HOW TO PREPARE NOISE EMISSION TEST CODES FOR A SPECIFIC MACHINERY FAMILY

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1. INTRODUCTION

Since more than 20 years ISO/TC43/SC1 "Acoustics, Noise" is establishing and harmonizing several so called "frame" standards dealing with the measurement, declaration and verification of noise emission values. These standards describe b a s i c methods only and consequently are not related to a s p e c i f i c machinery family directly. In order to have definite and unambiguous procedures for a given machinery or equipment it is necessary to select the most appropriate frame standard and to establish several additional specific requirements. Whilst the system of frame standards are completed and will be updated till to the end of this year finally, machinery specifc noise emissions standards, called noise test codes, exist for a limited number of machinery/equipment groups only and these standards are not in full line with the requirements given by the new ISO Draft Standard 12 XXX "Acoustics - Noise emitted by machinery and equipment - Rules for drafting and presentation of a noise test code" /1/. This paper informs about this Guideline-Standard and gives some interpretations.

2. GENERAL

The content of a noise test code according /1/ should cover the following three main aspects:

- the clear description of the machinery family being under consideration
- the noise emission measurement procedure(s) which may be used
- rules for declaring and verifying noise emission quantities.

3. DESCRIPTION OF THE MACHINERY FAMILY

The family, sub-family or type of machinery/equipment covered by the test code shall be described unambiously and in detail. Furthermore the following aspects should be taken into consideration:

Identify any auxiliary equipment if necessary for the operation of the machine/equipment under test and decide whether these noise sources are to be included into the noise radiation of the "main machine"

Optional components, devices, ... which may operate together with the sources should be specified and finally decided about their operation during the noise test.

PREPARATION OF NOISE TEST CODES

Sometimes it is suitable to limit the field of application of a noise test code totally or partially to certain ranges of sizes, capacities or powers of the machinery/equipment. If so these ranges should be defined clearly.

For machines which can be measured in the presence of one or more coupled machine only special requirements are necessary.

4. NOISE EMISSION QUANTITIES

The quantity describing the airborne noise radiated into the total space surrounding the machine is its sound power level. This quantity is mainly expressed as A-weighted sound power level L_{WA} in dB and may be supplemented by the sound power level spectrum given for an adequate band-width.

In cases where the machine/equipment usually operates under (approximate) free field conditions and where a workplace in the vicinity of the machinery exists it is appropriate to measure the A-weighted sound pressure level at this well defined location. Under these conditions this emission sound pressure level is a useful supplement to the main noise emission quantity means to the sound power level. Contrary to this rank order an EEC-Directive /2/ requires the use of the emission sound pressure level alone if the sound pressure levels are below 85 dB(A). But according long term practice in acoustical planning and noise control this handling is not sufficient in most cases. For machines/equipment usually operating under hemi-reverberant or reverberant conditions or for machines having no workplace the emission sound pressure level is a purely artifical value of less practical use.

4.1 Basic Procedures for Sound Power Determination and its appropriate Selection

At present 7 basic standards for measuring the sound power level are available. These standards are mainly distinguished

- different environmental conditions
- different requirements in respect to the background noise levels related to the noise level of the source
- different grades of accuracy

Consequently also the measurement effort is a criterion. High accuracy and bad environmental/background noise conditions requires more complicate measurements respectively "higher" measurement techniques (e.g. sound intensity devices). Simplier conditions allow to reduce this effort respectively to choice simplier methods for yielding good accuracy. An outline of the 7 basic standards is given by table 1 together with a rough description of their fields of application. For more details reference is given by the guideline standards ISO 12 XXX and ISO 3740 (see also figure 1).

Table 1: Sound Power Determination Procedures and Relations to their Fields of Application

Standard	Environment	Background Noise Levels	Grades of Accuracy
ISO 3741/ ISO 3742	special measurement room, "reverberant room"	very low background noise levels	class 1
ISO 3743	special measurement room, respectively high reverberant ordinary room	low background noise level	class 2
ISO 3745 (p^2-method)	special measurement room "anechoic;semi-anechoic room"	very low background noise levels	class 1
ISO 3744 (p^2-method)	in situ, but with limited environmental reflexions	low background noise levels	class 2
ISO 3746 (p^2-method)	in situ, less limited environmental reflexions	less limited background noise levels	class 3
ISO 9614 (intensity method)	in situ, practically no limitation	practically no limitation for background noise levels	class 1 or 2

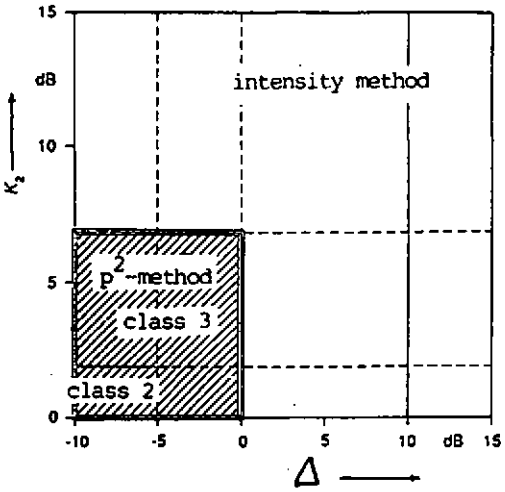

Fig. 1:
Fields of application for sound power determination methods

K_2: environmental correction (See e.g. ISO 3744)

$\Delta = \overline{L_{p,background}} - \overline{L_{p,source}}$ background noise level related to source level (levels of sound pressures averaged over measurement surface)

The most important criteria to select one or more basic standard(s) for the use of the relevant machinery specific noise test code is their field of application in respect to the conditions under which these machines/equipment are to measured in p r a c t i c e. Smaller machines not requiring special devices for their operation can be measured in special measurement rooms whilst the noise of other machines often must be checked i n s i t u. Up to the responsibility of the machinery specific standardization people this selection should be done in a most appropriate way taken into consideration all aspects discussed before.

The selected basic document shall be referred only and not transcribed word by word.

4.2 Additional Machinery Specific Requirements

For a noise test code the basic documents must be supplemented by well defined o p e r a t i o n and m o u n t i n g c o n d i t i o n s relevant for the machinery family under consideration. Within the basic documents these requirements are not given precise enough.

This task in the responsibility of the machinery specific standardization group only. Operating and mounting conditions should be representative for the n o r m a l u s e of the relevant machines. But taking into consideration that these conditions may influence the measurement uncertainty too the reproducibility of the sound emission quantity in correlation with the operation and mounting conditions having selected must be checked very carefully.

These conditions shall be taken as the same both for all sound power determinations if several (see table 1) a n d for emission sound pressure level determinations too.

A table of measurement uncertainties must be included into the noise test code taking into consideration b o t h the uncertainties given by the relevant basic document(s) a n d caused additionally by adjusting the prescribed operating and mounting conditions. This requires relevant investigations for the specific machinery family in general.

The noise test code related to one specific machinery family shall be established u n i f o r m l y world wide in order to avoid barriers in trade. (This is addressed to standardization groups responsible for the machinery family on different levels:national, european (CEN) and world wide (ISO)).

The result of a noise emission measurement shall be indicated by a double number: number of the relevant basic document and number of the relevant

noise test code. An example is given by the indication: ISO 1680/ISO 3744 where ISO 1680 is the noise test code for rotating electrical machines and ISO 3744 the class 2 sound power determination basic standard.

4.3 Basic Procedures for Emission Sound Pressure Level Determination and its Appropriate Selection

The former standard ISO 6081 "Acoustics - Noise emitted by machinery and equipment - Guideline for the preparation of test codes of engineering grade requiring noise emission measurement at the operator's position" now is replaced by the new ISO 11200 series. This new series covers 5 Standards ISO 11200 to 11204 which similar as described for the sound power standards are correlated with different fields of application, different methods and different grades of accuracy (see table 2). Details are given by the Guideline Standard ISO 11200.

Table 2: Emission Sound Pressure Determination Procedures and Relations to their Fields of Application

Standard	Environment	Background Noise Levels	Grades of Accuracy
ISO 11200	Guideline		
ISO 11201	free field	very low background noise levels	class 2
ISO 11202	approximate free field	low background noise levels	class 3
ISO 11203 (derived method)	in situ, practically no limitation	(low)background noise levels	class 2 or 3
ISO 11204	approximate free field	(very) low background noise levels	class 2

If a work place in machinery vicinity exists, this position (single point or line) should be defined exactly. Then one or several of the ISO 11200 series basic documents most practical for the conditions under which the specific machinery can measured in practice should be selected regarding their different fields of application and the required uncertainties (see table 2).

The appropriate standards shall be referred only and not transcribed word by word. Operation and mounting conditions should be the same as defined for the sound power measurements.

PREPARATION OF NOISE TEST CODES

5. DECLARATION AND VERIFICATION

The relevant ISO-basic standards: ISO 4871 and the ISO 7574 series distinguish whether the noise emission declaration is related to

- one single machine or to
- a well defined batch of machines

and consequently the machinery specific standardization group has to decide first whether one of these two possibilities or both are most appropriate for their objects. In all cases the verification procedures has to follow ISO 4871 respectively one of the 4 parts of ISO 7574.

In all cases declared noise emission number is defined only if this value is given together with the relation to the noise test code. If this document allows several possibilities the relevant measurement and verification procedure must be declared.

6. TYPICAL OUTLINE OF A NOISE TEST CODE

The typical outline of a noise test code is given as follows:

Title: Noise test code for family of machines, ...;
grade of accuracy: class ...

A.1 Scope
A.2 References
(list of International Standards referred to this noise test code)
A.3 Definitions
(Definitions of key technical terms used)
A.4 Description of machinery family
A.5 Sound power determination
A.5.1 Basic International Standard(s) which may be used
A.6 Installation and mounting conditions
A.7 Operating conditions
A.8 Emission sound pressure level determination (if suitable)
A.8.1 Basic International Standard(s) to be used
A.8.2 Description of relevant workstation(s)
A.9 Measurement uncertainty
A.9.1 table for sound power determination
A.9.2 table for emission sound pressure level determination
A.10 Information to be recorded and to be reported
A.11 Declaration and verification of noise emission values
A.11.1 Basic International Standards to be used.

7. REFERENCES

/1/ ISO Draft Standard 12 XXX: Acoustics - Noise emitted by machinery and equipment - Rules for drafting and presentation of a noise test code

/2/ EEC Council directive of 14 June 1989 on the approximation of the laws of the member states relating to machinery (89/392/EEC), see furthermore: EEC Council directive of 12 May 1989 on the protection of workers from the risk related to exposure to noise at work (86/188/EEC),especially articles 5.1 and 8.1