CHANGES TO ISO STANDARDS AND THEIR EFFECTS ON MACHINERY NOISE DECLARATIONS

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1. INTRODUCTION

This paper describes recent improvements in the basic ISO standards for measurement of machinery noise and how they can affect the ease of determination, or the reliability, of machinery noise declarations. These standards include the 3740 series [1-5] for measurement of sound power and the 11200 series [6-8] for measurement of emission sound pressure level. There have been a number of changes, particularly in the estimation of uncertainty. Their primary impetus was to facilitate compliance with the European Union's Machinery and Outdoor Equipment Directives [9,10]. Both require machinery noise declarations of emission sound pressure level and sound power level. Furthermore, the latter Directive prescribes limits to the sound power levels for certain machines.

Improvements to the ISO standards could be incorporated into potential revisions of the Canadian voluntary standard [11] for machinery noise declarations. These should aid conformance to the Health Canada recommendation [12] that machinery sold in Canada includes standardized noise emission declarations in sales literature and instructions for use. Health Canada's recommendation was made to strengthen efforts to reduce the number of workers who suffer hearing impairments (currently about 9000 per year). Noise declarations enable purchasers to select quieter machinery and plan noise controls to reduce risks caused by excessive occupational noise.

2. SUMMARY OF CHANGES

2.1. Uncertainty

Uncertainty must be included in noise emission declarations [13] and is an important consideration in meeting noise limits. Therefore the most significant change to the ISO machinery noise measurement standards was to incorporate uncertainty budgets [14]. Each standard now has an annex with a detailed listing of typical uncertainty components. These components can be quantified by measurements (statistically), experience, general knowledge, or manufacturers specifications [14]. Previous standards had only addressed one aspect of uncertainty; i.e., the reproducibility of the method, σ_{R0}, (as estimated for measurements at different times in different labs and by different users). In the past, the means to account for the remaining uncertainty components was implicitly left to the users.

In the new standards, the ability to explicitly account for each component of uncertainty allows the total uncertainty to be smaller than previously possible. In specific measurement situations, contributions to uncertainty can be systematically identified and reduced. This was not possible previously when uncertainty was based on generic estimates.

In addition to the detailed uncertainty budget, the standards also include a simplified uncertainty budget. This assumes that the dominant source of uncertainty is due to operating and mounting conditions, σ_{omc}. This component is combined with the reproducibility of the method, σ_{R0}, to obtain an estimate of the total uncertainty. Tabulated values for σ_{R0} values are similar to those given in the previous versions of the standards. Tabulated values for operating and mounting conditions can be as high as 4 dB when noise generated by the material processed varies strongly.

Uncertainties due to the reproducibility of the method, σ_{R0}, have been significantly reduced in some standards. In the standards for emission sound pressure level [6-8] uncertainties used to be on the order of 4 dB, comparable to survey grade estimates. Now these standards have been improved to include precision grade (0.5 dB uncertainty) and engineering grade uncertainty (1.5 dB). Also, precision grade uncertainty for sound power measurements in reverberation rooms [1] has been improved from 1 dB to 0.5 dB

2.2. Mounting and Operational modes

In the past there was some ambiguity about the conditions under which a noise emission value should be determined. Recommendations for mounting and operational modes are now included in all standards [1-8]. It is required that the source is tested, under conditions that are reproducible and representative of the noisiest operation in typical usage. This can have an important effect on the noise emission declaration.

2.3. Reference Meteorological conditions

To achieve repeatable results in different locations, measurements according to the new ISO machinery noise standards are normalized to reference meteorological conditions. This correction accounts for the different sound levels produced by machinery when the temperature and pressure change. The correction is usually small enough to ignore for survey grade standards. It is also unnecessary for engineering grade measurements at elevations less than 500 m above sea level when the temperature range is −20 °C to 40 °C.. This change will have most effect on measurements related to noise emission declarations in Western Canada, (particularly Alberta where most cities or towns are above 500 m elevation).

2.4. Frequency Range

In the current standards, the frequency range is explicitly extended to include all frequencies that have a significant effect on the A-weighted levels. Previous standards indicated the measurement range was from 100 Hz to 10 kHz. Some sources primarily emit sound at frequencies outside of this range, and omission of these frequencies could have led to under reporting of A-weighted levels in declarations.

2.5. Single Event Sound levels

All standards now include instructions to calculate sound levels for single events such as impulsive noise or noise from characteristic individual work cycles. The measured quantities are numerically the same as the familiar "sound exposure level" used in environmental noise. Use of sound energy levels can help to calculate declared values.

2.6. Calibration

All standards have a similar section on calibration of the required instrumentation. It is recommended that the calibrator is calibrated every year, and other equipment is to be calibrated every 2 years. Conformance with these requirements gives greater confidence in the declaration.

2.7. Changes Specific to ISO 3744

Requirements for the environmental correction K2 in the most common engineering grade sound power measurement standard [3] have been relaxed to allow free field measurements in more reverberant environments. As a result, adequate absorption is obtained in a room with a volume that is one quarter of the volume previously required. This significantly increases the number of facilities that can be used for noise declaration measurements.

The positions of measurement points have been changed. This may require changes in some facilities making machinery noise declarations. However, the new arrays are not mandatory, and alternative arrays can be used if they do not adversely affect uncertainty (see 2.1). The simplified measurement arrays of the now withdrawn ISO4872 [15] for outdoor construction equipment have also been added.

3. CONCLUSIONS

Changes to these standards as described above make noise emission declarations easier to obtain and more reliable. This facilitates implementation of noise emission declarations both in Canada and internationally.

REFERENCES

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[2] ISO 3743-1 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for small movable sources in reverberant fields -- Part 1: Comparison method for a hard-walled test room (2010)

[3] ISO 3744 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for an essentially free field over a reflecting plane (2010)

[4] ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Survey method using an enveloping measurement surface over a reflecting plane (2010)

[5] ISO 3747 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering/survey methods for use in situ in a reverberant environment (2010)

[6] ISO 11201 Acoustics - Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (2010)

[7] ISO 11202 Acoustics - Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (2010)

[8] ISO 11204 Acoustics - Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections (2010)

[9] Directive 2000/14/EC of the European Parliament and the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors, OJ L 162, 3.7.2000, (2000)

[10] Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast), . OJ L 157, 9.6.2006, (2006)

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