



# Sound pressure level and sound power level declarations: navigating the maze

Emma SHANKS<sup>1</sup>

<sup>1</sup> Health & Safety Laboratory, United Kingdom

## ABSTRACT

Under European law, high noise machinery supplied in Europe must be accompanied by a noise declaration. Declarations usually consist of a workstation emission sound pressure level ( $L_{pA}$ ) and, for the noisiest machines, an emission sound power level ( $L_{WA}$ ). Unexpected conflicts, confusion and inconsistencies have been observed for the declared  $L_{pA}$  and  $L_{WA}$ . The European NOMAD (Noise and the Machinery Directive) project reported that 80% of noise information supplied with machinery was inadequate, often because of weaknesses in the declared  $L_{WA}$  and/or  $L_{pA}$ . About 600 European (EN) standards contain the phrase "noise emission" and about 300 of those consider noise as a "significant hazard". The Health and Safety Laboratory (HSL) is currently investigating the practical challenges of measurement and declaration of  $L_{WA}$  and  $L_{pA}$ . So far, HSL has found difficulties when machines fall under multiple European Directives, when the EN standard test codes used do not provide data that represents real-use risk, or declarations that are difficult to make because the standards are ambiguous. The top priority for manufacturers is to reduce the noise emission of the machinery at source, through technical and design methods. The noise declarations should be a suitable means of verifying that this has been achieved.

Keywords: Noise, Emission, Declaration

I-INCE Classification of Subjects Number(s): 10, 80

## 1. INTRODUCTION

Under European law, noisy machinery supplied in Europe must be accompanied by a noise declaration. This requirement is cited in European Directives 2006/42/EC, the Machinery Directive, and 2000/14/EC, the Outdoor Equipment Directive (1, 2). These Directives are implemented in the United Kingdom (UK) through the Supply of Machinery (Safety) Regulations 2008 and the Noise Emission in the Environment by Equipment for use Outdoors Regulations 2001 respectively (3, 4). The noise requirements of the Machinery Directive are elaborated upon in European machinery safety and test standards (EN) which contain the instructions for measuring and declaring noise. The Outdoor Equipment Directive contains its own instructions as well as drawing on standards.

Inconsistencies exist between the two Directives. The Machinery Directive requires declaration of the emission sound pressure level ( $L_{pA}$ ) and the emission sound power level ( $L_{WA}$ ) when the  $L_{pA}$  exceeds given values. The Outdoor Equipment Directive requires only the declaration of the  $L_{WA}$ . Where both Directives are applicable to a machine, the  $L_{WA}$  is required to be declared according to the Outdoor Equipment Directive and the  $L_{pA}$  is declared according to the Machinery Directive. This is not immediately clear and has caused some confusion amongst duty holders, particularly when there is an apparent requirement in standards to declare  $L_{WA}$  to both Directives and hence to conflicting noise test methods.

Instructions on how to measure and declare noise emissions are usually contained within the EN standards. Research published in 2013 (5) by the Health & Safety Laboratory (HSL) for the Health and Safety Executive (HSE) showed that about 600 EN standards contained the phrase "noise emission" and in about 300 of those, noise was considered a "significant hazard". The noise clauses contained in these standards were not always accurate, helpful or achievable.

In March 2010 the Health and Safety Executive (HSE) launched the Buy Quiet campaign (6). The campaign promotes consumer demand for low noise equipment, encouraging its production and sale. This campaign places emphasis on purchasers of machinery looking at the noise emission declarations,

---

<sup>1</sup> emma.shanks@hsl.gsi.gov.uk

encouraging machine manufacturers to declare noise emissions that are both sensible and useful.  $L_{WA}$  and  $L_{pA}$  declarations have their advantages and disadvantages.  $L_{WA}$  values are independent of their test environment and therefore allow comparison between similar machine types for similar operations.  $L_{pA}$  declarations can provide information about noise risk at workstations. Machinery selection based on  $L_{pA}$  values should allow the purchasers to make an informed decision concerning potential operator noise exposure. However, a machine with a high  $L_{WA}$ , that was disregarded because of its high  $L_{WA}$ , could well have a low  $L_{pA}$ , for example plasma cutting machines. These machines have high a  $L_{WA}$ , but if the operators control the machine from a noise haven, the  $L_{pA}$  is low. Conversely, a machine selected because of a low  $L_{WA}$  could in fact have a high  $L_{pA}$ . This could be due to the operator station location or directionality of noise from the machine.

Inconsistencies also exist within the EN standards. In some cases machines from the same family, but with different power sources (for example pneumatic versus electric), are subject to different test conditions and noise emission calculations. Test conditions can vary: some tests involve measuring the noise from the machine under no load, with no operator present and calculating the  $L_{WA}$  and  $L_{pA}$ ; other tests involve representative working conditions, under load, with an operator, and calculation of the  $L_{WA}$  and direct measurement of the  $L_{pA}$ .

On behalf of HSE, HSL is currently investigating the challenges faced by equipment suppliers when it comes to noise declarations, in a bid to make the process simpler and easier. The top priority for manufacturers is to reduce the noise emission of the machinery at source, through technical and design methods. HSL is investigating the effectiveness of a sample of noise declarations as a means of verifying that this has been achieved.

## 2. NOISE DECLARATIONS: SIMPLE TO COMPLEX

In the very simplest and broadest sense, a noise declaration consists of a sound power level ( $L_{WA}$ ) and a sound pressure level ( $L_{pA}$ ). The  $L_{WA}$  is a measure of the amount of acoustic energy emitted by the machine. The historical intention of the  $L_{WA}$  values was to allow comparisons of different machines from the same machine category. The underlying test codes were designed to be repeatable and reproducible, and therefore usually carried out in controlled laboratory environments. The  $L_{pA}$  is a measure of the noise level at the operator position of the machinery. The  $L_{pA}$  values should allow an estimation of an operator's exposure to noise from the machinery.

Ideally, the  $L_{pA}$  values are simultaneously obtained with the  $L_{WA}$  values, using the same operating and environmental conditions. However, where both the Machinery Directive and Outdoor Equipment Directive apply, the operating and environmental conditions for the obtaining the  $L_{pA}$  and the  $L_{WA}$  values may be different. In addition, there may be conflicting test requirements associated with each Directive for the measurement of the  $L_{WA}$ . Finding a way through the maze of information is difficult.

The  $L_{WA}$  and  $L_{pA}$  should enable a potential purchaser to select quieter machinery, but it does not necessarily enable them to easily predict the noise levels in use. Installation and operating conditions, room conditions, and the contribution of noise from other sources may also affect the sound level and the risks within the workplace.

A machine manufacturer may question the relative returns on investment when faced with measuring  $L_{pA}$  and/or  $L_{WA}$ . Measuring  $L_{pA}$  is relatively straightforward. By comparison, measuring  $L_{WA}$  is much more difficult and involved. It can be particularly difficult in the case of large machinery. Clause 1.7.4.2u of the Machinery Directive contains special provisions for  $L_{WA}$  for 'very large machinery', although 'very large machinery' is not defined in the Directive and is therefore open to interpretation:

- *"In the case of very large machinery, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at specified positions around the machinery may be indicated."*

Similarly, the Clause also contains special provisions where workstations are undefined:

- *"Where the workstation(s) are undefined or cannot be defined, A-weighted sound pressure levels must be measured at a distance of 1 metre from the surface of the machinery and at a height of 1,6 metres from the floor or access platform. The position and value of the maximum sound pressure must be indicated."*

A machine manufacturer may decide that his machine fulfills these criteria, negating the need to measure the more difficult  $L_{WA}$ .

The  $L_{WA}$  and  $L_{pA}$  values are used in risk assessment and are under pressure from the duty holders to be representative of the working environment, not a controlled laboratory environment. This may in

part explain the hundreds of machine standards that now contain reference to noise emission, recognising, but not necessarily fulfilling, a need for suitable noise measurement to support declarations.

### 3. THREE MACHINE CATEGORIES: THREE DIFFERENT MAZES

#### 3.1 Sanders

In a similar vein to the NOMAD (Noise and the Machinery Directive) project (7), HSE asked HSL to investigate the quality of manufacturers' noise declarations for the specific machine category of sanders. The aim was to establish the level of compliance of such declarations with the requirements of the Machinery Directive. HSL assessed the noise emission declarations in a sample of 65 handbooks for electric and non-electric orbital and random orbital sanders. Overall, noise emission information was provided in 55 of 65 handbooks (85%).

The Machinery Directive requires the provision of the A-weighted emission sound pressure level at the workstation ( $L_{pA}$ ) where it exceeds 70 dB(A), including a statement if this level is not exceeded. Emission  $L_{pA}$  values were provided in 53 of 65 (82%) handbooks.

The Machinery Directive requires the provision of the A-weighted sound power level emitted by the machinery ( $L_{WA}$ ). This provision is linked to the  $L_{pA}$  in that the  $L_{WA}$  is only declared when the  $L_{pA}$  exceeds 80 dB(A). Emission  $L_{WA}$  values were provided in 52 of 65 (80%) handbooks. Two handbooks included  $L_{pA}$  values that were high enough to require  $L_{WA}$  values, but where the  $L_{WA}$  was not declared.

The Machinery Directive places emphasis on the declaration of the  $L_{pA}$  over the  $L_{WA}$ . However, the most recently dated noise test codes for both electric and non-electric sanders define a system of  $L_{WA}$  measurement first. The  $L_{pA}$  is then determined from  $L_{WA} - 11$  dB, equivalent to the surface sound pressure level of the  $L_{WA}$  measurement surface at 1 m from the centre of the machine radiating equally in all directions in free space.

Older noise test codes for electric sanders, which remain current, use the same premise of  $L_{pA}$  determined from  $L_{WA}$  but over a different shaped  $L_{WA}$  measurement surface. This results in the  $L_{pA}$  being determined from  $L_{WA} - 13$  dB.

An added complication is that electric sander test conditions are under no load conditions whilst non-electric sander test conditions are whilst sanding is carried out by a trained operator.

The noise emission information in the handbooks was also assessed for traceability and credibility. Only 13 of 65 handbooks (20%) contained noise information that was considered credible according to the operating conditions defined in an appropriate and fully referenced safety standard.

#### 3.2 Wood chippers

Previous research (8) concluded that manufacturers and suppliers of wood chippers were not consistently providing noise emission data. In 2013, at HSE's request, HSL carried out a review of the legislation, standard requirements and available literature for the noise emission measurements and declaration (9). Following this review HSL carried out measurements of the noise emission of nine wood chippers with the intention of providing an example of a satisfactory declaration of noise emission and supplementary information about noise risk. This was a complex task as both the Machinery Directive and the Outdoor Equipment Directive cover wood chippers. Essential health and safety requirements for noise are set out in the Machinery Directive. However, the Outdoor Equipment Directive has specific  $L_{WA}$  test requirements that take precedence over similar  $L_{WA}$  test requirements of the Machinery Directive.

BS EN 13525 (10) is the harmonised standard for noise emission of wood chippers, providing a presumption of conformity with essential health and safety requirements of the Machinery Directive. It contains a noise test code that defines the operating conditions for the measurement of the  $L_{pA}$ . These conditions are measurement over a hard reflecting surface while chipping single 4 m lengths of 50 mm square cut dry pine. Measurements of the  $L_{WA}$  under these operating conditions are also defined although it is currently unclear why as the Machinery Directive defers to the more specific  $L_{WA}$  test procedure given by the Outdoor Equipment Directive.

The Outdoor Equipment Directive noise test code for the measurement of  $L_{WA}$  defines preferred measurement conditions over a lawn or absorptive surface while chipping 1.5 m lengths of round dry pine or plywood of the maximum diameter specified for the chipper. Measurements over a hard reflecting surface are also allowed. The Outdoor Equipment Directive has no interest in  $L_{pA}$ .

The measurement data showed that all wood chippers emitted sound that was directional in all

chipping conditions. Most sound came from the direction of the infeed hopper. A 20-position measurement array was needed for the  $L_{WA}$  measurement to meet the measurement specification of current standards. However, the Outdoor Equipment Directive prefers, and the BS EN 13525 test code permits, a 6-position array. This reduced array provides an unreliable estimate of  $L_{WA}$  for these types of machine. Values of  $L_{WA}$  could vary by more than 4 dB when chipping logs and more than 6 dB when chipping 50 mm square cut lengths depending on the chosen orientation of the wood chipper within the array.

There is erratic motion of the infeed material as it engages in the feed to the wood chipper. BS EN 13525 could compromise operator safety, as it requires the operator to remain stationary at the infeed during chipping whilst measuring the  $L_{pA}$  using a microphone mounted on the side of the operator's head. BS EN ISO 11201 (11) also defines this measurement position. However, this standard also allows a safer option with a freestanding microphone at the workstation, allowing the operator to move safely out of the way. There remains ambiguity as to which option is preferred.

### 3.3 Printing industry

As part of an HSE industry specific guidance review, HSL investigated noise in the UK printing industry. This included workplace noise measurements, analysis of changes in the noise levels in the UK printing industry over a 25-year time gap, observation of possible reasons for changes in noise exposure and review of the quality of noise emission declarations of 15 machines against the requirements of the Machinery Directive (12, 13).

Printing machinery is treated as 'very large machinery' under Clause 1.7.4.2u of the Machinery Directive and consequently noise emission declarations do not need to have  $L_{WA}$  values. They can instead have  $L_{pA}$  values at specified positions around the machine. All 15 printing machinery handbooks contained emission  $L_{pA}$  rather than emission  $L_{WA}$  data. The quality of the  $L_{pA}$  declarations varied. Qualifying parameters for the  $L_{pA}$  ranged from the very clear (for example "*continuous equivalent level*", "*acoustic pressure level*", "*sound pressure level*") to the more ambiguous and then incorrect for a noise emission declaration (for example "*noise level*", "*noise pressure level*", "*sound intensity level*"). Traceability and credibility of the declarations also varied with some of the handbooks correctly referring to the Directive and relevant standards and others not at all.

Comparison of the declared  $L_{pA}$  with the workplace noise measurements, even with some ambiguity in the declarations, was favourable for 11 of the 15 (73%) declarations. Declared  $L_{pA}$  information provided for printing machinery will help the user assess and manage real-use risk.

Information on protective measures included in the printing machinery handbooks covered the use of hearing protection, acoustic enclosures and sound covers. Any quantification observed was in terms of  $L_{pA}$ . There was also evidence that those purchasing printing machinery are following the guidance provided to manage the risk from noise. Noise enclosures were observed at some of the printing premises visited during the workplace noise measurements. While noise enclosures can be very effective at controlling workplace noise, they need proper installation and regular maintenance to be effective.

## 4. A VACUUM CLEANER'S MAZE

In a bid to make the noise emission declaration process simpler and easier, HSL has embarked on a programme of work intended to understand in detail the challenges currently experienced by machinery suppliers and manufacturers. To improve HSL's understanding of these challenges the programme of work consists of selecting sample machinery and tracing its noise emission declaration from the information supplied by the manufacturer back to the relevant noise standard(s) used to make the measurement for the noise emission declaration. One piece of sample machinery is a vacuum cleaner.

The vacuum cleaner's noise emission declaration heritage, and the tracing of it, typifies the many challenges of noise emission declaration faced by machine manufacturers. For completeness, the full designations of all the standards encountered during the tracing exercise are listed in Annex A.

### 4.1 Finding the Noise Emission Declaration

The owner's instructions were the starting point of the tracing exercise to find the vacuum cleaner's noise emission declaration. The manufacturer's website gave instructions dated January 2014. These instructions contained the EU declaration of conformity (Figure 1a), and a data page containing some noise information (Figure 1b). The noise information reads "*sound pressure 64 dB - 68 dB (A)*

(IEC 60704-2-1) Uncertainty 0.2 dB”.

Whilst searching the manufacturer’s website, a 20-language technical specifications booklet was also found and downloaded. This booklet also contained an EU declaration of conformity along with general information about the machine and the use of dry vacuum cleaners (Figures 2a to 2c). This booklet was dated February 2010.

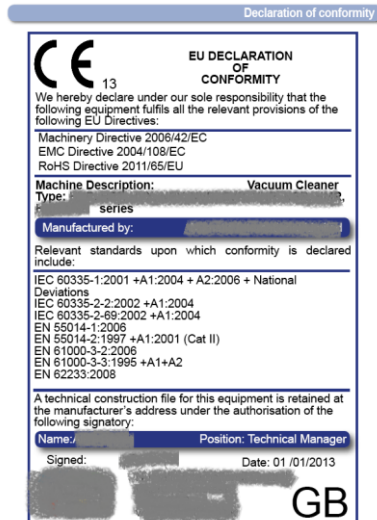


Figure 1a. EU declaration of conformity from the owner instructions dated 01/01/2013

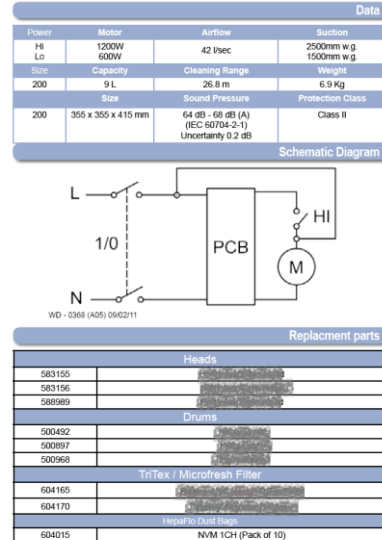


Figure 1b. Data page containing noise information from the owner instructions [noise information reads: sound pressure 64 dB - 68 dB (A) (IEC 60704-2-1) Uncertainty 0.2 dB]

Figures 1a to 1b. Pages from the owner’s instructions dated January 2014

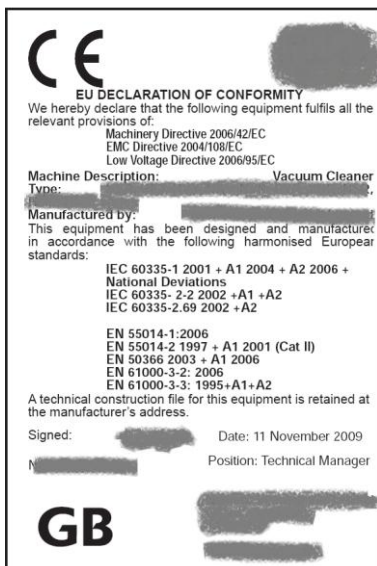


Figure 2a. EU declaration of conformity dated 11/11/2009

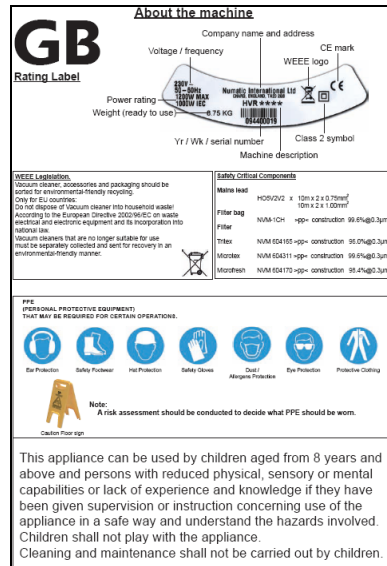


Figure 2b. ‘About the machine’

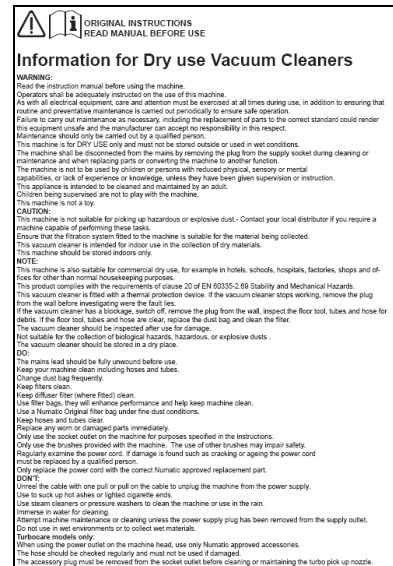


Figure 2c. Information for dry use vacuum cleaners

Figures 3a to 3c. English language information pages from the 20 language Technical Specifications booklet dated 23 February 2010

## 4.2 Unravelling the EU Declarations of Conformity

The vacuum cleaner had two EU declarations of conformity with different dates. The declaration in the owner instructions was dated 01/01/2013 and the declaration in the 20-language technical specifications booklet was dated 11/11/2009. The EU declaration should detail all the relevant European Directives to which the machine conforms, including the relevant test standards. The details of the two EU declarations are shown in Table 1.

Table 1. Details of the two EU declarations of conformity including standards referenced

EU Declaration of conformity (11/11/2009)		EU Declaration of conformity (01/01/2013)	
Machinery Directive 2006/42/EC	IEC 60335-1:2001+A1:2004+A2:2006+ National Deviations	Machinery Directive 2006/42/EC	IEC 60335-1:2001+A1:2004+A2:2006+ National Deviations
	IEC 60335-2-69:2002+A2		IEC 60335-2-69:2002+A1:2004
EMC Directive 2004/108/EC	EN 55014-1:2006	EMC Directive 2004/108/EC	EN 55014-1:2006
	EN 55014-2 1997 + A1 2001 (Cat II)		EN 55014-2 1997 + A1 2001 (Cat II)
	EN 61000-3-2: 2006		EN 61000-3-2: 2006
	EN 61000-3-3: 1995+A1+A2		EN 61000-3-3: 1995+A1+A2
Low Voltage Directive 2006/95/EC	IEC 60335-2-2:2002+A1+A2	Directive not listed	IEC 60335-2-2:2002+A1+A2
	EN 50366 2003 + A1 2006		EN 62233:2008
(No further listings)		RoHS Directive 2011/65/EC	(No standards listed)

Four Directives are referenced in the EU declarations of conformity and the Machinery Directive addresses noise. The European Commission website for the Machinery Directive (14) assists identification of the relevant harmonised standards listed on the EU declaration of conformity. Use and declaration of a harmonised standard carries a presumption of conformity with the Directive.

The two standards referenced for the Machinery Directive are IEC (International Electrotechnical Commission) standards. IEC standards are usually fully adopted as European EN standards. Investigation into the transposition of the IEC standards to EN standards determined that the IEC and EN documents were identical for the purposes of the tracing exercise. All harmonised EN standards are automatically accepted as British Standards (BS), and printed in English with the BS EN prescript.

The EN standards sometimes contain special national conditions and deviations. A special national condition is national characteristic or practice that cannot be changed even over long period, for example climatic conditions, electrical earthing conditions. A deviation is due to national regulations, the alteration of which is outside the competence of the national committee member drafting the standard. An example of special national conditions and a deviation for the UK are present in BS EN 60335-1:2012. The special national condition is to do with the minimum cross-sectional area of a supply cord conductor. The deviation is to do with the type of plug fitted to the supply cord.

## 4.3 Unravelling the Standards: Are They Harmonised?

For the Machinery Directive, both EU declarations of conformity referenced the same two parts of IEC 60335:

- Part 1, General requirements
- Part 2-69, Particular requirements for wet and dry vacuum cleaners, including power brush for commercial use

Investigation into the transposition of the IEC standards to EN standards had already determined that, for the purposes of the tracing exercise, the IEC and EN standards were identical. The tracing exercise followed the EN standards trail.

#### 4.3.1 EN 60335-1

At the time of the tracing exercise, the British Standards Institution (BSI) Technical Index listed four separately dated current versions of EN 60335-1:

- BS EN 60335-1:2012. Current, Work in hand. IEC 60335-1:2010 Modified
- BS EN 60335-1:2002+A15:2011. Current, Revised. IEC 60335-1:2002 Modified
- BS EN 60335-1:2002+A14:2010. Current, Work in hand. IEC 60335-1:2002 Modified
- BS EN 60335-1:1994+A2:2000. Current, Revised. IEC 60335-1:1991 Modified

The 1994 document contained no reference to noise, sound or airborne acoustics. Both 2002 documents and the 2012 document contained an identical clause that stated "... *airborne noise emissions, determined and declared in accordance with the relevant Part 2.*" (Clause 7.12.Z1 and Clause 7.12.ZE1 respectively).

The 2012 document is harmonised under the Machinery Directive. The 2002 documents were harmonised but superseded by the 2012 document. The 1994 document is not listed at all on the European Commission website for the Machinery Directive.

#### 4.3.2 EN 60335-2-69

At the time of the tracing exercise, the BSI Technical Index listed one current version of EN 60335-2-69:

- BS EN 60335-2-69:2012. Current. IEC 60335-2-69:2012 Identical & Modified

The European foreword details that a new Annex EE (normative) on acoustical noise emission has been added. Annex EE is the noise test code. It states that the emission  $L_{pA}$  is determined in accordance with ISO 11203. It also states that the emission  $L_{WA}$  is determined in accordance with ISO 3744, or with ISO 3743-1 or with ISO 9614-2. ISO 3744 and ISO 3743 have the same precision level but allow for the use of different environments. ISO 9614 is a different method.

Clause 7.12.102 "Information on noise" of BS EN 60335-2-69:2012 references the new Annex EE. EN 60335-2-69 is harmonised under the Machinery Directive.

#### 4.3.3 Where's IEC 60704-2-1 that was in the Data Page?

Careful reading of EN 60335-2-69:2012 revealed an undated reference in Annex ZC (normative) to IEC and EN 60312-1 "Vacuum cleaners for household use - Methods of measuring the performance". Clause 6 of EN 60312-1:2013 is titled "Miscellaneous tests" and Clause 6.15 "Noise" references EN 60704-1 and EN 60704-2-1. EN 60312-1:2013 also contains normative undated references to the EN 60704 family of standards. EN 60704 is generally titled "Household and similar electrical appliances. Test code for the determination of airborne noise."

At the time of the tracing exercise, the BSI Technical Index listed three separate current parts of EN 60704 relevant to the vacuum cleaner:

- BS EN 60704-1:2010+A11:2012. Household and similar electrical appliances. Test code for the determination of airborne noise. General requirements. Current. IEC 60704-1:2010 identical
- BS EN 60704-2-1:2001. Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances. Particular requirements. Particular requirements for vacuum cleaners. Current, Work in hand. IEC 60704-2-1:2000 Identical
- BS EN 60704-3:2006. Household and similar electrical appliances. Test code for the determination of airborne acoustical noise. Procedure for determining and verifying declared noise emission values. Current. IEC 60704-3:2006 identical

Part 1 primarily references the general ISO 374x sound power level family of standards as does Part 2-1. Part 3 largely self-references Part 1 and Part 2-1 with a vast amount of information relating to uncertainties and standard deviations. Part 3's bibliography does contain a dated reference to ISO 4871, concerning the declaration and verification of noise emission values of machinery and equipment.

None of the EN 60704 standards are harmonised under the Machinery Directive.

#### 4.4 Confusion at the Centre of the Vacuum Cleaner Maze

The owner's instruction manual for the vacuum cleaner, dated January 2014, contains an EU declaration of conformity citing the Machinery Directive. According to the EU declaration of conformity, the noise emission data should come from IEC 60335-2-69 (traced as an EN). However, the 2002 date on that standard is not listed on the European Commission website as being harmonised under the Machinery Directive. There cannot therefore be a presumption of conformity with the Directive by using this standard.

The noise emission information in the owner's instruction manual is cited as coming from

IEC 60704-2-1 (undated), also not harmonised. When traced as its equivalent EN standard, EN 60704, it can be linked to EN 60335-2-69, but only through normative references in EN 60312.

EN 60704-2-1:2001 is a test code for the determination of airborne noise for household appliances and would apply to vacuum cleaners. But it is not harmonised. Annex EE of EN 60335-2-69:2012 is also a test code and is harmonised. Working to a harmonised standard gives a presumption of conformity with the essential health and safety requirements (within the scope of that standard) of the relevant Directive. However, a harmonised standard may not necessarily be the most appropriate standard to use. Clarification is still required around these issues.

#### 4.5 Maze Navigation for Sound Pressure Level and Sound Power Level Declarations

This maze navigation alone demonstrates very clearly the difficulty a machinery manufacturer potentially faces when trying to determine the correct noise test code to use. Finding, following and understanding the machine specific standards, as well as all the normative references to general acoustics standards, is an enormous task.

### 5. CLOSING REMARKS

European Directives, which must be transposed into UK law, require noise emission information to be supplied with machinery. The standardisation surrounding and supporting these European Directives, and containing various instructions on how to measure and declare noise emissions, is complex and confusing to the well informed. Research undertaken by HSL so far has enabled a much deeper understanding of the complexities surrounding  $L_{WA}$  and  $L_{pA}$  measurement and declaration. At the time of submission, many questions remain unanswered such as:

- What is the value of the 600 standards containing the phrase “*noise emission*”?
- Would permitting use of the nearest suitable environment for  $L_{WA}$  and/or  $L_{pA}$  measurement be a simplification or are there pitfalls that need publicising?
- Is it worth determining the  $L_{WA}$  of production machinery (e.g. a woodworking machine while processing wood) or is the  $L_{pA}$  alone sufficient?
- Could the 'very large machinery' approach in the Machinery Directive provide a simpler alternative measurement than the current  $L_{WA}$  requirement, and would it also have other benefits?

The results of the NOMAD project showed that the difficulties described here are not confined to the UK but are spread across Europe. Moreover, the Europe-wide Buy Quiet campaigns that encourage end users to demand low noise equipment, place pressure on suppliers and manufacturers to provide noise information.

At the time of submission, it is not clear how the process of noise emission and declaration might be improved. Both HSL and HSE now have a much deeper understanding of the challenges, previously only anecdotal or theory. Both organisations also continue to challenge the amount of effort required to provide a noise declaration, and to emphasise the need to reduce noise at source using available technology and good design.

### ACKNOWLEDGEMENTS

The author would like to thank HSL colleagues Elizabeth Brueck, Jacqui Patel, Sue Hewitt and Paul Pitts and HSE colleague Paul Brereton for their maze navigation guidance. Thanks also go to the many premises and machine manufacturers who assisted HSL in gathering noise data and declaration information.

### REFERENCES

1. Council and Parliament Directive 2006/42/EC of 17 May 2006 on machinery
2. Council and Parliament Directive 2000/14/EC of 08 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
3. UK Statutory Instrument No. 1597, The Supply of Machinery (Safety) Regulations 2008
4. UK Statutory Instrument No. 1701, The Noise Emission in the Environment by Equipment for use Outdoors Regulations 2001
5. Patel J. Survey of noise emission and risk information supplied with a range of work machinery. Research Report RR962. HSE Books. <http://www.hse.gov.uk/research/rrpdf/rr962.pdf> (accessed 13 July 2014)



6. Buy Quiet <http://www.hse.gov.uk/Noise/buy-quiet/index.htm> (accessed 13 July 2014)
7. Brockett G, Châtillon J, Jacques J, Jeanjean G, Jensen JG, Juan y Seva Guevara B, Korver D, Kurtz P, Lankinen P, Marie PJR, Maujean C, Monica L, Szyszko M, Ward T. Report on the “NOMAD” project – A survey of instructions supplied with machinery with respect to noise and the requirements of the Machinery Directive. May 2012. <http://www.hse.gov.uk/noise/nomad-report.pdf> (accessed 13 July 2014)
8. Brueck EJ. Noise emissions and exposure from mobile wood chippers. Research Report RR618. HSE Books. <http://www.hse.gov.uk/research/rrpdf/rr618.pdf> (accessed 17 July 2014)
9. Brueck EJ. Standards and regulations for the declared noise emission of wood chippers. HSE Books. Research Report (in press)
10. British Standards Institution (2009) Forestry machinery – Wood chippers – Safety, British Standard, BS EN 13525:2005+A2:2009
11. British Standards Institution (2010) 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, British Standard, BS EN ISO 11201:2010
12. Shanks E. Noise in the printing industry: then and now. *Acoustics Bulletin*, Institute of Acoustics. September/October 2013. p. 42-44
13. Shanks E. Noise in the United Kingdom printing industry: then and now. *Proc INTER-NOISE 2014* (in press)
14. European Commission website for harmonised standards of the Machinery Directive 2006/42/EC [http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/machinery/index\\_en.htm](http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/machinery/index_en.htm) (accessed 13 July 2014)

## ANNEX A - A Plethora of Vacuum Cleaner Standards

Table A1 details the full designations of all the standards encountered during the tracing exercise for the vacuum cleaner.

Table A1. Full designations of all standards encountered during the tracing exercise for the vacuum cleaner

Standard Number	Standard Title
BS EN 55014-1:2006	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission
BS EN 55014-2 1997 + A1 2001 (Cat II)	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Immunity. Product family standard
BS EN 61000-3-2: 2006	Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current $\leq 16$ A per phase)
BS EN 61000-3-3: 1995+A1+A2	Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq 16$ A per phase and not subject to conditional connection
BS EN 50366 2003 + A1 2006	Household and similar electrical appliances. Electromagnetic fields. Methods for evaluation and measurement.
BS EN 62233:2008	Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure
IEC 60335-1:2001+A1:2004+A2:2006 +National Deviations	Household and similar electrical appliances. Safety. General requirements
IEC 60335-2-2:2002+A1+A2	Household and similar electrical appliances. Safety. Particular requirements for vacuum cleaners and water-suction cleaning appliances
IEC 60335-2-69:2002+A2	Household and similar electrical appliances. Safety . Particular requirements for wet and dry vacuum cleaners, including power brush for commercial use
IEC 60335-2-69:2002+A1:2004	
BS EN 60335-1:2012	Household and similar electrical appliances. Safety. General requirements
BS EN 60335-1:2002+A15:2011	

<b>Standard Number</b>	<b>Standard Title</b>
BS EN 60335-1:2002+A14:2010	
BS EN 60335-1:1994+A2:2000	
BS EN 60335-2-69:2012	Household and similar electrical appliances. Safety . Particular requirements for wet and dry vacuum cleaners, including power brush for commercial use
IEC 60312-1	Vacuum cleaners for household use. Dry vacuum cleaners. Methods for measuring the performance
BS EN 60312-1:2013	Vacuum cleaners for household use. Dry vacuum cleaners. Methods for measuring the performance
IEC 60704-1:2010	Household and similar electrical appliances. Test code for the determination of airborne noise. General requirements
IEC 60704-2-1:2000	Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances. Particular requirements. Particular requirements for vacuum cleaners
IEC 60704-3:2006	Household and similar electrical appliances. Test code for the determination of airborne acoustical noise. Procedure for determining and verifying declared noise emission values
BS EN 60704-1:2010+A11:2012	Household and similar electrical appliances. Test code for the determination of airborne noise. General requirements
BS EN 60704-2-1:2001	Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances. Particular requirements. Particular requirements for vacuum cleaners
BS EN 60704-3:2006	Household and similar electrical appliances. Test code for the determination of airborne acoustical noise. Procedure for determining and verifying declared noise emission values
BS EN ISO 11203:2009	Acoustics. Noise emitted by machinery and equipment. Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level.
BS EN ISO 3744:2010	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
BS EN ISO 3743-1:2010	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. Comparison method for a hard-walled test room
BS EN ISO 9614-2:1997	Acoustics. Determination of sound power levels of noise sources using sound intensity. Measurement by scanning
BS EN ISO 4871:2009	Acoustics. Declaration and verification of noise emission values of machinery and equipment

© British Crown copyright (2014)

*This publication and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.*