGITAL TOOLBOX

4.1 General introduction

Our company has developed software by which firms are able to determine the exposure to harmful noise in their own company, not only for the metal working industry. By means of this toolbox the daily dose can be determined and assessed in relation to legal limits. Furthermore an overview is provided of the main dominant noise sources. The toolbox is connected to a digital data file of feasible noise reducing provisions, describing the principles of those provisions. For each provision an estimate is given of the noise reduction to be expected, as well as an estimate of the cost of the provision and the influence on the production process. Combination of measures can be derived to reduce the daily dose.

This digital toolbox is incorporated in the so-called “improvement check on noise”, which again is part of a greater program on improvement of labour circumstances.

This “improvement check on noise” provides information about:

- situations within the company where noisy activities take place such as grinding, welding, use of compressed air, use of pneumatic tools, sawing etcetera.
- activities that take place within the company for which personal hearing protection is provided to employees or are have to be applied in a obligatory way.

It starts to inform the user about the aims, usability and accuracy.

4.2 Technical background

The toolbox contains average noise levels as occur during the application of specific equipment. These average values are based on extensive surveys of occupational noise exposure in the metal working industry by our company [3, 4]. The average noise reduction of specified measures is also based on practical experience as well as product information of manufacturers.

The contribution of background noise in daily dose calculations takes into account the dimensions of the specific department, and the room acoustical characteristics especially the finishing of walls and ceiling/roof.

4.3 Software structure

4.3.1 Program steps

In the program the following steps have to be taken:

- log in to the specific website
- if wanted: reading the general introduction to the program
- completing forms regarding:
  - general information about the company
  - defining departments of interest
  - choosing calculation alternative A or B
  - input for specific (groups of) employees
  - selecting measures already implemented/ to be added
- calculation of daily dose
- improvement plan
- assessment

In the following the different steps are discussed in more detail.

4.3.2 Introduction

The tool box ("improvement check") starts with a short introduction, containing:

- general background of the toolbox,
- introduction to harmful noise,
- which firms should use the toolbox,
- time needed to process the toolbox,
- accuracy of the results,
- more general information about noise.

The time needed to complete the "improvement check" is about 30 to 40 minutes for small companies (less than 20 employees) and up to 1 hour for larger companies.

The importance of correct input is emphasized, because it strongly influences the accuracy of daily dose calculation. The period of time that employers are present in specific departments where they are exposed to high noise levels respectively the duration of activities have to be determined by the user. The average sound levels per activity are provided by the program and are based on many investigations in practice. Because no measurements are carried out in the specific situation, the derived daily dose is a statistical approximation and not an exact calculation of the real situation (if that might ever be possible to determine because of the permanent change of activities and circumstances). However, the calculation of the daily dose is accurate enough to provide necessary information regarding the occupational noise situation.

If in a specific situation other noisy activities take place that are not incorporated in this "improvement check", the outcome is not accurate, and additional action should be taken. If this is the case the user is made aware of it.

4.3.3 Specification of departments and activities

After the general introduction the user has to determine which departments are involved. For each department the user has to specify the dimensions, as well as:

- the general noise sources involved,
- the different activities taking place.

Figure 1 shows a part of the list to be completed in this chapter.
To calculate the daily dose the user has to choose between two alternatives:

- alternative A: calculation of daily dose on an individual base; for each employee an analysis of daily tasks has to be made, concerning duration of time in different departments and the activities involved. It is especially meant for smaller and middle range firms where employees circulate between departments.
- Alternative B: calculation of the daily dose for each separate department based on activities of an average worker in that department. It is especially meant for larger firms where specialisation of activities of workers is the case: employees in each department have roughly the same schedule of activities and connected period of times.

In calculating the daily dose the following noise contributions are taken into account:

- the own activities,
- nearby activities and use of equipment,
- reverberation noise level due to other noise sources which contribute to the overall background noise.

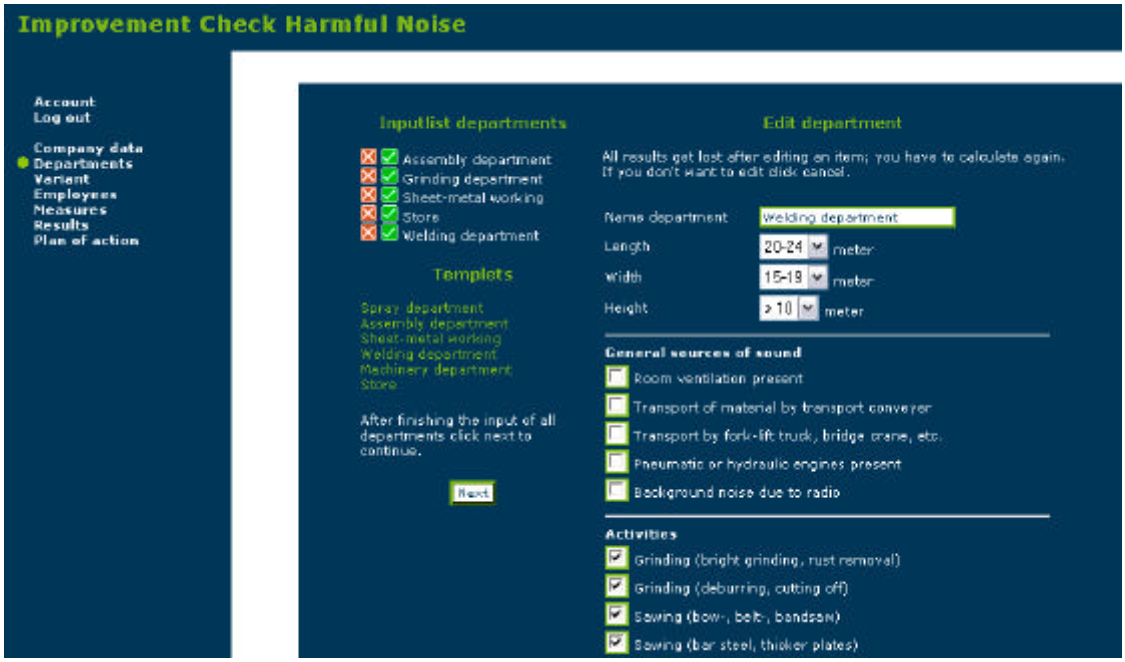

Figure 1. Example of part of list to be completed

For the employees the average duration of each activity has to be defined, based on an weekly-averaged 8 hours working day. To help the user completing the form, the program suggests for each activity a representative duration of time, based on practical experience in many firms. Although the user has to make his own decision, it functions as reference and over exaggerated values are also prevented by this. Figure 2 shows an example of this form.

Figure 2. Example of form concerning activity analysis

Sound reducing measures already taken in the existing situation have to be incorporated also.

4.3.4 Calculation of daily dose

Based on the completed form the daily dose is calculated regarding the existing situation. Besides the daily dose it also provides the separate contributions of the main three activities. The daily dose is compared with the noise limits. Furthermore a more general judgement of the results is given, taking into consideration the sound reducing measures applied already and the state of the art regarding feasible measures.
Figure 3 shows an example of calculation results.

Results variant A: Existing

Employee	Daily dose	Top 3 contribution 1		Top 3 contribution 2		Top 3 contribution 3	
Jerry	96	89	Cutting off, deburring	89	Cutting off, deburring	87	Cutting off, deburring
John	97	92	Cutting off, deburring	92	Cutting off, deburring	85	Sawing (circular sawing,non-ferro plate material)

Figure 3. Example of calculated daily dose

4.3.5 Selecting additional sound reducing measures and calculation of the effect

For most activities specific measures to reduce the sound emission are described. For the selected 3 activities with the most dominant contribution to the daily dose specific measures can be selected. Besides that, sound reducing measures for each activity involved can be selected. Based on the sound reducing effect of the selected measures the daily dose is recalculated, and compared with the original situation. Figure 4 shows an example of such an exercise.

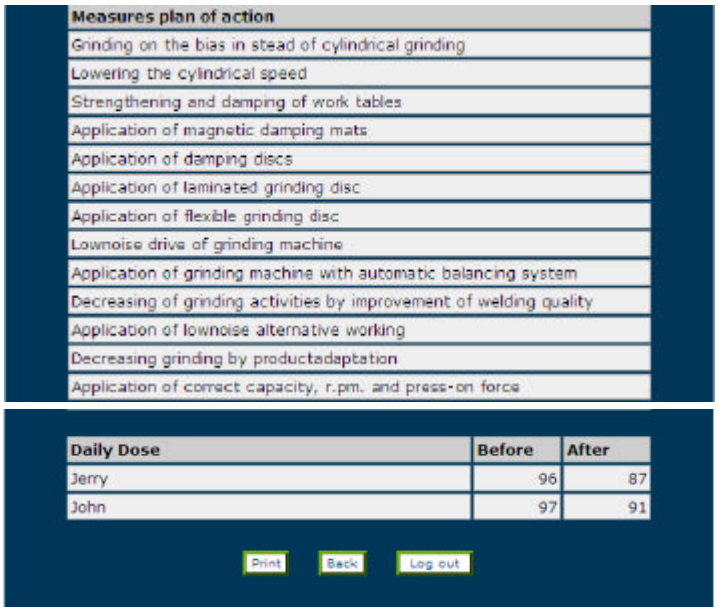

Figure 4. Example of calculated effect of specified sound reducing measures.

For each measure also other relevant information is offered such as:

- short description of measure,
- conditions regarding the usability,
- sound reduction to be expected,
- applicability in practice,
- validity (proven measure) and effectiveness,

- estimate of investment cost and potential financial benefits,
- influence on production process,
- potential environmental consequences.

Figure 5 shows an example of such a data sheet.

Application of laminated grinding discs

Description:	Laminated grinding discs make less noise than ceramic bounded grinding discs
Reference:	Recommended by Metal branche. If this solution is not possible, use flexible grinding discs, low noise grinding discs, heavy damped working tables or magnetic damping mats.
Activity:	Grinding
Applicability:	The applicability of laminated grinding discs is good. They are used for deburring, rust removal, final finishing of welds. They are unfit for heavy grinding, like cutting-off grinding.
Validity:	Practice proves that the solution is effective
Effectiveness:	The measure is effective. The result is a noiselevel reduction of 7 to 15 decibel
Costs and benefits:	Costs: Initial expense is 25 % higher than standard ceramic grinding discs. Standing time grinding discs is shorter. Benefits: Increased quality of the grinded surface Increase of costs of the total grinding 6 to 8 %
Environment	Environmental advantage: less noise

Figure 5. Data sheet of a sound reducing measure

5 CONCLUSIONS

A toolbox regarding occupational noise for the metal working industry has been developed, enabling the calculation of the daily dose of workers, the most dominant noise sources and practical measures to reduce the noise levels. It provides a practical way of investigating the own noise situation, and gives extensive information about proven and specific provisions to reduce the noise.

This methodology can be used for other branches also, especially where more or less the same situations occur regarding high noise levels in combination with a large variety of activities and equipment.

6 REFERENCES

[1] Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise).

[2] Acoustics - Determination of occupational noise exposure and estimation of noise-induced hearing impairment, ISO 1999: 1990.

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[4] J.H. Granneman, J.P.J. Oostdijk and F.A.G.M. Schermer, “Extensive survey of occupational noise exposure in the metal working industry," Internoise (2004).