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# Publication of "Handbook to Deal with Low Frequency Noise (2004)"

<sup>a</sup>**Kenji KAMIGAWARA, <sup>a</sup>Jun-ichi YUE, <sup>a</sup>Teruhiko SAITO, <sup>a</sup>Takashi HIRANO,**  
<sup>b</sup>**Exploratory Committee about Low Frequency Noise (Japan)**

(Yasuo Tokita, Shinji Yamada, Yukio Inukai, Yasuo Inoue, Tsuneyasu Okuma, Fumitoshi

Okiyama, Toshihiko Sato, Masazumi Shioda, Youichi Suzuki, Tsutae Sebayashi, Sho Hirose, Nobuo Machida, Hiroaki Ochiai)

<sup>a</sup>Ministry of the Environment, 1-2-2 Kasumigaseki, Chiyodaku, Tokyo, 100-8975, Japan

<sup>b</sup>International Institute of Noise Control Engineering JAPAN, 3-20-41 Higashimotomachi, kokubunjishi, Tokyo 185-0022, Japan

<sup>a</sup>[kenji\_kamigawara; junichi yue; teruhiko\_saito; takashi\_hirano]@env.go.jp

<sup>b</sup>office@ince-j.or.jp

In August 2002, a technical committee on Low Frequency Noise (LFN) was established in INCE/Japan in response to the commission by the Ministry of the Environment of Japan. In June 2004, the Ministry published the result of this study as "Handbook to Deal with Low Frequency Noise", and the handbook suggests "reference values to deal with complaints, about low level Low Frequency Noise from stationary sound sources". It is hoped that local governments will make use of this handbook for response to complaints, about Low Frequency Noise.

## INTRODUCTION

Recently, the number of complaints increased against low frequency noise (low LFN) arising indoors with very low SPL, just above the hearing threshold. These complaints about LFN arise from stationary sound sources such as boilers, air conditioners and power generators, etc. There is no regulation about LFN. Complaints lodged against local government can include complaints caused by tinnitus. Investigators within local government cannot judge complaints caused by LFN. There has been a gap between complainants and local government. In August 2002, the Ministry of the Environment of Japan established a technical committee of LFN in INCE/Japan. The committee carried out experiments on physical and psychological effects, and suggested reference values as criteria to judge the cause of rattling of house fittings, discomfort and sleep disturbance. The Ministry of the Environment of Japan, in June 2004, declared and published

the committee's results as a "Handbook to Deal with Low Frequency Noise". It is available at <http://www.env.go.jp/air/teishuha/manual/index.html>.

## 1. SOUND SOURCES, WHICH THE HANDBOOK TARGETS

The Ministry considers reception of statements about complaints, solution of the complaints and technical advice in the handbook. The handbook is applicable to the LFN of stationary sound sources like factory plant and facilities such as shops, which generate LFN continuously, and is not applicable to fluctuating or impulsive LFN emitted by such sources as roads, airplanes, railways, and blasts.

Reference values cannot be used also as a target value for countermeasures, environmental preservation in environmental evaluation, or work environmental guidelines.

## 2. STRUCTURE OF THE HANDBOOK

It is hoped that local governments make use of this handbook in responding to complaints about Low Frequency Noise. The Handbook has 3 parts. The outline is as follows.

- Hints for dealing with complaints against LFN

The handbook describes the reception of statements about complaints, research and measurement of LFN, evaluation, resolution of complaints and technical advice.

- Precepts of evaluation

The handbook has 2 types of reference value. One is on the rattling of house fittings and the other is on psychological effects like discomfort and sleep disturbance in a room.

- Explanation of precepts

The handbook describes the coverage of the precepts of evaluation, the use of the reference values, and the methods for measurement and evaluation of LFN.

## 3. CONTENTS OF THE HANDBOOK

The handbook deals with each stage, the reception of statements about complaints, research into and measurement of LFN and evaluation, resolution of complaints and technical advice.

### (1) FIELD SURVEY

It is important to interview complainants politely, when local government staff receive a complaint. And it is essential to observe the environment and to consider the sound sources. Afterwards, the local government staff specify by hearing (on sensing), the approximate position of the sound sources, and the existence of a correspondence between the facility operation and the content of the allegation.

### (2) MEASUREMENT

It is necessary to check measurement aspects, such as place, time and background. In the measurement of LFN, the "Manual for measurement of LFN (published in 2000 by the Ministry)" should be referred to. It is desirable that the LFN is measured at the time of operation and non-operation of the facility with the manager of the facility and the complainant.

### (3) EVALUATION METHODS

The Ministry of the Environment of Japan indicates two sorts of reference values to judge whether LFN exists or not when an allegation is made. One reference value is for the rattling of house fittings and the other is for the psychological effects of discomfort and sleep disturbance. These reference values are adopted when the correspondence between the facility operation and the content of allegation is established. Evaluation methods are as follows.

Table.I Reference values for Complaints of Rattling

1/3oct.band center frequency(Hz)	5	6.3	8	10	12.5	16	20	25	31.5	40	50
1/3oct.band sound pressure level(dB)	70	71	72	73	75	77	80	83	87	93	99

Table.II Reference values for Complaints of Mental and Physical Discomfort

1/3oct.band center frequency(Hz)	10	12.5	16	20	25	31.5	40	50	63	80
1/3oct.band sound pressure level(dB)	92	88	83	76	70	64	57	52	47	41

### 3.1 Complaints of rattling

Doors and window fittings have characteristic frequencies. Rattling of house fittings tends to take place when the frequency of the LFN coincides with the resonant frequency of the house fittings. The result of a laboratory experiments carried out in the past shows that the threshold of rattling has a range of 30dB to 40dB at each fitting. The reference value for the rattling of doors or windows is "mean minus standard deviation". This value agrees well with the formerly used "Rattling threshold of house fittings".

Evaluation is made by comparing the measured value with the reference value on rattling of doors or windows. When  $\frac{1}{3}$  octave band sound pressure levels exceed the reference value for rattling of doors or windows (Table I) in any frequency band, it is highly possible that this frequency band is the cause of the complaint. If  $\frac{1}{3}$  octave band sound pressure levels are less than the reference value for complaints of rattling, however, rattling will occur rarely. In this case, it is necessary to look for another cause, for example ground vibration or noise, for the complaints.

### 3.2 Complaints of mental and physical discomfort

There are great differences between individuals with respect to the perception of LFN. From the results of experiments in a low frequency chamber, the 10th percentile of acceptability for ordinary adults similar to the acceptable limit for complainants. So the handbook prescribes this 10<sup>th</sup> percentile as the reference value for mental and physical discomfort.

Evaluation is done by comparing measured values with the reference value for mental and physical discomfort (mainly for psychological complaints). If the  $\frac{1}{3}$  octave band sound pressure level is higher than or equal to the reference values for mental and physical discomfort (Table II), at any

frequency band, it is highly likely that the frequency band is the cause of the complaint. Additionally, if the measured G-weighted level is 92dB (G) or higher, it is highly likely that there is an effect from infrasound. If the measured value is less than the reference value at every frequency, noise, ground vibration, and other factors are needed to be surveyed.

### (4) COUNTERMEASURES AND FOLLOW-UP MEASUREMENTS

If there is a causal relationship between the operation of the source and the complaints, and the measured value exceeds the reference value, consideration of countermeasures is necessary. Officials of local government should take the following steps:-

- Mediate between the source and the complainant and arrange for discussions.

- Provide the source with data, etc. to develop effective countermeasures.

- Advise the source about countermeasures including changing the operating time of the facilities.

- Ask experts for their cooperation

When countermeasures are carried out, it is important to obtain the complainants' agreement about the method and the time of countermeasures. After conclusion of the countermeasures, the researcher and local government should explain carefully the measured result to the owner of the sound source and to the complainant.

## 4. SUPPORT FOR LOCAL GOVERNMENT TO DEAL WITH COMPLAINTS

Law of Environmental Pollution Disputes requires the settlement of complaints made to local government concerning environmental pollution, including noise. In order to deal with complaints concerning LFN, local

governments should utilize this handbook in addition to "The manual for measurement of LFN" published in 2000 and "The casebook on countermeasures to LFN" published in 2002. In order to support local government in dealing with complaints concerning LFN, the Ministry is also planning to provide adequate information, to publish Q~A, and to hold seminars for officials of local government, introducing experts on LFN to local government.

### CONCLUSION

The Ministry of the Environment published a handbook, which was prepared by INCE/J, to support local government in dealing with complaints on LFN. The Handbook shows the reference values based on the experiments by Inukai. The purpose of the reference values is to judge whether LFN is the real cause of problems or not. Hence the reference values are not the target values for countermeasure or for environmental preservation in

environmental evaluation or work for environment guidelines. From this year (2004) the Ministry will hold seminars in several cities to introduce the Handbook to officials of local government. The Ministry will review the Handbook in future on hearing comments from local governments, which implement the Handbook, and also by collecting information from foreign countries.

### REFERENCES

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### NEW AERO-ACOUSTIC TECHNOLOGY FROM MERCEDES-BENZ

Mercedes-Benz says it has built the quietest CL-Class model with the application of new aero-acoustic technology including a three-metre parabolic mirror. Engineers designed more airflow-efficient A-pillars and a new sealing concept for the doors using the technology, the car maker says. Mercedes engineers created a three-metre parabolic mirror which acts as a sound reflector and fitted it with numerous microphones. From a distance of five metres, the microphones at the focal point of the mirror record the noises caused by the airstream as it passes around the vehicle body. In the past numerous individual sound measurements were required while the parabolic mirror process requires only a single measurement to examine complete areas of the vehicle body. Aeroacoustics is a relatively new field in automotive research, with the aim of reducing wind noise, also seeking to establish how drivers and passengers perceive the level of acoustic comfort.

### DETROIT METROPOLITAN

A program to provide sound insulation for more than 2,400 homes and seven schools near Detroit Metropolitan Airport has been completed. The program is part of a larger plan put into place by the airport to reduce noise that includes the installation of berms around the airport's perimeter and modified air traffic control procedures. Over 14 years, more than \$118 million has been spent around the airport to reduce noise. Nearly \$76 million of that was spent on sound insulation for homes in the locality.