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## Methodological aspects in the determination of the auditory filters and critical band at low and mid-frequencies

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6:20

**2aPPa22. Noise perception of wall-hung gas boilers.** Patrick Chevret (01dB-Metravib, 200 Chemin des Ormeaux, 69578 Limonest Cedex, France, patrick.chevret@01db-metravib.com), Anne Coulon (CETIAT, Domaine Scientifique de la Doua, 25 avenue des Arts, BP 2042, F-69603 Villeurbanne cedex, France, anne.coulon@cetiat.fr), François Bessac (CETIAT, Domaine Scientifique de la Doua, 25 avenue des Arts, BP 2042, F-69603 Villeurbanne cedex, France, francois.bessac@cetiat.fr), Etienne Parizet (Laboratoire Vibrations Acoustique, Insa Lyon, 25 bis, av. J. Capelle, 69621 Villeurbanne Cedex, France, etienne.parizet@insa-lyon.fr)

The aim of this study is to assess the quality image for domestic wall-hung gas-fired boilers, based on their noise. Nine boilers were recorded using an acoustic manikin in a hemi-anechoic room, for different operating conditions. Two of these operating conditions (maximum heat input, hot water tapping) were first studied. Five-second sequences were presented (through headphones) to sixty listeners using the mixed assessment method allowing for the comparison between signals. Analyses showed several assessment strategies: according to listeners, the relevant noise parameters could be the loudness, the sharpness or the presence of tonal components. A second experimental phase focused on tonal components by artificially modifying some sounds to offer a relevant perceptive indicator. The results of this second experiment will also be presented.

### Invited Papers

6:40

**2aPPa23. Methodological aspects in the determination of the auditory filters and critical band at low and mid-frequencies.** Carlos A. Jurado (Acoustics, Aalborg University, Fredrik Bajers Vej 7 B5, 9220 Aalborg Ø, Denmark, cjo@es.aau.dk), Henrik Møller (Acoustics, Aalborg University, Fredrik Bajers Vej 7 B5, 9220 Aalborg Ø, Denmark, hm@acoustics.aau.dk), Christian Sejer Pedersen (Acoustics, Aalborg University, Fredrik Bajers Vej 7 B5, 9220 Aalborg Ø, Denmark, cp@acoustics.aau.dk)

In order to evaluate loudness or audibility of complex sounds, knowledge of the auditory filter characteristics is necessary. At low frequencies, where both the threshold of hearing and dynamic range become considerably frequency dependent, care must be taken to account for this both in the psycho-acoustical model and the methodological approach. To account for variation in hearing sensitivity at low frequencies, equal loudness contours have been used to weight the stimuli accordingly. At mid and high frequencies, threshold of hearing curves have been used. These stimuli weightings can be applied before or after the experiment, normally being applied afterwards. Due to the non-linear characteristics of the cochlear amplifier, it is arguable whether post-experimental weighting is a proper approach, or whether at low frequencies there will be any difference between pre or post stimuli weighting. Listening experiments are then to be performed to test possible differences in pre or post filtering the stimuli. The most appropriate approach will then be discussed. Measurements will be done at low and mid frequencies. To obtain accurate auditory filter estimates, individual ELC or threshold curves will be determined. Methods such as the notched-noise method and the classical band-widening approach will be tested with these conditions.

7:00

**2aPPa24. Effect of recording/playback technique and experimental method on assessments of noise.** Emine Çelik-Christensen (Aalborg University / Rockwool International A/S, Rockwool International, Building Knowledge Center, Hovedgaden 584, Entrance C, 2640 Hedehusene, Denmark, emine.christensen@rockwool.com), Kerstin Persson Waye (Dept. of Environ. Medicine, The Sahlgrenska Acad. of Gothenburg Univ., Box 414, 405 30 Gothenburg, Sweden, kerstin.persson-waye@amm.gu.se), Henrik Møller (Acoustics, Aalborg University, Fredrik Bajers Vej 7 B5, 9220 Aalborg Ø, Denmark, hm@acoustics.aau.dk)

The study investigated possible effects of recording/playback technique and experimental method on assessments of annoyance, loudness and unpleasantness. A possible effect of exposure duration was also studied. Sounds were recorded with two different techniques: monophonic and binaural (dummy-head technique). In addition, they were reproduced with three different techniques: monophonic recordings presented through a loudspeaker system, binaural recordings presented through closed (circum-aural) and completely open (free-of-the-ear headphones). The study adopted three psychometric methods for collecting responses from test-subjects. Fifty-four subjects participated, and three types of sounds were used: everyday restaurant sound, road traffic sound and ventilation sound dominated by low frequencies. Each sound was played back at three different levels. The results show that there is no significant main effect of recording and playback technique for any of the three perceptual attributes; however, significant interactions between techniques and sounds were found. Since the effect of recording and playback technique differs depending on sound, this finding is of importance for future design of experiments and interpretation of results. The results also show that long-term annoyance and unpleasantness are poorly predicted by short-duration methods.

### Contributed Papers

7:20

**2aPPa25. Relation between the overall unpleasantness of a long duration sound and the one of its event6: application to a delivery truck.** Emilie Geissner (Laboratoire Vibrations Acoustique - INSA Lyon, 25 bis avenue Jean Capelle, Bâtiment Saint-Exupéry, F-69621 Villeurbanne cedex, France, emilie.geissner@insa-lyon.fr), Etienne Parizet (Laboratoire Vibrations Acoustique, Insa Lyon, 25 bis, av. J. Capelle, 69621 Villeurbanne Cedex, France, etienne.parizet@insa-lyon.fr)

The goal of this study was to investigate the link between the unpleasantness assessment of an unstationary long duration sound composed of several distinct sound events and the corresponding judgments of each of those events. For that purpose, a sound sequence of a delivery truck was evaluated by 16 listeners during a test in laboratory: first, subjects had to continuously quantify the perceived unpleasantness of the sequence by moving a sliding cursor along a five levels graduated scale and then give a global rating by

using the same scale. In a second step, listeners had to express their overall judgment of unpleasantness for eight samples of the delivery sequence. As previously shown for loudness by Kuwano and Namba (1985), the global rating of the unpleasantness of long sound could not be estimated by the arithmetic mean of the continuous assessment. It also appeared that the overall judgment corresponds to the arithmetic mean on the local values of unpleasantness of each main sound event. This last result was similar to the conclusions of Hellbrück et al. (2001) for the loudness scaling of traffic noise.

7:40

**2aPPa26. Just noticeable differences of loudness and sharpness for earth moving machines.** Francesca Pedrielli (CNR-Imamoter, via Canal Bianco 28, 44100 Ferrara, Italy, f.pedrielli@imamoter.cnr.it), Eleonora