"DETECTSOUND" and "dBOHS": A software package for the analysis of health and safety in noisy workplaces

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1. Introduction

Every year serious injuries occur in noisy workplaces because a warning signal is not heard. Very few practical tools allowing direct prediction of the ability to detect acoustic signals in noisy environments are available. The Groupe d'Acoustique de l'Univesité de Montréal (GAUM) has developped a computerized model called DETECTSOUND which runs on an IBM-PC compatible and which can predict the capability of workers to detect auditory warning signals in noise. To run DETECTSOUND, it is necessary to obtain 1/3 octave band levels at each work station. dBOHS was designed to obtain this information from a recording made on the site using a digital audio-tape recorder and a hand-held controller. The following paragraphs present the main characteristics of each software.

2. DETECTSOUND software

DETECTSOUND allows user to:

1) Specify the characteristics of warning sounds to be installed in a workplace;

2) Evaluate the effectiveness of the warning sounds in use in a workplace.

The foundations of the model have been presented in a previous paper [1].

DETECTSOUND takes into account the following information:

- the background noise at each workstation (1/3 octave band levels from 25 to 12 500 Hz);
- the hearing protectors worn by a standard individual or by specific individuals (attenuation in dB from 63 to 8000 Hz);
- the audiogram of a standard individual or the actual individuals assigned to a workstation (hearing thresholds from 125 to 8000 Hz);
- all warning sounds that can be heard at the station (1/3 octave band levels from 25 to 12 500 Hz).

A standard individual refers to five different stages of hearing loss, stage 0 meaning normal hearing for a 50 years old man and stage 4 meaning an advanced level of noise-induced hearing loss.

The loss of frequency selectivity is also taken into account in the software. It is statistically related to the loss of sensitivity. In fact, the user do not have to enter this information. It is automatically computed based on the hearing thresholds.[2]

When these informations are entered in their specific table forms and computed together, the results are displayed in a graphic or a table form. Figure 1 presents an example of a graphic display.

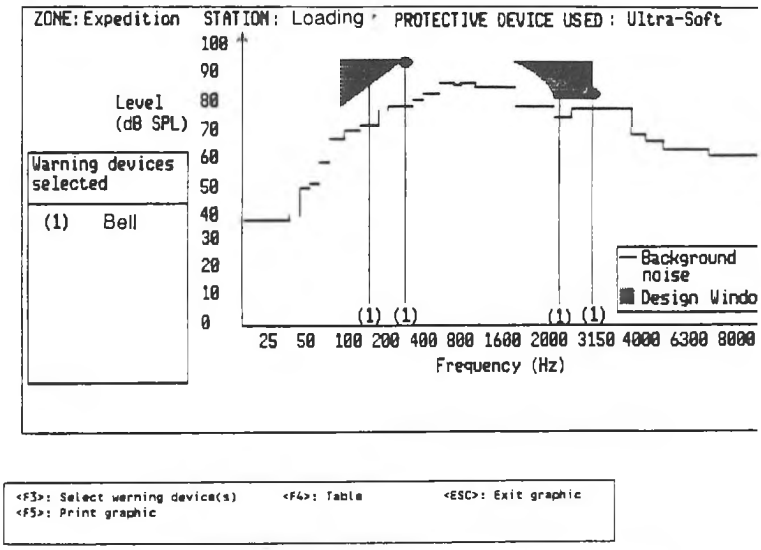

Fig.1 Graphical display of the design window for a particular workstation.

The frequency content is presented on the x axis and the level of each 1/3 octave band of the noise or the warning sound is on the y axis. The full horizontal line corresponds to the background noise level at the loading workstation of the expedition zone. The vertical lines correspond to the spectral content of the bell heard at this workstation. The dark zone represents the design window, i.e. the spectral and level region in which at least two spectral lines of a warning sound should be in order to attract attention and be recognized among different warning sounds. In this example, the bell should be well recognized by 50 years old workers (stage 0 has been used in this example) because each of the four lines are inside or at the borders of the design window. If all the spectral lines would have been below the design window, this would have meant that the spectral content of the warning sound should have been changed or the level increased . If the lines would have been over the design window, this would have meant that the warning sound level would have been too high and could have caused hearing damage, interference with communication or a startle reaction.

3. dBOHS software

dBOHS has been developped to help health and safety professionnals to make complete, rapid and automated noise measurements. It gives directly and simultaneously the noise dosis, the temporal evolution (short L_{eqs}, L_p^{Δ}) and the spectral content (in octave and 1/3 octave band levels) of the background noise and of the warning sounds. The temporal evolution of each 1/3 octave band levels is also available. These parameters are useful to evaluate the risk of acquiring hearing loss and the audibility of warning sounds in workplaces.

Recordings of background noise and warning sounds are made with a special controller plugged into a digital audio-tape recorder (DAT) at each workstation. A type 1 microphone is plugged into the controller which sends signals (calibration, sampling, pause) to the second channel of the DAT . These signals are later used by dBOHS to automatically analyse the recordings. This method is presently used by Hydro-Quebec to evaluate the noise emitted by transformer stations[3,4] and saves a lot of time to the user.

The values given by dBOHS can be directly transferred to DETECTSOUND and synthetized on a personnalized form like the one presented on figure 2.

4. Conclusion

The ultimate goal of DETECSOUND and dBOHS is to supply practical, reliable and rapid means for health and safety personel to assess the audibility of warning sounds and the risk of acquiring hearing loss. Both software run on IBM-PC compatibles and are user-friendly. GAUM is now working on an upgraded version of DETECSOUND to allow users to enter individual data on frequency selectivity.

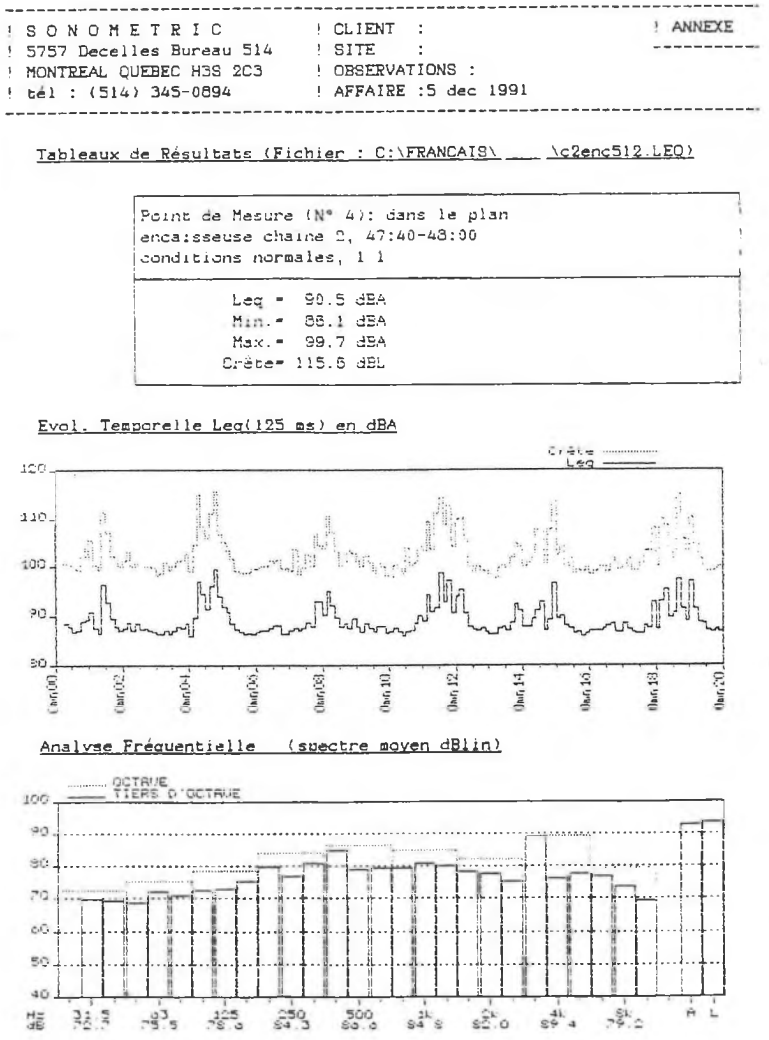

Fig.2 Example of a dBOHS form. Table of results, temporal evolution and spectral content.

Acknowledgments

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References

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