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Changes in Ecma standards for measurement of noise from IT products

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ABSTRACT

This paper discusses changes in new editions of Ecma standards for noise from information technology (IT) equipment and future work items. The tenth edition of ECMA-74 (measurement of IT equipment noise) and the fourth edition of ECMA-108 (measurement of high frequency noise) were approved in December 2008. The major changes were: new product categories (multi-function devices and hand-held devices); operating modes for central processing units; and the concept of threshold of hearing when evaluating very low noise products for prominent discrete tones. The new editions reflect changes being made in the basic sound power level and emission sound pressure level standards: ISO 3741, ISO 3744, ISO 3745 and ISO 11201. Future work items for these standards include revision of ECMA-108 to cover the testing of products whose emissions vary with temperature, revision to ECMA-109 on determining declared noise emission values, and revisions in ECMA-74 Annex C to modify printing patterns and add further new product categories. ISO/FDIS 7779 (measurement of IT noise) references Annex C of ECMA-74 for product categories and product operation ensuring that ISO 7779 test methods include the latest products and customer usage. Future work includes development of an Ecma technical report on reporting fan performance using constant sound power (“iso-acoustic”) curves and testing fans to determine system inlet effects.

1. INTRODUCTION

The three primary Ecma International standards relating to acoustics from IT equipment are ECMA-74¹, ECMA-108² and ECMA-109³. The ISO counterparts to these three ECMA standards are ISO 7779⁴, ISO 9295⁵ and ISO 9296⁶, respectively. ECMA-74 is the acoustic testing standard for determination of sound power levels and emission sound pressure levels for information technology equipment in the frequency range covered by octave bands with center

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frequencies from 125 Hz to 8,000 Hz. ECMA-108 specifies four methods for the determination of the sound power levels of high-frequency noise emitted by IT equipment in the frequency range covered by the octave band centered at 16,000 Hz. ECMA-108 relies on operating modes and installation conditions according to ECMA-74. ECMA-109 specifies the method of determining the declared noise emission values, acoustical and product information to be given in technical documents supplied to users by the manufacturer, and the method for verifying the declared noise emission values given by the manufacturers. ECMA-109 uses the noise emission data obtained in accordance with ECMA-74, and the procedures specified in ISO 4871 and ISO 7574.

These Ecma and ISO standards have been developed by Ecma Technical Committee 26 (Acoustics) [Ecma TC 26] and by ISO Technical Committee 43 (Acoustics) Subcommittee 1 (Noise) Working Group 28 [ISO TC 43/SC1/WG 28] – the two committees work closely and collaboratively together with the INCE/USA Technical Committee on Information Technology Equipment Noise Emissions and American Standards Committee S12 Working Group 3. The Ecma standards complement the ISO standards and can be modified bi-annually as required when new products are developed, when typical product usage changes, or when underlying basic ISO standards change.

Another Ecma standard also relates to acoustic noise emissions from IT products: ECMA-370⁷ “TED - The Environmental Declaration” is a standard which specifies environmental attributes and measurement methods to meet customer demands for standardized, comparable product environmental information. ECMA-370 includes product noise information and relies on ECMA-109 declarations based upon ECMA-74 measurements.

2. ECMA-74 MEASUREMENT OF AIRBORNE NOISE FROM INFORMATION TECHNOLOGY AND TELECOMMUNICATIONS EQUIPMENT

ECMA-74 specifies procedures for measuring and reporting the noise emission of information technology and telecommunications equipment. ECMA-74 together with ECMA-109 form a noise test code for this type of equipment. ECMA-74 is based on basic noise emission standards ISO 3741, ISO 3744, ISO 3745 and ISO 11201. The basic emission quantity is the A-weighted sound power level which may be used for comparing equipment of the same type but from different manufacturers, or for comparing different equipment. The A-weighted sound power level is supplemented by the A-weighted emission sound pressure level determined at the operator position(s) or the bystander positions.

The 10th edition of ECMA-74 was approved by the Ecma General Assembly in December 2008. The major changes to the standard include modifying provisions reflecting changes in the basic ISO standards, the addition of new product categories and operating modes in Annex C, and modifications for the determination of prominent discrete tones in Annex D. A summary of these changes are described in the following sub-sections. In addition to these changes, the 10th edition of ECMA-74 reflects the latest version of the Final Draft Amendment 2 to ISO 7779.

A. Changes in ISO Basic Standards

References to ISO basic standards, such as ISO 3741, ISO 3744, ISO 3745, and ISO 11201 were changed to no longer include the date of the standard. Users of ECMA-74 must now use the latest version of these basic standards. There are several provisions in the basic standards that are changing, and clarification notes have been added to indicate some of these changes, such as the concept of an absolute background level in addition to relative criteria for testing low noise products. Another change in the ISO standards is determining and reporting sound power level

and emission sound pressure level under “reference atmospheric conditions”. Reduced atmospheric pressure creates a bias in the sound power level. ISO/FDIS 3744 contains the following requirement: at altitudes greater than 500 m above sea level, the sound power levels corresponding to the reference barometric pressure of 1.013×10^5 Pa and the reference atmospheric temperature of 23.0 °C shall be calculated.

B. Annex C - New Specific Product Categories

There are now 21 categories of products for which detailed installation and operating conditions are specified. Two new categories were added in the 10th edition of ECMA-74: multi-function printing devices and “hand-held computing and media playback devices”.

Category C.21 *Multi-function devices* (MFD) includes equipment which is capable of two or more functions such as printing, copying, scanning and faxing defined in C.3, C.6, C.13 and C.16. MFD may be capable of monochrome or color modes, or both, and may offer two-sided printing or copying. MFD may have an automatic document feeder that loads masters into the MFD, or output devices such as stackers, sorters, staplers, which assist document preparation. The input and output devices are either part of the standard product configuration or are optionally purchased by the customer.

Category C.22. “*Hand-held computing and media playback devices*”, such as mobile internet devices, hand-held computing and media playback equipment, have been introduced in the last few years. Some of these have a hard disk drive and small air moving devices for electronic cooling, therefore emitting acoustical noise. Devices in this category are often supported by hand and operated at a much closer distance to the user than many existing product categories such as computers and workstations. This category covers hand-held equipment for computing, office productivity software, internet browsing, digital media playback, and similar functions. Devices may be held in one or both hands during typical usage, and do not have a keyboard large enough for touch-typing. Ultra-mobile PCs (UMPC), hand-held MP3 players, and hand-held digital video players come under the scope of this category. Hand-held optical disk players do not come under the scope of this category. During sound power testing the unit is supported 0.25 m above the floor, and during emission sound pressure level testing the unit is on the standard test table. A new operator position for hand-held equipment was also defined in Section 8.6.

C. Annex C - Installation and Operating Conditions for Product Categories

A new operating mode for systems with central processing units, memory and graphics cards has been added in order to determine noise levels when the noise emissions are a function of component power and workload. Previous versions of ECMA-74 did not consider this aspect of these types of components. The previous mode was established more than a decade ago when most PCs and servers had fan speeds that were independent of workload and device power and thus had noise emission levels that also did not depend on workload and power. The rationale for these new modes is given in the paper by Man¹² and the references contained therein. The new operating mode for products with noise emissions that are dependent on workload is given below:

“C.15.3.2 g) Equipment with a central processing unit shall be tested under the typical workload to best represent the noise levels that majority of customers may encounter. The central processing unit may include multiple microprocessors, multiple memory modules and multiple add-in cards (for example, graphics card), here on referred to as subsystems

of the central processing unit. If operation of the subsystem below does not result in an increase in fan speed(s) or acoustically significant noise level, that subsystem does not need to be tested. Operating of each subsystem shall follow:

1) Central processing units with multiple microprocessors: Typical workload of all microprocessors shall be half of the maximum load using microprocessor centric performance testing applications. If multiple microprocessors are included in a central processing unit, the typical workload shall be evenly distributed across all microprocessors, if possible.

NOTE

If load-scalable performance testing applications, such as Specpower, MaxPower or ThermNow are used, then the acoustic measurement should be done at the 50 % of the maximum load setting. If load non-scalable applications, such as Linpack and Prime95 are used, the manufacturer may modulate the load between max and idle to meet the typical workload condition. Modulation should be adjusted such that a steady-state noise emission condition is measured.

2) Central processing units with a memory subsystem: A memory subsystem consists of all memory modules within the central processing unit, whether installed on a motherboard, or via multiple riser cards. Typical workload for the memory subsystem operating mode shall be half of the attainable platform performance bandwidth of the memory subsystem, with bandwidth equally distributed over all memory modules, if possible.

NOTE

Attainable platform performance bandwidth may be obtained by running a load-scalable memory performance application at the maximum performance bandwidth setting. The acoustic testing should then be done at the 50 % of this maximum performance bandwidth setting.

3) Central processing units with discrete graphic cards: typical workload of graphics cards shall be half of the maximum performance as specified by the manufacturers of the card. If multiple cards from different vendors are part of the central processing unit, each card shall be exercised and reported separately.”

The microphone position for determining emission sound pressure level is determined by whether an operator position is defined. If the operator position is defined for a product type, the microphone position is at a typical operator position; if an operator position is not defined, measurements are taken at bystander positions, which are further away from the product. In order to remove ambiguity as to whether an operator position is defined, ECMA-74 contains a new Table C.1 to be used to determine whether an operator position or bystander positions measurements are required. For example for facsimile machines, the bystander position shall be used for determination of emission sound pressure levels for all modes.

Future editions of ECMA-74 will clarify printing device operating modes.

D. Annex D - Prominent Discrete Tones

The procedure for evaluating whether low sound level tones are prominent discrete tones was clarified and modified. The concept of “lower threshold of hearing”, that is, the one percentile threshold of hearing, is used when evaluating low level tones for prominence in order to reduce unnecessary computations of low level tones that are not audible or are not prominent because of the criteria for prominence. (Only one percent of the population can hear a tone at that level; 99% cannot hear the tone at the level.) If the sound pressure level of the tone is less than the one

percentile threshold of hearing, the tone is assumed to be *inaudible*, and no further analysis is required. If the sound pressure level of the tone is less than 10 dB above the one percentile threshold of hearing, the tone is assumed to be *not prominent* and then further analysis is not needed. The 10 dB criterion is conservative since the difference between prominence and threshold of detection is 10 – 14 dB depending on frequency. Equations in D.6.2 are given defining the lower threshold of hearing.

Studies are continuing on how to evaluate low level tones that exceed these screening criteria in D.5.2 and when some or all of the noise in the critical bands are below threshold of hearing.

3. ECMA-108

Some information and telecommunications equipment emits high-frequency noise which may be broad-band noise (e.g. paper noise of high-speed printing) or narrow-band noise and discrete tones (e.g. noise of hard disk drives, switching power supplies, and video display units). The 4th edition of this Ecma Standard was published in December 2008. The primary change was to incorporate changes in the 10th edition of ECMA-74, which limits the frequency range of interest for determining A-weighted sound power levels to one-third-octave bands with center frequencies from 100 Hz to 10,000 Hz. With the 4th edition of ECMA-108, noise in the 16 kHz octave band is no longer used to determine overall A-weighted sound power level of the unit under test; only contributions in the 100 Hz – 10,000 Hz one-third-octave bands determined according to the tenth edition of ECMA-74 are used to determine A weighted sound power level.

Future work items for ECMA-108 will cover the testing of products whose emissions vary with temperature and the modifications of the air absorption tables for reverberation room testing to cover more temperatures.

4. ECMA-109

Future revisions to ECMA-109 will delete the reference to ECMA-160, which covers sound power determination based on intensity, in order to be consistent with sound power determination in accordance with the 10th edition of ECMA-74. The future revision will remove the single equipment sound power level declaration clause since there has been confusion that this section applied to testing of one product in a family of products, when in fact it referred to testing of a single unique machine and reporting values only applicable to that unique machine. The future revisions will give better guidance when testing a “small sample size”.

5. ECMA TECHNICAL REPORT ON FAN NOISE: CONSTANT SOUND POWER PERFORMANCE CURVES AND INLET EFFECTS

Ecma TC 26 is preparing a technical report on fan noise, which covers two aspects: constant sound power performance curves and inlet effects. This future Ecma technical report is based on the research of Baugh and MacDonald¹³ and their colleagues. Fan performance in terms of flow and pressure can be measured using an airflow chamber in accordance with AMCA 210, and such a fan curve is normally provided in a manufacturer’s datasheet. The datasheet may also contain a measured sound pressure level, typically at 1 m from the fan inlet, with the fan in free space. Sound power level in a loaded condition, as a function of static pressure, may be measured in accordance with ISO 10302-1 by using an acoustic fan plenum. Such data is much more indicative of the noise the fan will make when installed in a device, but is difficult to compare to the fan curve without cross-plotting between multiple data sets. A simpler way to comprehensively state fan performance is with a constant sound power, or iso-acoustic, fan

curve. Using this iso-acoustic fan curve, the performance of two fans may be easily compared in terms of flow, pressure, and noise.

Inlet effects can have a large impact on fan flow rate and noise generation. For example, an axial fan commonly has a finger guard or grille, while a blower used in a notebook computer operates within a very constrained space. Since these effects cannot be accounted for by a simple pressure drop due to the complicated flow physics, it is desirable that the fan curve for a specific application include such inlet losses directly. A fixture to approximate the inlet restriction in a notebook computer is described that has been shown to correlate closely with the noise of actual systems¹⁴.

6. CONCLUSIONS

Ecma acoustic standards for IT equipment are continually undergoing revisions to ensure that they represent the latest product types, current product usage by customers, and reflect requirements in the basic ISO sound power level and emission sound pressure level standards. Final Draft Amendment 2 to ISO 7779 references Annex C of ECMA-74 for specific product categories and detailed product operating and installation while maintaining general requirements on installation and operating procedures. This revision to ISO 7779 will ensure that ISO 7779 also has current product categories and reflects actual customer usage of products during testing. The continuing cooperation of the various IT technical committees involving standards bodies, the public, and engineering organizations (Ecma, ISO, INCE, ANSI, JBMIA) helps to ensure the desired world-wide consistency of acoustic test and reporting methods and verifying declared noise values for IT products.

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