

# Survey of noise emission and risk information supplied with a range of work machinery

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# Survey of noise emission and risk information supplied with a range of work machinery

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Previous work has shown that the noise emission data provided by the manufacturers can be of variable quality and be based on standards that no longer exist. In some cases no noise emission data are provided at all. The Health and Safety Executive (HSE) needs to be in a position to challenge or support the validity of noise emission data or other information provided by manufacturers, to offer robust advice to dutyholders on the management of noise exposure based on this information, and facilitate the promotion of low noise machinery on a general or machine specific basis.

The aim of the project was to assess the suitability of information on noise emission required under the Supply of Machinery (Safety) Regulations and the Noise Emission in the Environment by Equipment for Use Outdoors Regulations for workplace risk assessment. The noise information provided by manufacturers and suppliers of a wide range of machine types for which noise declaration is required was assessed.

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## KEY MESSAGES

The Health and Safety Laboratory (HSL) assessed a sample of seventy-three sets of instructions across fourteen different machine types against the requirements of the Supply of Machinery (Safety) Regulations. The majority of instructions (82% of the sample) contained inadequate noise emission information. As a consequence, it is considered highly likely that purchasers and users of machinery will be unable to make informed choices regarding the safety of potential purchases or understand what control measures are necessary to mitigate the risks from noise during real use.

The most common reasons instructions failed to comply with the requirements of the Supply of Machinery (Safety) Regulations were absent or incomplete declared noise emission values, absent or incomplete traceability to operating conditions for declared noise emission values, and inadequate information on safe use, residual risk, or noise control measures.

Manufacturers and suppliers should be influenced to supply the required noise emission information, either through guidance or enforcement activities. Guidance is also needed on the responsibilities of manufacturers of partly completed machinery and bespoke machinery.



# EXECUTIVE SUMMARY

## Objectives

Previous work has shown that the noise emission data provided by the manufacturers can be of variable quality and be based on standards that no longer exist. In some cases no noise emission data are provided at all. The Health and Safety Executive (HSE) needs to be in a position to challenge or support the validity of noise emission data or other information provided by manufacturers, to offer robust advice to dutyholders on the management of noise exposure based on this information, and facilitate the promotion of low noise machinery on a general or machine specific basis.

The aim of the project was to assess the suitability of information on noise emission required under the Supply of Machinery (Safety) Regulations and the Noise Emission in the Environment by Equipment for Use Outdoors Regulations for workplace risk assessment. The noise information provided by manufacturers and suppliers of a wide range of machine types for which noise declaration is required was assessed.

## Main Findings

Following a review of over three hundred safety standards for machine types where noise was considered a significant hazard, HSE and Health and Safety Laboratory (HSL) noise specialists selected twenty machine types for further investigation based on: the equipment is likely to be a major contributor to significant noise exposure in the workplace, there is potential for reducing noise emission, for example by better design, and further investigation could make a positive contribution to reducing noise exposure in the workplace.

The noise emission information contained in the machinery instructions was analysed using the method developed for a European project, referred to as NOMAD, set up by the Administrative Cooperation Group for market surveillance under the Machinery Directive (Machinery ADCO). This method enabled both the quality of the noise emission data and its compliance with the requirements of the Machinery Safety Regulations to be assessed.

Seventy-three sets of instructions were obtained from the manufacturers and suppliers of fourteen different categories of tools and machines. The noise emission information contained in sixty sets of instructions (82% of the sample) failed to satisfy the requirements of the Supply of Machinery (Safety) Regulations for the following reasons:

- Absent or incomplete declared noise emission values.
- Absent or incomplete traceability to operating conditions for declared noise emission values.
- Lack of adequate (or in some cases any) information on safe use, residual risks, or noise control measures.

The information contained in thirteen sets of instructions satisfied the requirements of the Supply of Machinery (Safety) Regulations; six were judged as including comprehensive and high quality noise data and information. Most of the compliant instructions were for tools and machines in the following categories: compaction machines, powered lawnmowers, and edge banding machines.

It is considered highly likely that purchasers and users of machinery, who are supplied with inadequate (or missing) noise emission information, will be unable to make informed choices regarding the safety of potential purchases or understand what control measures are necessary to mitigate the risks from noise during real use.

## **Recommendations**

Manufacturers and suppliers should be influenced to supply users with the required noise emission information, either through guidance or enforcement activities. Guidance is also needed on the responsibilities of manufacturers of partly completed machinery and bespoke machinery.

Several machine categories were identified during this study where further investigation of the noise emission and real use noise exposure should be considered. These include granulators, shredders, masonry and stone cutting machines, floor cutting-off machines, and balers/compactors. These machine types were chosen because:

- They generate very high noise levels.
- The standard noise emission data is unlikely to provide the user with a realistic understanding of the risk during real use.
- The machines are used in a growth area and there is little information on the actual risk due to noise exposure during real use.

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# 1. INTRODUCTION

The European Machinery Directive (89/392/ECC, 98/37/EC and 2006/42/EC) was introduced to enable free trade and consistent standards of safety across Member States and European Free Trade Agreement (EFTA) countries. A wide range of standards has been developed to assist and enable compliance with some or all of the essential health and safety requirements of the Directive. These standards – commonly referred to as harmonised standards – can provide manufacturers with a straightforward route to conformity with relevant essential health and safety requirements. This simple framework enables manufacturers to comply with their legislative duties under the Directive as implemented in Member States, for example the Supply of Machinery (Safety) Regulations 2008 have implemented the Machinery Directive into UK law. These Regulations are referred to as the Machinery Safety Regulations throughout this report.

The Machinery Safety Regulations place duties on machine manufacturers and suppliers to design and construct their products in such a way that the risks resulting from the emission of airborne noise are reduced to the lowest level taking account of technical progress and the availability of techniques for reducing noise, particularly at source. There is also a requirement for manufacturers and suppliers to provide information on noise emissions in instructions accompanying the product, and in technical documents describing the product such as technical sales literature. The information that must be supplied, according to the Machinery Directive (2006/42/EC) is:

- Declaration of noise emissions, to include:
  - The A-weighted emission sound pressure level at workstations, where this exceeds 70 dB; where this does not exceed 70 dB, this fact must be indicated.
  - The A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB.
  - The peak C-weighted instantaneous sound pressure value at workstations, where this exceed 63 Pa (130 dB).
- Any measures needed to keep noise under control when the machine is used (ie instructions for safe use).
- Instructions showing how the machinery should be assembled or installed to reduce noise or vibration (eg by using anti-vibration mounts).

It should be noted that the current version of the Machinery Directive (2006/42/EC) extended the duties on manufacturers to include the same information on noise emissions as is contained in the instructions in the sales literature describing the performance characteristics of the machinery, as well as reducing the level from 85 to 80 dB above which the declared sound power level is required.

The supplier must also provide warnings about risks that have not been eliminated and which the user will need to manage, ie residual risks. This includes, for example, any training requirements for correct use of the machine, instructions for mounting, and any need to restrict the duration of use during a typical working day. The purpose of declaring this information is to allow purchasers and users of machinery to make informed choices regarding the safety of a potential purchase and to understand what measures will be necessary to mitigate the risk in real use.

The Noise Emission in the Environment by Equipment for Use Outdoors Regulations 2001 (referred to as the Outdoor Equipment Regulations throughout this report) also place duties on manufacturers and suppliers of certain categories of equipment commonly used outdoors, including:

- Provide information on the sound power emitted by the machine.
- For some of the machines covered by the Outdoor Equipment Regulations, meet set targets for the sound power emitted (ie the manufacturer is required to declare a guaranteed sound power level that does not exceed the applicable permissible sound power level laid down in the Outdoor Equipment Regulations).

Previous work has shown that the noise emission data provided by manufacturers can be of variable quality and be based on standards that no longer exist. In some cases no noise emission data are provided at all. The Health and Safety Executive (HSE) needs to be in a position to challenge or support the validity of noise emission data and other information provided by manufacturers, to offer robust advice to dutyholders on the management of noise exposure based on this information, and to facilitate the promotion of low noise machinery on a general or machine specific basis.

The objective of the project described here was to assess the suitability of information on noise emission required under the Machinery Safety Regulations and the Outdoor Equipment Regulations for workplace risk assessment. The noise information provided by manufacturers of a wide range of machines, tools and equipment, for which noise declaration is required, was assessed. The Machinery Directive requires manufacturers to provide instructions, also commonly referred to as instruction handbooks and instruction manuals. Throughout this report the term “instructions” is used to describe the noise emission information provided by manufacturers and suppliers.

The aims of the work were:

- To review the machine categories for which information is provided and to identify categories suitable for further investigation.
- For selected machines categories, assess the quality of noise information provided by manufacturers.

## 2. REVIEW OF MACHINE CATEGORIES

A number of machine types were identified during the first part of the project based on the likelihood that this equipment, under conditions of typical use, is a major contributor to significant noise exposures in the workplace. The British Standards Institution (BSI) website was searched to identify standards and test codes, which included a noise clause, based on the search criteria:

((noise emission) NOT (domestic or alarm or railway)) AND (current standards)

Several draft standards were identified by this search. Additional harmonised standards, produced by CEN and CENELEC in support of the Machinery Directive 98/37/EC, were also identified from the list of harmonised standards detailed at:

[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) (23/10/2012)

An Excel spreadsheet was compiled containing details of 600 standards and noise test codes, which had been identified during the initial search. Since this number of standards could not be reviewed in detail within the timescale of the project, all draft and acoustics (eg measurement and analysis standards) standards were excluded; this reduced the list of standards to about 500. With the help of HSE Noise and Vibration Specialist Inspectors, the list was further reduced based on their experience as inspectors. Machine types were excluded because they were:

- Unlikely to generate high noise levels.
- Not widely used.
- Used in work environments alongside machine types generating much higher noise levels.

Appendix A contains details of the information contained in the spreadsheet and of the machine types excluded from the review.

The noise clauses contained in the remaining 500 standards were assessed against the criteria detailed in Appendix A. This assessment identified over 300 standards covering machine types for which noise was considered a significant hazard. From this list, HSE and HSL noise specialists compiled a list of machine types based on:

- Machine types for which the risk from exposure to the noise they generate is likely to be significant during normal use.
- Machine types that represent a range of different characteristics, for example mobile/static, long and short anticipated lifespan, large plant/hand-held equipment, etc.
- Machine types widely used across a number of different industry groups.
- Machine types confined to particularly high noise industry sectors.
- Machine types covered by safety standards with noise clauses that fulfil the requirements of BS EN 1746: 1999 *Safety of machinery – Guidance for the drafting of the noise clauses of standards*, such that they contain specific noise control design solutions and information on residual risks.
- Machine types covered by safety standards with noise test codes that include either apparently realistic or unrealistic operating conditions.
- Machine types covered by safety standards with poor noise clauses, for example those requiring manufacturers to provide noise emission data without providing any guidance how the data should be obtained.

This review identified twenty machine types for further investigation. Details of these machine types are given in Appendix B, with information on the relevant safety standards, including noise reduction guidance or requirements and noise test codes.

### **3. ASSESSMENT OF NOISE EMISSION DATA**

The following process was used to obtain and assess noise emission data for the selected machine types:

- Obtain information (technical and/or appropriate sales literature) from up to five manufacturers and suppliers of each machine type.
- Assess the availability, range and quality of the supplied information.
- Objectively assess the noise emission data provided by manufacturers and suppliers in instructions and technical/sales literature, to establish what information is actually supplied (such as declared noise emission data, residual risk, low-noise features, training requirements).
- Review the noise emission data supplied to check its compliance with the Machinery Safety Regulations, that the meaning of the information is clear and easy to understand, and that the data has been obtained according to an appropriate, defined test method.
- Note low-noise features.
- Summarise the results and use them to prioritise machine types for further investigation.

#### **3.1 METHOD FOR OBTAINING NOISE EMISSION DATA**

An Internet search was used to obtain contact details for manufacturers and suppliers of the twenty machine types selected for further investigation. This method was effective for some machine types, for example blade granulators, floor cutting off-saws and powered lawnmowers. Relevant contact details were obtained and instructions available as Internet downloads were identified. However this approach was not successful for other machine types. One of the main difficulties was that for some machine types, the standard definitions were different from those used commercially to describe the products, for example “non-threaded mechanical fasteners” and “stationary and mobile equipment for long line manufacture of prestressed products”.

In total 100 contacts were identified. Instructions were obtained from 52 of the contacts, 18 of the contacts failed to respond to multiple requests from HSL for instructions, and 30 of the contacts did not provide instructions for a number of reasons, including:

- The contacts buy and sell used machines and pass on instructions only if available.
- The contacts do not, or no longer, supply tool/machinery.
- The contacts are agents who never see instructions.
- The contacts are in the process of closing down/merging.

HSL were unable to identify UK or European manufacturers or suppliers for six machine categories.

The project highlighted a number of problems associated with HSL staff directly approaching manufacturers and suppliers, including:

- Some contacts were very unhelpful once they knew the work was being carried out on behalf of HSE.
- Suppliers did not always have instructions, whether in the form of instruction handbooks, operating instructions, or safety instructions. Agents typically did not even see the machines.
- Some instructions had a cost value (between £10 and £250) and as such the manufacturers and suppliers were unwilling to give them away for free. In some

cases, they were persuaded to email relevant pages but this could result in incomplete information (noise emission data can be spread throughout instructions, which means it can be easy to overlook some relevant information).

- Some manufacturers claimed that they did not produce standard instructions because they made bespoke products.
- Some manufacturers (of food processing machines in particular) generally saw their products as components that would be fitted into a larger machine/plant. In these cases, there was some confusion about who is responsible for producing instructions for the complete machine; the manufacturer of what was perceived as a component left the responsibility with the company assembling the complete machine. According to the Machinery Safety Regulations, manufacturers of partly completed machinery have to produce technical data that is incorporated into the instructions for the complete product. No such data was made available to HSL.
- Requests from HSL were commonly ignored, presumably because participation in this research was on a voluntary basis and because HSL staff do not have the same enforcement powers as HSE. Once this became apparent, the HSE customer drafted a letter on HSE letter headed paper, which was emailed to manufacturers and suppliers after initial contact had been made; this was intended to encourage participation in the project. Sixty-one letters were sent to manufacturers and suppliers. HSL received instructions in response to 25 of these letters; 36 letters were ignored, and within this group 13 failed to respond when the HSE letter was resent to them.
- It was difficult to communicate effectively with European (non-English) speaking manufacturers.

Towards the end of the project postal requests, which included a copy of the letter from the HSE customer, were sent to the managing directors of many companies who had ignored earlier requests. Direct contact with managing directors resulted in 20 sets of instructions for inclusion in the study; this approach should be considered for similar future studies.

### **3.2 METHOD FOR ANALYSING NOISE EMISSION DATA FROM INSTRUCTIONS**

The noise emission information contained in instructions, or the documents provided by manufacturers and suppliers, was analysed using the method developed for the NOMAD (NOise MACHinery Directive) project. This European-wide survey was developed by the Administrative Cooperation Group for market surveillance under the Machinery Directive (Machinery ADCO). The aim of the survey was to investigate the quality of noise emission data machine manufacturers provide in instructions, in accordance with the noise clauses of the Machinery Directive (98/37/EC and 2006/42/EC).

The UK was one of a number of Member States who contributed to the NOMAD project; others included France, Germany, Spain, Norway, and Cyprus. Noise emission data includes declared noise emission values, residual risk information, and instructions for safe use. The noise emission data obtained from the instructions described in this report were input to the NOMAD project as the UK contribution.

The NOMAD project team designed an electronic template for collecting noise emission data from instructions, which was used by all Member States taking part in the project. Use of the template ensured that all the relevant noise emission data were collected using a consistent approach. A similarly structured approach was developed for analysing the noise emission data, which was used here. Appendix C contains a copy of the NOMAD assessment grid used for the analysis, which enabled both the quality of the noise emission data and its compliance with the requirements of the Machinery Safety Regulations to be assessed.

Based on the results of the completed assessment grid, the noise emission information included in each set of instructions was categorised as:

- *C(i)* Compliant – Information correct and very clear
- *C(ii)* Compliant – Information correct and understandable
- *NC(i)* Not compliant – Some correct information
- *NC(ii)* Not compliant – Information absent or unusable

## 4. RESULTS AND DISCUSSION

Table 1 contains details of the instructions obtained for each machine category, the source of the instructions, and the number of instructions that were compliant or not compliant with the requirements of the Machinery Safety Regulations.

### 4.1 SUMMARY OF ANALYSIS OF INSTRUCTIONS

#### 4.1.1 Packaging machines (BS EN 415)

Requests for instructions were made to five manufacturers and suppliers of packaging machines, however only three sets of instructions were obtained: two vertical packing machines (BS EN 415-3) and one wrapping machine (BS EN 415-6). The noise emission data in all three sets of instructions failed to satisfy the requirements of the Machinery Safety Regulations. One set of instructions contained no noise emission data; it was for a machine manufactured in China, which the UK importer had decided was inadequate for the European market with regard to safety. This particular supplier was aware of its responsibility for putting a safe product on the UK market, and for ensuring the claims made by the manufacturer are true. The company does some of this in-house, for example checking guarding requirements; however, it also uses external consultants, for example for assessing noise emission.

Two sets of instructions included noise emission values, which declared that equivalent continuous A-weighted sound pressure levels experienced by the operators would not exceed 76 dB. However neither instructions referenced a relevant safety standard, noise test method, operating conditions, etc therefore it was difficult to assess the credibility of this noise data.

Personal correspondence with two suppliers showed they understood that the declared noise emission data might not reflect the noise generated by the machine during real use. In personal correspondence, one supplier made the comment:

*“The noise level is a maximum for the machine running in the manufacturing factory conditions. It is possible that machines in production could have an increased noise level, but this would be due to the application and not generated directly by the machine. For example, frozen chicken pieces falling onto stainless steel are quite noisy, but this is an application noise and not machine generated.”*

Unfortunately, this information was not included in the instructions, although it is quite clearly needed by the users in order to understand the limitations of the standard noise emission data provided.

The safety standard for vertical packaging machines (BS EN 415-3) specifies measurement locations and operating conditions: machine running dry and if possible when running with the product for which the machine has been specified or a representative product. None of the instructions for vertical packaging machines included in this study referenced BS EN 415-3, perhaps indicating a lack of awareness of either the requirements of the Machinery Safety Regulations or the safety standard.

**TABLE 1: Details of instructions obtained for each machine category**

Machine type	Number of instructions	Source of instructions	Number of templates compliant or not with the requirements of the Machinery Safety Regulations					
			Compliant (C)			Not compliant (NC)		
			C(i)	C(ii)	Total	NC(i)	NC(ii)	Total
Packaging machines	3	Manufacturers, authorised agents	0	0	0	1	2	3
Food processing machinery	5	Manufacturers, authorised agents	0	0	0	1	4	5
Compaction machines	6	Internet downloads	2	1	3	3	0	3
Hand-held non-electric power tools – assembly tools for non-threaded mechanical threaded fasteners	8	Suppliers, internet downloads	0	0	0	4	4	8
Powered lawnmowers	7	Internet downloads	0	4	4	3	0	3
Edge banding machines	2	Authorised agents	2	0	2	0	0	0
Band re-saws	4	Manufacturers, internet downloads	0	1	1	2	1	3
Blade granulators	5	Manufacturers, authorised agents	1	0	1	1	3	4
Shredders	3	Authorised agents	0	0	0	3	0	3
Masonry and stone cutting machines	7	Manufacturers, authorised agents, internet downloads	0	0	0	6	1	7
Machines for manufacture of precast reinforced concrete products	1	Manufacturer	0	0	0	0	1	1
Machines for manufacture of prestressed concrete products	0	No instructions obtained	0	0	0	0	0	0
Floor cutting-off machines	4	Internet downloads	0	0	0	4	0	4
Cold flat rolling mills	0	No instructions obtained	0	0	0	0	0	0
Automatic back splitting machines	0	No instructions obtained	0	0	0	0	0	0
Transportable circular saw benches	5	Manufacturers, suppliers	1	0	1	1	3	4
Compactors/ balers	13	Manufacturers, authorised agents, suppliers	0	1	1	5	7	12
Yarn twisting/ processing machinery	0	No instructions obtained	0	0	0	0	0	0
		<b>Totals</b>	<b>6</b>	<b>7</b>	<b>13</b>	<b>34</b>	<b>26</b>	<b>60</b>

#### **4.1.2 Planetary mixers, rotating bowl cutters, mixers with horizontal shafts (BS EN 454, BS EN 12855, BS EN 13389)**

Requests for instructions were made to nine manufacturers and suppliers of food processing machines; five sets of instructions were obtained. The noise emission data included in these instructions did not satisfy the requirements of the Machinery Safety Regulations.

One of the better sets of instructions was only missing the sound power level ( $L_{WA}$ ), which was required as the sound pressure level ( $L_{pA}$ ) was 93 dB. The supplier of this machine provided the following information, which confirmed the credibility of the noise test code contained in BS EN 12855:

*“The noise generated does depend on knife speed but also on the type of material being processed. The final size of the particulate (ie coarse or fine emulsion) will also influence the noise level generated by the machine. The finer the emulsion produced, the higher the noise level, in fact water will produce one of the highest noise levels in this machine type.”*

BS EN 12855 specifies that a noise cover shall be provided for all types of rotating bowl cutters. Although the standard defines the noise cover as “*equipment for covering the part of the bowl, which is not covered by the blade cover, intended to decrease the noise emitted by the cutting set*” it does not specify any acoustic characteristics for the cover.

BS EN 12855 also specifies that:

*“The noise cover for machines with a bowl volume greater than 30 litres shall be interlocked with the blade drive so that only half maximum speed can be achieved when the noise cover is open.”*

A noise protection/noise dampening cover was described in the instructions of the two machines covered by BS EN 12855. The instructions also included a statement that “*when opening the noise dampening or vacuum hood the knife speed will be reduced to 50% of the maximum speed*”, which will further reduce the noise exposure of the operator. It was encouraging to see that the manufacturers had complied with the requirements of the safety standard.

Two sets of instructions declared *noise levels* < 70 dB(A) in accordance with an inappropriate standard EN ISO 12001. The purpose of this standard is to assist technical standardisation committees prepare noise test codes; it does not contain a measurement method or operating conditions. The credibility of the noise declarations in these instructions is therefore in doubt, both in terms of traceability and usefulness to the user about actual risk during use. Another set of instructions included an *idling noise level* of 75 dB(A) in accordance with a basic measurement standard for sound power. The credibility of this value to the user was questionable since it was unclear whether the value referred to the sound pressure level,  $L_{pA}$  or sound power level,  $L_{WA}$ .

Only one set of instructions included a credible declared noise emission value in terms of traceability to realistic operating conditions and relevance to the user with regard to actual risk; the emission noise level was  $L_{pA}$  93 dB.

#### **4.1.3 Compaction machines (BS EN 500-4)**

Six sets of instructions were downloaded from the websites of four manufacturers of compaction machines. All the instructions contained noise emission values, which had been obtained in accordance with the appropriate safety standard, and information on safe use and hearing protection. The noise emission data in three sets of instructions fully complied with the requirements of the Machinery Safety Regulations; two in particular were of a very high standard, containing comprehensive safety information, for example highlighting the

importance of training and warning that the use of hearing protection might compromise the audibility of warning signals.

Both the Machinery Safety Regulations and the Outdoor Noise Regulations cover compaction machines. The Outdoor Noise Regulations include a noise test method for  $L_{WA}$ ; they do not require an  $L_{pA}$  declaration although the safety standard BS EN 500-4 referenced in the Outdoor Noise Regulations includes a noise test method for both  $L_{pA}$  and  $L_{WA}$ . The test method in BS EN 500-4 potentially gives realistic noise emission data as it requires measurements during actual operation on a course of gravel. Unfortunately, three sets of instructions did not include  $L_{pA}$  data and therefore failed to satisfy fully the requirements of the Machinery Safety Regulations.

The noise emission values were relatively consistent across all compaction machines:  $L_{pA}$  values were between 90 and 95 dB and,  $L_{WA}$  values were between 101 and 108 dB. The  $L_{WA}$  values for five of the six compaction machines were between 107 and 108 dB. The applicable permissible sound power level, specified in the Outdoor Noise Regulations for compaction machines whose net installed power is less than 70 kW, is between 108 and 109 dB. These  $L_{WA}$  values may indicate that manufacturers design their products in such a way so that noise emission values are just within any specified limits, rather than attempting to achieve as low a level as possible as required by the Machinery Safety Regulations.

#### **4.1.4 Hand-held non-electric power tools – assembly tools for non-threaded fasteners (BS EN 792-1)**

This was one of the categories for which it was difficult to identify the correct tool, based on the descriptions contained within the appropriate safety standard. BS EN 792-1 covers: breakstem fastener, rivet or plug tools; breakstem lockbolt tools; mandrel loaded riveting tools; and rivet nut setters. These terms were used to search for manufacturers and suppliers of assembly tools for non-threaded fasteners. Nine manufacturers and suppliers were approached and eight sets of instructions were obtained. One set of instructions consisted of a list of part numbers but was included in the study as it is the only information provided to the supplier by the German manufacturer.

The instructions for three of the tools – speed fastener air tool, breakstem fastener, and lockbolt tool – referenced BS EN 792-13, which covers fastener-driving tools. Unfortunately different noise test methods and operating conditions are referenced in BS EN 792-1 and BS EN 792-13:

- BS EN 792-1 references BS EN ISO 15744. It is unclear which of the tool families described in BS EN ISO 15744 covered non-threaded fasteners and therefore the exact operating conditions are unclear, although all the tools are generally tested under no load.
- BS EN 792-13 references BS EN 12549, which requires the measurement of both single-event  $L_{pA,1s}$  and single-event  $L_{WA,1s}$ ; the tools are tested with the largest fasteners and intended energy specified by the manufacturer.

According to BS EN 12549, the fasteners are driven into wood, even though the tool is intended for use with a variety of different materials, including metal and plastic. There is some uncertainty therefore whether the noise emission data obtained under the standard test conditions is a good indicator of noise risk under normal use.

The information contained in all the instructions did not fully satisfy the requirements of the Machinery Safety Regulations. The main reasons were credibility of the declared noise levels with regard to the actual risk during use, and absence of information for safe use. Six sets of instructions claimed *noise levels* < 79 dB(A); only the battery powered cordless framing nailer declared higher noise emission data ( $L_{pA}$  96 dB and  $L_{WA}$  103 dB). Two sets of

instructions included  $L_{pA}$  values but referenced measurement standards for sound power; this contradictory information may be confusing to the user.

BS EN 792-1 identifies the main sources of noise as the power tool itself, the inserted tool, and the workpiece. Some guidance is given to reduce noise including use of a well-designed silencer, and acoustic isolation and vibration damping to reduce vibration-induced noise. Vibrating surfaces are likely to be a significant source of noise, and should be identified in the instructions. None of the instructions contained information on noise control.

#### **4.1.5 Powered lawnmowers (BS EN 836)**

Seven sets of instructions from five different manufacturers of powered lawnmowers were downloaded from the Internet. Four sets of instructions contained information that complied with the requirements of the Machinery Safety Regulations. None of these instructions were assessed as exceptional (category C(i)) because none included all of the information as required by BS EN 836:

*“If after taking all possible technical measures for reducing noise at the design stage a manufacturer considers that further protection of the operator is necessary, then the instruction handbook shall: recommend the use of low-noise operating modes, and/or limited time of operation; give a warning of the noise level and recommend the use of hearing protection.”*

In general, the instructions advised the use of hearing protection and the replacement of faulty silencers.

Three sets of instructions contained incomplete information and therefore did not comply with the requirements of the Machinery Safety Regulations; one set of instructions contained no guidance on the need for hearing protection even with a declared  $L_{pA}$  value of 88 dB; two sets of instructions did not include  $L_{pA}$  values. Lawnmowers are also covered by the Outdoor Noise Regulations, which only require an  $L_{WA}$  declaration. Although the noise test methods in both BS EN 836 and the Outdoor Noise Regulations (which references ISO 11094) contain the same operating conditions and measurement locations, ISO 11094 only requires the measurement of  $L_{WA}$ .

The declared  $L_{pA}$  values were between 83 and 94 dB. HSL measured the noise levels generated by lawnmowers during normal use. At the operator's ear,  $L_{Aeq}$  values were between 83 and 85 dB for rotary type mowers and between 75 and 82 dB for cylinder-type mowers. These measured levels were generally comparable with the declared  $L_{pA}$  values provided with the lawnmowers tested, confirming the credibility of the manufacturer's data for providing the user with information on actual risk.

The declared  $L_{WA}$  values were between 95 and 105 dB. As observed for other tools covered by the Outdoor Noise Regulations, the declared  $L_{WA}$  values were just within the applicable permissible sound power levels, which are between 96 and 105 dB depending on the cutting width of the lawnmower.

#### **4.1.6 Edge banding machines (BS EN 1218-4)**

No UK manufacturers of edge banding machines were identified. UK suppliers confirmed that most edge banding machines are manufactured in Italy and Taiwan. One supplier was unable to provide instructions because these are included in the boxes with machine; he thought the instructions might not contain any noise data. Instructions for two different machines were obtained, which contained comprehensive and high quality noise emission data.

The  $L_{pA}$  values were between 78 and 83 dB and the  $L_{WA}$  values between 91 and 99 dB. The instructions referenced BS EN 1218-4, which requires noise measurements under no load and

load conditions. The noise emission values were considered credible both in terms of traceability and providing the user with information on actual risk during normal use. The instructions also stated that soundproof booths were installed on the machines and that hearing protection was compulsory during machine use. The advice regarding the use of hearing protection is perhaps surprising given the declared  $L_{pA}$  values were less than 83 dB.

#### **4.1.7 Band re-saws (BS EN 1807)**

Only one UK manufacturer of band re-saws was identified; it provided instructions for a radial arm band resaw. Three other sets of instructions were downloaded from the websites of European manufacturers. Instructions were obtained for two band saws and a log house moulder.

The noise emission data for only one of the machines satisfied the requirements of the Machinery Safety Regulations although noise control information could have been better, based on the guidance included in BS EN 1807. According to this standard, the instructions shall include a warning regarding residual risks as:

*“Instructions on factors that influence exposure to noise. This includes: the use of saw blades designed to reduce the emitted noise; optimum speed selection; saw blade and machine maintenance; regular maintenance of saw blades, extraction system, cleaning and lubrication of the saw blade etc is necessary to help control machine noise;”*

The declared noise emission values contained in the four sets of instructions varied, however this was probably due to the fact that the machine types were different. Noise emission data was provided for no load conditions (eg not cutting, idling, empty machine) and under load (eg cutting, during sawing) as required by BS EN 1807. The  $L_{pA}$  values for no load conditions were between 73 and 84 dB; under load the  $L_{pA}$  values were between 82 and 100 dB. It is likely the noise data were credible based on the noise test code contained in BS EN 1807, and therefore useful for providing the user with information on the actual risk during use.

The three sets of instructions that failed to comply with the requirements of the Machinery Safety Regulations for noise emission did so because of the lack of useful information on noise control.

#### **4.1.8 Blade granulators (BS EN 12012-1)**

Requests for instructions were made to nine manufacturers and suppliers of blade granulators; five sets of instructions were obtained. Two agents were contacted who confirmed that they facilitated the purchase of new equipment between US manufacturers and purchasers and did not see either the product or the associated literature.

The noise emission information in only one set of instructions satisfied the requirements of the Machinery Safety Regulations. Although the instructions did not reference the safety standard for granulators, the operating conditions and measurement locations included in the instructions were identical to those specified in BS EN 12012-1. This traceability and the realistic operating conditions gave credibility to the declared  $L_{pA}$  value of 83 dB.

The noise emission information in the instructions for the other four granulators failed to comply with requirements of the Machinery Safety Regulations because it contained no numerical data or the data lacked credibility with regard to operating conditions or measurement locations.

One contact approached confirmed he was an agent for a Chinese manufacturer, who claimed that the granulator conformed to noise regulations. However, the UK agent realised that the

instructions provided were inadequate and had rewritten them to improve the English and include some safety guidance, as shown below:

*“Approximate noise value <80 dB(A) (no load); likely to exceed 85 dB(A) under load depending on the type of material being processed.”*

*“What is the noise level around the machine? If this exceeds the maximum permitted levels then suitable safety precautions must be taken including ear protectors and/or sound attenuation enclosures. (The company) would be happy to assist and advise on this if necessary. More information about acceptable noise levels can be obtained from the HSE website [www.hse.gov.uk](http://www.hse.gov.uk).”*

Although this text demonstrates some knowledge of current noise legislation, the lack of noise emission values for the granulator highlights the need for guidance for manufacturers and suppliers on their duties under the Machinery Safety Regulations. The use of “noise level” rather than sound power level or sound pressure level further highlights the need for guidance.

Declared noise emission values provided for the five granulators varied widely, with  $L_{pA}$  values between 68 and 85 dB during idling and between 110 and 120 dB (presumably not during idling). These wide ranges highlight the importance of traceability, for without reference to operating conditions or measurement locations such data is of limited use for assessing the risk during normal use.

#### **4.1.9 Shredders (BS EN 12012-3)**

Six manufacturers and suppliers of shredders were contacted; three provided instructions. None of the instructions contained information that satisfied the requirements of the Machinery Safety Regulations. The main issue was lack of traceability for the declared emission data making it difficult to assess properly the credibility of the noise emission values included in the instructions. One set of instructions referenced the Outdoor Directive 2000/14/EC so that the  $L_{WA}$  values were at least traceable, if not the  $L_{pA}$  data.

The safety standard for shredders requires noise measurements under no load conditions. However Annex A (normative) of BS EN 12012-3: 2001+A1: 2008 contains the note:

*“This clause specifies only operating conditions with no load. The reason is that shredders can only operate at the manufacturer’s place with no load and manufacturers presently do not measure noise emission at the user’s place when installing new machines. However, it is recognised that noise emission of shredders with no load is not representative of the noise emitted in normal operation, ie under load. It is therefore recommended that manufacturers start gathering noise emission data under load. This data can be obtained from measurements carried out by manufacturers at user places on machines newly installed or during the installation phase of new machines. From this data, manufacturers will progressively become able:*

- to assess the effectiveness under load of the noise control measures they implement at the design stage;*
- to provide users with noise emission values that can be expected for various possible loads.*

*Noise emission data under load can be obtained at the user place using existing in-situ measurement methods....”*

Although the safety standard recommends measuring the noise generated under load in-situ, only one manufacturer appeared to have done this. Also, it is unusual that the safety standard appears to allow manufacturers to provide declared noise emission data (under no load) that is

of limited use, and only recommends rather than requires the measurement of noise emission data under load.

The safety standard also includes guidance on methods of reducing noise, for example using enclosures, reducing cutting speed and anti-vibration mounts. However all three sets of instructions just stated that hearing protection was needed.

$L_{pA}$  values were between 82 and 103 dB; the higher level was obtained during operation and it was assumed that the lower values were measured under no load conditions. The wide range of sound pressure levels highlights the importance of providing the user with all the relevant information so that the actual risk during use can be assessed properly; for example by stating the operating conditions under which the measured noise levels were obtained.

In personal correspondence, one supplier of shredders made the comments:

*“I have been going through some of the manuals for the plastic and rubber shredders, but there are no noise levels for these. This is because they are a static electric powered machine, which run quietly. The noise is made from the material that is being shredded. For instance, a hard brittle plastic will create a louder noise than soft rubber. It is therefore up to the customer to carry out their own noise testing once they have decided what material they will be putting through their shredder. The sound level would also vary depending on the size of the building that the machine was situated in.”*

It should be made clear to those purchasing shredders that declared noise emission data might not reflect the noise levels generated under normal operating conditions, and that noise levels are dependent on the material being processed; for example by clearly stating it in the instructions.

Contact was made with an agent who supplies shredders and balers from Finland, Portugal, America and China. He stated that importing machines from China, compared with Europe, could make much greater profits. The agent confirmed that he rarely sees noise information in instructions. He also deals with second-hand machines, which may or may not have instructions.

#### **4.1.10 Masonry and stone cutting machines (BS EN 12418)**

Requests for instructions were made to seven manufacturers and suppliers of masonry and stone cutting machines; seven sets of instructions were provided by four of the contacts. The noise emission information in all the instructions failed to comply with the requirements of the Machinery Safety Regulations. One set of instructions contained particularly unreliable noise data, with identical dB(A) and dB(C)max values of 62.7 dB, both without and under load. All the instructions referenced the appropriate safety standard BS EN 12418. This standard was first issued in 2000 and then revised in 2009. However, none of the instructions indicated which version of the standard was used. The noise test code in BS EN 12418: 2000 requires noise measurements at maximum speed no load; following the revision in 2009, noise measurements are now carried out at maximum speed and cutting through concrete. Therefore reference to the correct version (either 2000 or 2009) of BS EN 12418 is important to assess whether the noise values provide the user with relevant information about the actual risk during use.

$L_{pA}$  values for masonry saws were between 74 and 95 dB and the  $L_{WA}$  values were between 89 and 113 dB (note that the term sound energy level was used in place of  $L_{WA}$ , which was confusing). Information contained in some sets of instructions showed that the noise generated by petrol driven tools could be up to 14 dB higher than the noise generated by electric tools, suggesting engine noise is significant. The significance of engine noise during real use is unclear, especially for those machines tested under no load, and should be investigated further.

Advice to users on noise control generally consisted of “*hearing protection must be worn*”.

#### **4.1.11 Machines for the manufacture of precast reinforced concrete products (BS EN 12629-6)**

According to BS EN 12629-6 there is no customary term for the machinery dealt with by this standard. The term featured in the title is one term commonly used, but other terms may be encountered. This made searching for appropriate manufacturers and suppliers difficult.

A general search for “precast concrete products” identified five potential manufacturers and suppliers, however only one provided instructions, which was for a modular extruder. The other contacts included manufacturers of concrete products, manufacturer who was no longer in the concrete business as it was considered to be a shrinking market, and an agent with no access to the instructions provided to users.

The instructions for the modular extruder contained no declared noise emission data and therefore did not satisfy the requirements of the Machinery Safety Regulations. They did include advice that hearing protection should be worn at all times when operating the machine. However, it was unclear how the user should select suitable hearing protection with no indication of the level of noise typically generated by the machine. The instructions also included the statement:

*“Sound proofing and protective panels have been fitted to the machine to reduce the sound output of the machine. Sound outputs are recorded of the machine upon first build, and it is recommended that regular sound tests are made to ensure the relevant warnings and ear protection/PPE areas are established within the factory. Sound test meters can be supplied by (the manufacturer) if required.”*

Statements such as these indicate that the manufacturer has some knowledge regarding noise emissions but requires guidance to ensure that they provide adequate noise emission data as required by the Machinery Safety Regulations. This particular manufacturer confirmed that noise measurements had been made after the machine was modified in 2002; HSL has a copy of the noise report. However the measured noise levels were not included in the instructions.

The relevant safety standard BS EN 12629-6 includes some general guidance on how to measure noise emission data, but no specific operating conditions are given. It states that in the absence of a noise test method, sound pressure levels and sound power levels shall be determined according to specified B-standards. There is no guidance on the mounting and operating conditions, and these and the operator’s position should be detailed with the noise emission values.

Recent modifications to BS EN 12629-1 (Common requirements) state that:

*“If noise elimination or reduction according to 5.7.1 and 5.7.2 is not possible, the manufacturer of the machine shall state a warning in the instruction handbook that where appropriate, noise reduction or protection measures may be included. In addition, the instructions shall, if necessary, recommend the use of: low-noise operating modes, and/or limited time of operation; and, ear protection.”*

It appears that some support, guidance or enforcement is needed for the manufacturers to comply with the requirements of the appropriate safety standard.

One of the contacts made during this project was a UK agent for overseas manufacturers, mainly from Germany. In the agent’s opinion, the precast market is small and there is very little interest in investing to make new equipment quieter. Much better equipment is manufactured in Europe, where equipment competitors seem more inclined to pool resources and experience when dealing with safety issues, such as noise. All new equipment is bespoke and the agent claimed it was well specified in terms of noise, with new build manufacturers aiming to achieve 80 dB  $L_{pA}$ . However there is likely to be a noise issue with old machinery,

and it is especially difficult to control noise from mobile machinery. This agent has offered help if HSE wants to investigate concrete machines further.

#### **4.1.12 Machines for the manufacture of prestressed concrete products (BS EN 12629-7)**

Although BS EN 12629-7 covers a number of machines, including spinners, extruders and vibrodistributors it was difficult to identify manufacturers and suppliers of machines covered by this standard. Eight contacts were identified who were involved with production of long line prestressed hollow core floor slabs, plain slabs and floor joists. Many were product suppliers, rather than machine suppliers, only three were based in the UK. No instructions were obtained for this category of machine.

#### **4.1.13 Floor cutting-off machines (BS EN 13862)**

Four sets of instructions were downloaded from the websites of three manufacturers of floor cutting-off machines. These machines are covered by the Outdoor Noise Regulations although they are not subject to noise limits (permissible sound power levels). The information contained in all the instructions failed to comply with the requirements of the Machinery Safety Regulations. The main reason for this was that although all the instructions included  $L_{WA}$  data, only one included  $L_{pA}$  data.  $L_{WA}$  data can be useful when selecting a low-noise machine, however it cannot be used to assess the risk to the user during use.

The terminology used in two sets of instructions (from the same manufacturer) was confusing. Values were given for *noise levels* and *noise levels during operation*, which were assumed to  $L_{WA}$  values since the instructions only contained a reference to the Outdoor Noise Directive 2000/14/EC. The  $L_{WA}$  values were between 106 and 108 dB; the *noise level* of two of the machines during operation was 114 dB(A). BS EN 13862 contains measurement and operating conditions for  $L_{pA}$  unfortunately it was not referenced in the instructions therefore the  $L_{pA}$  value of 97 dB was not traceable.

The operating conditions in both 2000/14/EC and BS EN 13862 require the machine to be tested at maximum speed under no load conditions. One set of instructions contained noise levels during operation, which were 7 dB higher than the declared noise level. This suggests that the declared noise emission data are unlikely to provide the user with information on actual risk during use. Changes made to BS EN 13862 in 2009 recognise the limitation of emission data. BS EN 13862 now includes the text:

*“The operator’s instructions shall contain:*

- *information on noise emission levels of the machine determined at no load in accordance with Annex A.*
- *information that noise emission values obtained under the measurement conditions described in this European Standard will not necessarily correspond to the diverse noise levels produced under the operational conditions of practical use.”*

None of the instructions assessed included this text.

Noise control information consisted of advice to wear hearing protection. Some instructions advised users not to exceed maximum usage times for vibration, but there was no comparable information for limiting noise exposure. The instructions also contained advice to replace/tighten various components should the machine generate excessive or unusual noise from the blade. However, the purpose of this advice was to keep the machine working properly rather than limit the noise exposure of the users.

#### **4.1.14 Cold flat rolling mills (BS EN 15094)**

This was another difficult category and HSL struggled to find manufacturers and suppliers of cold flat rolling mills who could provide instructions. Four contacts were identified and contact was made with two, a user and a designer who outsourced the manufacturing. Neither could provide instructions.

#### **4.1.15 Automatic back splitting machines (BS EN 15166)**

It was difficult to identify manufacturers and suppliers who could provide instructions for back splitting machines. One contact imported machines from Germany and confirmed that that the machines were supplied with instructions. However, rather unusually, the company did not have access to these instructions. No instructions were obtained for this category of machine.

#### **4.1.16 Transportable circular saw benches (BS EN 61029-2-1)**

Requests for instructions were made to eight manufacturers and suppliers of transportable circular saw benches; five sets of instructions were obtained. The information contained in these instructions did not satisfy the requirements of the Machinery Safety Regulations. One set of instructions for a contractor's saw advised users to wear hearing protection; however, it contained no noise emission values making it very difficult for the user to select suitable hearing protectors. Another common failing was the absence of information on measurement locations and operating conditions under which noise emission values had been measured; either no standards or incomplete standards were referenced, for example BS EN 50144 (the correct reference is BS EN 50144-2-5). The full reference, including part number, is important because it confirms that for the specific machine type, the correct standard has been used and indicates the appropriate operating conditions.

There was confusion about the appropriate safety standard for this category of machine. Several standards appear to cover these machines:

- BS EN 61029-2-1: covers electric transportable circular saw benches used for cutting wood and analogue materials, with a blade diameter < 315 mm.  $L_{WA}$  and  $L_{pA}$  values are measured under no load and under load (cutting chipboard 19 mm thick).
- BS EN 1870-1: covers stationary and displaceable circular saw benches and building site saws designed to cut solid wood, chipboard, fibreboard, plywood, etc.  $L_{WA}$  and  $L_{pA}$  values are measured under no load and under load (sawing particle board 16 mm thick) in accordance with Annex A ISO 7960.
- BS EN 50144-2-5 (which has been replaced by BS EN 60745-2-5): covers circular saws for cutting various materials.  $L_{WA}$  and  $L_{pA}$  values are measured under no load and under load (cutting chipboard either 19 or 38 mm thick depending on maximum cutting depth of tool).
- Outdoor Noise Regulations: covers building site circular saw benches with blade diameter greater than or equal to 350 mm up to a maximum of 500 mm.  $L_{WA}$  values are measured under no load and under load (sawing particle board 16 mm thick) in accordance with Annex A of ISO 7960.

Manufacturers might struggle to identify the most appropriate safety standard. However all the standards require the measurement of  $L_{WA}$  and  $L_{pA}$  under no load and under load conditions. The Outdoor Noise Regulations only require the measurement of  $L_{WA}$  values. Declared  $L_{pA}$  values were between 75 and 89 dB under no load, and between 85 and 98 dB under load. Declared  $L_{WA}$  values were between 84 and 98 dB under no load, and between 99 and 112 dB under load conditions.

There is a wide range of both  $L_{pA}$  and  $L_{WA}$  values across this small sample of five machines, and the reasons for this are unclear. The machines with the highest motor speed generated the

highest noise levels. However, other machine characteristics could have contributed to the noise generated, as could differences in the noise test methods.

According to BS EN 61029-2-1 the information for use should contain the following, under maintenance and servicing:

*“Operator’s instructions on factors influencing exposure to noise (eg saw blades designed to reduce the emitted noise, saw blade and machine maintenance)”*

All the instructions recommended the use of hearing protection, but none advised the use of low noise blades or an appropriate maintenance regime to control noise exposure. One set of instructions included general advice on hearing protection zones, proper warnings and noise enclosures and another included the following, which was at least specific to the machine:

*“Wear hearing protection.*

*Make sure the riving knife is not bend (sic). A bent riving knife will push the workpiece against the side of the saw blade, causing noise.”*

#### **4.1.17 Can crushers/compactors/balers (currently no standard)**

Currently there are no standards for balers and compactors. However according to the HSE sector contact, three European standards are being drafted for horizontal balers, vertical balers, and horizontal compactors. The draft safety standard for horizontal balers should be available for public consultation in 2011. The draft currently does not contain a noise test method.

Thirteen sets of instructions were obtained from eight manufacturers and suppliers; one manufacturer provided five sets of instructions. Instructions were obtained for a number of machines including manual metal baler, tin baler, vertical baler, open ended baler, can flattener, and compactor. The noise emission data in twelve of the thirteen instructions failed to satisfy the requirements of the Machinery Safety Regulations. The main problem was that the majority of instructions included *noise levels* (also referred to as *sound levels* and *noise emissions*) but no details of either measurement locations or operating conditions. Therefore, it was difficult to assess the credibility of the noise emission data because of the lack of traceability to either a standard test method or the manufacturer’s noise test method. Two sets of instructions did not contain any noise emission data, not even confirming that the  $L_{pA}$  value was < 70 dB. One set of instructions (for a can flattener) also included the text:

*“It is the client’s responsibility to ensure that operators within the building wear appropriate hearing protection.”*

Although this statement is true, the manufacturer has tried to use it as a substitute for providing information that is legally required. The supplier confirmed that the can flattener should not be located in an area occupied by people; it does not require operators to be working close to it. However, this information was not included in the instructions, only the advice that it is the client’s responsibility to protect its employees.

Noise data for the only machine whose instructions complied with the requirements of the Machinery Safety Regulations - a vertical baler - had been measured in accordance with an appropriate German DIN standard (operating conditions unknown):  $L_{pA}$  at 1 m no load running 68 dB, and full load 76 dB. The *noise levels* included in the other instructions were generally between 72 and 80 dB. Most of the machines are designed to process cardboard, paper, and other lightweight materials it is likely therefore that the declared noise emission values will provide the user with relevant information on actual risk during use.

Two manufacturers included details of how noise emission values had been obtained. However although measurement locations were described, operating conditions were not.

The noise levels included in the instructions for balers and compactors – assuming they were credible – were low enough not to require the provision of additional information, for example on noise control measures or hearing protection. One manufacturer of a tin baler included the noise data:

*“Operating position noise level was 76 DB(A) rising to 85 DB(A) for 2 seconds at a point of change over and again at final retraction point.”*

Although no other noise information was included in the instructions, the manufacturer sent a photograph of the tin baler in-situ, which carried the label:

*“WARNING: Noise level between 80 and 85 dB(A) – Ear protection available on request”*

If hearing protection should be made available to operators, then this information should be included in the instructions.

HSL measured the noise generated by an open-end baler in situ. According to the instructions the “noise level machine was < 80 dBa”, however the  $L_{Aeq}$  value measured during operation was 84 dB. This suggests that the noise emission data for this machine does not provide the user with information on actual risk.

#### **4.1.18 Yarn twisting/processing machinery (BS EN ISO 9902-4)**

Four contacts were identified:

- Textile manufacturer who did not use this type of machinery.
- Auctioneers who were involved only in the disposal of this type of machinery.
- An international manufacturer.
- UK-based spare parts supplier for a German manufacturer of textile machinery.

None of the UK contacts were able to provide information for this project. Contact was not made with either of the European contacts. No instructions were obtained for this category of machine.

## **4.2 COMMON ERRORS**

Seventy-three sets of instructions were obtained from the manufacturers and suppliers of fourteen different categories of tools and machines. The noise emission information contained in sixty of these instructions (82% of the sample) failed to satisfy the requirements of the Machinery Safety Regulations. The most common reasons were:

- Absent or incomplete declared noise emission values, in particular  $L_{pA}$  values were commonly missing for those machines covered by the Outdoor Noise Regulations. Although  $L_{WA}$  values can be useful for selecting quieter machines to purchase, they do not provide the user with relevant information about the actual risk to hearing during normal use.
- Absent or incomplete traceability to operating conditions for declared noise emission values, which should be specified either in the instructions or referenced in an appropriate safety standard. It is essential that operating conditions are known; they enable the credibility of the data to be assessed and also its usefulness for providing the user with relevant information on actual risk during use.
- Inadequate information, for example on safe use, residual risks, noise control measures. Information contained in the instructions commonly consisted of advising users to wear hearing protection, often with little or no information on how to select suitable hearing protection. The absence of residual risk information in instructions is particularly negligent when machine manufacturers are fully aware that declared noise emission data underestimates the noise levels generated during real use. Similarly,

where safety standards identify safe working practices to reduce noise exposure, or installation, configuration or maintenance issues, then it is unacceptable for manufacturers not to pass this information to users. If machine manufacturers do not use the information contained in safety standards to improve the information they provide to users, there seems little point in resourcing standards development.

Possible reasons why manufacturers and suppliers fail to provide noise emission data in their instructions that comply with the requirements of the Machinery Directive include:

- Lack of knowledge of their legal duties, of noise as a significant hazard in relation to hearing damage, of machine safety standards or noise test codes, and of technical issues related to noise, for example the difference between sound pressure and sound power.
- Apparent lack of care, for example providing either no noise emission data or information that does not indicate real use risk, or considering that the risks associated with machinery noise are only the responsibility of the purchasers and users.

## 5. CONCLUSIONS

Seventy-three sets of instructions were obtained from the manufacturers and suppliers of fourteen different categories of tools and machines. The noise emission information contained in sixty of these instructions (82% of the sample) failed to satisfy the requirements of the Machinery Safety Regulations for the following reasons:

- Absent or incomplete declared noise emission values.
- Absent or incomplete traceability to operating conditions for declared noise emission values.
- The lack of adequate (or in some cases any) information on safe use, residual risks, or noise control measures.

The information contained in thirteen sets of instructions satisfied the requirements of the Machinery Safety Regulations; six were judged as including comprehensive and high quality noise data and information. Most of the compliant instructions were for tools and machines in the following categories:

- Compaction machines (3 out of 6 were compliant)
- Powered lawnmowers (4 out of 7 were compliant)
- Edge banding machines (2 out of 2 were compliant)

It is difficult to identify common factors that explain why the information in the instructions for these particular machine types complies with the requirements of the Machinery Safety Regulations. In the author's opinion there could be a number of reasons including:

- Good safety standards, which include operating conditions that produce credible, noise emission values.
- The existence of only a small number of manufacturers, who remain aware of the machines produced by the competition and modify their own products accordingly.

The work presented in this report shows the scale of the problem and identifies some of the reasons why the noise emission data in manufacturers' instructions fails to satisfy the requirements of the Machinery Directive. However it is not clear why manufacturers and suppliers fail to provide adequate noise emission data. Based on the evidence presented here, it is the author's opinion that this failure could be due to a number of reasons including:

- Lack of knowledge among manufacturers and suppliers of:
  - their legal duties,
  - noise as a significant hazard in relation to hearing damage,
  - machine safety standards or noise test codes, and
  - technical issues related to noise.
- An apparent lack of care for providing noise emission data that indicates real use risk for the user.

It is considered highly likely that purchasers and users of machinery, which are supplied with inadequate (or missing) noise emission information, will be unable to make informed choices regarding the safety of potential purchases or understand what control measures are necessary to mitigate the risks from noise during real use.

## 6. RECOMMENDATIONS

Manufacturers and suppliers should be influenced to supply the required noise emission information, either through guidance or enforcement activities. Guidance is also needed on the responsibilities of manufacturers of partly completed machinery and bespoke machinery. It should be noted that guidance already exists:

- The Department for Innovation, Business and Skills (BIS) has published guidance notes on the Machinery Safety Regulations, which can be found at:
  - <http://www.bis.gov.uk/files/file52968.pdf> (23/10/2012)
- The European Commission has published internet-based guidance on the Machinery Directive, which explains the scope and clarifies the application of the Directive, which can be found at:
  - <http://ec.europa.eu/enterprise/sectors/mechanical/machinery/> (23/10/2012)
- HSE has published internet-based guidance on work equipment and machinery for manufacturers, suppliers and purchasers, which can be found at:
  - <http://www.hse.gov.uk/work-equipment-machinery/index.htm> (23/10/2012)

Several machine categories were identified during this study where further investigation of the noise emission and real use noise exposure should be considered. These include:

- **Granulators:** Granulators can generate very high noise levels, assuming the declared noise emission values are credible. Based on anecdotal evidence of a growing supply of these machines from outside the EU, it is increasingly likely that users will have to rely on the noise emission information provided by suppliers rather than manufacturers. Guidance should be provided to UK importers to help them influence manufacturers supplying into the UK or to ensure they take responsibility for providing adequate noise emission data to users.
- **Shredders:** Shredders can generate very high noise levels. The safety standard for shredders seems to suggest an additional problem with this category of machine is that they can only operate at the manufacturer's premises under no load; this claim seems worthy of further investigation. The safety standard recommends that manufacturers start gathering noise emission data under load at user premises on newly installed machines or during the installation of new machines. There is no evidence that this is happening in the instructions reviewed during this study. It is also noted that the supply situation for shredders is similar to that described for granulators.
- **Masonry and stone cutting machines:** The safety standard containing the noise test method for these machines was modified in 2009 to include more realistic operating conditions. However, there is no evidence that better noise data is included in the instructions. Data obtained for both electric and petrol driven machines indicates engine noise is significant, increasing emission noise values by up to 14 dB. The significance of engine noise during real use should be investigated further. These machines can generate high noise levels and it is important the noise emission data included in the instructions helps the users select suitable hearing protection.
- **Floor cutting-off machines:** The instructions for these machines generally lacked  $L_{pA}$  data, which is common for machines also covered by the Outdoor Directive 2000/14/EC.  $L_{WA}$  data does not provide the user with relevant information on the actual risk during use although it will indicate relative risk between machines and facilitate choice of a quieter machine. Limited  $L_{pA}$  data suggests these machines generate high noise levels, and that standard test conditions (no cutting) underestimate the noise generated during normal use.

- **Balers/compactors:** The declared noise emission data for these machines suggests that noise may not be a problem;  $L_{pA}$  values were generally <80 dB. However, there are no standards for these machines, and the instructions contained no operating conditions for the standard noise tests. These machines are used in the recycling industry, which is a growth area. Draft safety standards are being prepared for compactors and balers. Further work is recommended to obtain information on the noise generated by these machines, including the effect on noise emission values when processing different materials. This information could be used to inform the committee developing the safety standard, so users will be provided with adequate noise information.

## 7. REFERENCES

BS EN 12549: 1999 Acoustics – Noise test code for fastener driving tools – Engineering method

BS EN 1746: 1999 Safety of machinery – Guidance for the drafting of the noise clauses of standards

BS EN 1870-1: 2007 Safety of woodworking machines – Circular sawing machines – Part 1: Circular saw benches (with and without sliding table), dimension saws and building site saws

BS EN 50144-2-5: 2000 Safety of hand-held electric motor operated tools – Part 2-5: Particular requirements for circular saws and circular knives

BS EN 792-13: 2000 Hand-held non-electric power tools – Safety requirements – Part 13: Fastener driving tools

BS EN ISO 12001: 1997 Acoustics – Noise emitted by machinery and equipment – Rules for the drafting and presentation of a noise test code

BS EN ISO 15744: 2008 Hand-held non-electric power tools – Noise measurement code – Engineering method (grade 2) (ISO 15744: 2002)

ISO 11094: 1991 Acoustics – Test code for the measurements of airborne noise emitted by power lawn mowers, lawn tractors, lawn and garden tractors, professional mowers, and lawn and garden tractors with mowing attachments

ISO 7960: 1995 Airborne noise emitted by woodworking machine tools – Operating conditions for woodworking machines

Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)

Directive 98/37/EC of the European Parliament and of the Council of 22 June 1998 on the approximation of the laws of the Member States relating to machinery

Council Directive 89/392/EEC of 14 June 1989 on the approximation of the laws of the Member States relating to machinery

Directive 2000/14/EC of the European Parliament and of 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

Noise Emission in the Environment for use Outdoors Regulations 2001, Statutory Instrument No. 1701, and 2005 Amendment, Statutory Instrument No. 3525

The Supply of Machinery (Safety) Regulations 2008, Statutory Instrument No. 1597

# APPENDIX A

## Methods used to compile a list of priority machines/tools for further investigation

### Information recorded for each standard/test code identified

An Excel spreadsheet was compiled containing the following details for each of the standards/noise test codes that were identified:

- Standard number
- Title
- Key words
- Cross references
- International relationships
- BSI committee
- CEN committee
- Published in Official Journal (ie harmonised standard)

### Criteria against which standards/test code reviewed

#### ***BS/CEN committee***

The search identified 613 standards; 175 of these were excluded from the review because they were either draft standards or had no relevance to the project. HSE Specialist Noise and Vibration Inspectors then reviewed the list and, based on their experience as inspectors, decided that the standards for which the following BS committees were responsible should also be excluded from further review:

- ACE/57 aircraft ground support equipment
- AGE/30 irrigation machines
- AMT/-/2 robots
- AW/24 bulk milk coolers
- B/538/3 blinds and shutters
- CPW/172/9 laser processing machines
- EH/1, EH/1/2, EH/1,4 acoustics standards (measurement/analysis methods)
- FSH/17/3, 5 fire and rescue service equipment (turntables and ladders)
- FSH/23 mines equipment used in potentially explosive atmospheres
- GSE/27 forced draught burners
- MCE/19 centrifuges
- MHE/12 lifting equipment, including vehicle lifts and tail lifts
- MHE/3/11 cranes (instructions for use)
- MHE/3/12 cranes (lifting attachments)
- MHE/4 lifts
- MRE/1 machines for underground mines (excluded because of low levels of employment)
- PEL/2 rotating electrical machines
- PEL/27 electroheat installations

- PEL/69 electrically propelled road vehicles
- PEL/88 wind turbine generators
- PH/9 auditory and visual danger signals
- PVE/21 petrol filling stations
- RHE/18 refrigerating systems
- WEE/1 welding terms and symbols

The standards for which the following BS committees were responsible were included in the review:

- AGE/20 garden equipment
- AGE/29 agricultural and forestry machinery
- AGE/6 tractors
- AGE/32 agricultural machinery
- B/508/1 refuse collection vehicles
- B/513 tunnelling and piling, road construction vehicles
- B/513/-/6 masonry and stone cutting-off machines, transportable wall saw/wire saw equipment
- B/513/-/8 machinery for the preparation of concrete and mortar
- B/513/1 mobile road construction machinery
- CPL/61/6 hand held electric tools
- FSH/17 fire-fighting pumps and rescue vehicles
- FSH/17/3 platforms and high rise aerial appliances
- FSH/17/4 pumps
- FSH/17/5 turntable ladders
- FSH/17/7 hydraulic rescue tools
- MCE/13 hand-held non-electric power tools
- MCE/14 reciprocating combustion engines and generators
- MCE/14/-/4 reciprocating internal combustion engines
- MCE/14/-/8 generating sets
- MCE/17 industrial fans
- MCE/18 hydraulic fluid power system
- MCE/23 machines for the continuous casting of steel
- MCE/3 general machinery safety requirements
- MCE/3/10 foundry machinery
- MCE/3/11 tannery machinery
- MCE/3/12 footwear, leather and imitation leather goods manufacturing machines
- MCE/3/13 machinery and plant for the manufacture, treatment and processing of glass
- MCE/3/14 ceramic machines
- MCE/3/15 machines and installations for the mining and tooling of stone
- MCE/3/2 plastics and rubber machines
- MCE/3/3 packaging machines
- MCE/3/5 food processing machines
- MCE/3/7 machines for the manufacture of construction products from concrete and calcium silicate

- MCE/3/8 industrial thermoprocessing equipment
- MCE/3/9 paper making and finishing machines
- MCE/6 pumps and pump units for liquids
- MCE/8 hand-held non-electric power tools
- MCE/8/-/2 hand-held non-electric power tools
- MHE/12/-/2 lifting tables
- MHE/14 mobile racking and shelving
- MHE/3 cranes
- MHE/3/11 cranes – lifting of persons
- MHE/3/12 cranes – lifting attachments
- MHE/3/3 slewing jib cranes
- MHE/3/5 loader and mobile cranes
- MHE/3/6 power driven winches
- MHE/6 builders hoists
- MHE/7 industrial trucks
- MHE/9 continuous handling equipment and systems
- MTE/1 numerically controlled turning machines
- MTE/1/1 pneumatic presses and guillotine shears
- MTE/23 woodworking machines
- RAE/2 railway applications
- TCI/33 textiles and laundry machinery

### **Noise clauses**

The noise clauses contained in the standards were reviewed against the criteria defined in BS EN 1746: 1999 *Safety of machinery – Guidance for the drafting of the noise clauses of standards*, which gives guidance on how to deal with noise in type C-Standards where noise is identified as a significant hazard. These criteria included:

- Noise as a hazard
- Noise reduction as a safety requirement
  - Noise reduction at source by design
  - Noise reduction by protective devices
  - Noise control by information
- Verification of compliance with the safety requirements and measures
  - Verification based on noise emission values
  - Verification of noise reduction
- Instruction handbook

When assessing the standards/noise test codes against these criteria, yes/no answers were logged where possible. This enabled the standards to be reviewed within the required timescale, and made analysis of the reviewed standards easier. Notes were included in the spreadsheet where for example a standard contained exemplary noise control solutions or where manufacturers were required to provide noise emission data but without any guidance on how to do this. One of the aims of the review was to identify, where possible, a specific noise test code and/or general test code with specific operating conditions for each machine type for which noise is identified as a significant hazard.

### ***Method used to compile list of machine types for further investigation***

One of the most important aspects of the review was to identify those machine types for which noise is listed as a significant hazard. When reviewing the standards the following responses were used:

- YES Noise is listed as a significant hazard
- YES\* This standard does not cover the hazards associated with noise
- NO Noise is not considered to be a significant hazard
- NO\* Noise is not listed as a significant hazard
- n/a This has been used to identify noise test codes, and also those standards where noise is covered but not in relation to occupational exposure (eg electrical noise, interference of speech from audible alarms, etc)

Reviewing the 438 standards showed that:

- Noise was not considered a significant hazard for 30 of the standards.
- Noise was not listed as a significant hazard for 11 of the standards, although it was not clear whether or not noise could be a problem for the particular machine type.
- Noise was considered a significant hazard for 293 of the standards.
- Noise was considered a significant hazard but was not dealt with for 37 of the standards. While some of these standards noted that a noise test code or an amendment was in preparation to deal with noise, others did not.

The list of machine types selected for further investigation was based on a detailed review of those standards for which noise was identified as a significant hazard.

## APPENDIX B

### Machine types selected for investigation

Table B1 contains details of the machine types selected for investigation. It also includes details of the relevant safety standards, information on noise reduction guidance or requirements, and noise test codes contained in these standards.

**Table B1: Machine types for further investigation**

Machine type	Comments
Packaging machines – form, fill and seal machines	<p><i>BS EN 415-3: 1999 + A1: 2009</i></p> <p>This standard covers form, fill and seal packaging machines and the filling machines, which are particularly associated with them. Main sources of noise are identified and recognition that noise emission may alter depending on the product being packed or the packaging material being used. Some noise reduction measures provided.</p> <p>Standard includes measurement locations and operating conditions (machine running dry and if possible when running with the product for which the machine has been specified or a representative product). Where the sound pressure levels exceed 70 dB(A) or 130 dB(C) the measurements shall be recorded in the instructions for use.</p> <p>These machines included for further investigation because the noise measurement method contains lots of "shall" statements, yet there is a lot of potential for variation both in the measurement locations and in the operating conditions.</p>
Food processing machinery – rotating bowl cutters	<p><i>BS EN 12855: 2003 + A1: 2010</i></p> <p>Bowl cutters are food machines used to process fresh or frozen meat, meat products, fish and vegetables in a rotating bowl, which comprises vertical blades rotating around a nearly horizontal axis.</p> <p>BS EN 12855 specifies that a noise cover shall be provided for all types of machine. The purpose of this cover is to reduce the noise emitted by the cutting set. The standard includes a noise test code, which specifies the method for measuring sound pressure levels and sound power levels. Operating conditions are defined: machine at maximum speed, with maximum number of knives and bowl filled 50% with water.</p> <p>Rotating bowl cutters included to investigate whether or not manufacturers provide a noise cover as required.</p>
Food processing machines – mixers with horizontal shafts	<p><i>BS EN 13389: 2005 + A1: 2009</i></p> <p>Although from the same family as the rotating bowl cutters, this machinery mixes rather than cuts. The standard contains no guidance on specific noise control measures. It includes a noise test code, which specifies the method for measuring sound pressure levels and sound power levels. Operating conditions are defined: the machine shall be empty and operate at its maximum speed.</p> <p>These mixers are used to mix, kneed and homogenise food for animal or human consumption in powder, paste and liquid form. It is possible the machine/motor noise is dominant over the process noise, in which case no-load operating conditions will be valid.</p>
Food processing machines – planetary mixers	<p><i>BS EN 454: 2000 + A1: 2009</i></p> <p>BS EN 454 applies to fixed bowl planetary mixers of capacity greater than or equal to 5 litres and less than 500 litres, which are used to process various ingredients, eg cocoa, flour, sugar, oils and fat, minced meat, eggs, and other ingredients in the food industry and shops.</p>

Machine type	Comments
	<p>The standard contains no guidance on specific noise control measures. It includes a noise test code, which specifies the method for measuring sound pressure levels and sound power levels. Operating conditions are defined: the machine shall be empty and operate at its maximum speed.</p>
<p>Mobile road construction machinery – compaction machines</p>	<p><i>BS EN 500-4: 2006 + A1: 2009 (and also Directive 2000/14/EC)</i>  This standard applies to machines, which compact materials, eg rock fills, soil or asphalt material, through a rolling and/or vibrating action of the wheel bodies or by tamping and vibrating movements of vibratory plates or rammers. Hand-guided vibratory ground compaction machines covered by this safety standard will be investigated further as they are widely used and can generate high noise levels.</p> <p>The standard contains no guidance on specific noise control measures. It includes a noise test code, which specifies the method for measuring sound pressure levels and sound power levels. The machines are tested during actual operation on a course of gravel (for hand-guided and remote-controlled vibratory ground compaction machines).</p>
<p>Hand-held non-electric power tools – assembly tools for non-threaded mechanical fasteners</p>	<p><i>BS EN 792-1: 2000 + A1: 2008</i>  This standard applies to hand-held non-electric assembly power tools for the installation, tightening or removal of non-threaded mechanical fasteners from one side of a work-piece into metals, plastics and other materials. The standard covers the following power tools: breakstem fastener, rivet or plug tools; breakstem lockbolt tools; mandrel loaded riveting tools; and, rivet nut setters.</p> <p>The standard identifies the main sources of noise as the power tool itself, the inserted tool, and the workpiece. Some guidance is given to reduce noise including use of a well-designed silencer, and acoustic isolation and vibration damping to reduce vibration-induced noise. Vibrating surfaces are likely to be a significant source of noise, and should be identified in the instructions.</p> <p>BS EN ISO 15744: 2008 is referenced with regard to measuring emission sound pressure and sound power levels. Although it contains a table describing the hand-held power tool families and their operating conditions, it could be difficult to identify appropriate operating conditions for some power tools.</p>
<p>Garden equipment – powered lawnmowers</p>	<p><i>BS EN 836: 1997 (and also Directive 2000/14/EC)</i>  This standard covers powered rotary and cylinder lawnmowers, including pedestrian-controlled and ride-on types, and lawn and garden tractors, professional lawnmowers, and lawn and garden tractors with mowing attachments. The reduction of risks from noise will be the subject of an amendment to this standard being developed.</p> <p>Noise sources for these machines are identified in the standard. There is also a requirement for the manufacturer to provide guidance in the instruction handbook if further protection is necessary after taking all possible technical measures to reduce noise. This guidance includes recommending the use of low noise operating modes and/or limited time of operation, and giving a warning of the noise level and recommendation to use hearing protection.</p> <p>This machine included for further investigation because the noise test code is confusing. The operating conditions for both sound pressure and sound power level are that the cutting means is engaged and unloaded with the engine at maximum operating speed.</p>

<b>Machine type</b>	<b>Comments</b>
Woodworking machines – edge banding	<p><i>BS EN 1218-4: 2004 + A2: 2009</i>  This standard covers edge banding machines fed by chains where loading and unloading is manual and where the maximum workpiece height capacity is 75 mm. These machines are designed to process solid wood, chipboard, fibreboard or plywood.</p> <p>The standard includes a requirement for machines to be provided with noise enclosures – specific details are included in terms of the surface area and the noise absorption characteristics.</p> <p>Noise emission measurements are defined in the safety standard with reference to Annexes F or G of ISO 7960 for operating conditions for both sound pressure and sound power level measurements. Tests are carried out under no load and under load (edge banding of particle board and final processing) conditions.</p>
Woodworking machines – band sawing machines	<p><i>BS EN 1807: 1999 + A1: 2009</i>  This standard covers stationary and displaceable band sawing machines fed with either manual or automatic loading and/or unloading. These machines are designed to process solid wood, chipboard, fibreboard or plywood.</p> <p>The standard contains no guidance on specific noise control measures. It includes a noise test code, which specifies the method for measuring sound pressure levels and sound power levels. Operating conditions are defined in Annex J of ISO 7960 – tests are carried out under no load and load (cutting softwood) conditions. For machines not covered by an annex of ISO 7960 the operating conditions shall be typical for the type of work expected to be carried out on the machine.</p> <p>The latest version of this standard includes a separate (and new) section covering noise emission measurements for building site band saws (these are covered by Directive 2000/14/EC).</p>
Plastics and rubber machines – blade granulators	<p><i>BS EN 12012-1: 2007 + A1: 2008</i>  This standard applies to blade granulators, which are used to reduce objects and materials made from plastics and rubber into granules.</p> <p>The main sources of noise are identified (eg cutting chamber, hopper, feed opening) and details are given of some of the measures for reducing noise (eg increasing sound insulation of cutting chamber, reduction of cutting speed, acoustic enclosures).</p> <p>The standard includes a test code, with methods for measuring sound pressure levels and sound power levels and operating conditions. This machine has been included in this project because the test code seems credible, ie noise emission data is obtained under real conditions with no option to test the machine under no load. These machines are widely used, and some of the larger ones are likely to be noisy. It will be interesting to see whether manufacturers are following the specified test code.</p>
Plastics and rubber machines - shredders	<p><i>BS EN 12012-3: 2001 + A1: 2008</i>  This standard covers shredders used for plastics and rubber. The machine begins with the outer edge of the feed hopper and ends with the discharge area.</p> <p>The main sources of noise are identified (eg shredding chamber, hopper, feed opening) and details are given of some of the measures for reducing noise (eg reduction of cutting speed, acoustic enclosures - if possible the chamber should be fitted with silencing in the outlet or</p>

Machine type	Comments
	<p>discharge area, mounting so that structure-borne noise is isolated).</p> <p>The standard includes a test code specifying methods for measuring both sound pressure levels and sound power levels. The operating conditions are that the machine shall operate with no load at the rotor speed corresponding to the maximum nominal throughput. The reason these conditions are specified is that shredders can only operate at the manufacturer's place with no load and manufacturers currently do not measure noise at the user's place when installing new machines. It is recognised that noise emission under no load conditions is not representative of the noise emitted in normal operation. It is therefore recommended that the manufacturers start gathering noise emission data under load. This data can be obtained from measurements carried out at user places on machines newly installed or during the installation phase of new machines.</p> <p>This machine has been included to investigate what noise emission data is available from shredder manufacturers.</p>
Masonry and stone cutting machines	<p><i>BS EN 12418: 2000 + A1: 2009</i></p> <p>This standard applies to transportable masonry and stone-cutting machines stationary during work, mainly used on job site building construction for cutting-off stones, other mineral construction materials and composite materials having at least one supporting surface. The power for the tool rotation is supplied by electrical or internal combustion prime motor. These machines are designed for use with rotating diamond cutting-off wheels with a continuous rim and/or segmented rim.</p> <p>The standard contains only general information on designing low noise machinery. It also includes a noise test code. There is a requirement to provide information on noise emission values of the machine determined at no load and maximum speed in accordance with the test code (sound pressure levels and sound power levels). However this standard has been modified and operating conditions are detailed in the vibration test code (which is new annex), which appear to involve cutting through either a plain concrete slab, ceramic wall tile or a pre-cast concrete from block at maximum engine speed.</p> <p>The latest version of this standard obviously includes an improved noise test code, although errors introduced during the revision process are potentially confusing for the user. There is still minimal information on specific noise control solutions although there is potential for low-noise designs for these machines (eg electric motor/engine enclosed, cutting-off wheel damped, etc).</p> <p>These tools have been included to investigate the declared noise emission data, which is likely to be lower than the noise generated when the machines are cutting construction materials if tested under no load conditions. The old noise test code will give a measure of the noise generated by the engine/motor; it will not include the process noise generated when the machine cuts through stone, concrete, tiles, etc. The danger with a noise test that gives low emission data is that it does not encourage machine manufacturers to design low noise products.</p>
Machines for the manufacture of constructional products from	<p><i>BS EN 12629-1: 2000 + A1: 2010</i></p> <p>This standard includes some general guidance on how to measure noise emission data, but no specific operating conditions are given. This standard includes a statement that in the absence of a noise test</p>

Machine type	Comments
concrete and calcium-silicate – manufacture of precast reinforced products	<p>code contained BS EN 12629-2 to 8 sound pressure levels and sound power levels shall be determined according to specified B-standards. There is no guidance on the mounting and operating conditions and these and the operator’s position should be detailed with the noise emission values. For this reason, two machines from this family have been selected for further investigation. For information, this standard has been modified so that the instruction handbook shall, if necessary, recommend the use of low-noise operating modes, and/or limited time of operation, and ear protection.</p> <p><i>BS EN 12629-6: 2004 + A1: 2010</i>  BS EN 12629-6 applies to stationary and mobile equipment for the manufacture of non-reinforced moulded product (pre-cast reinforced products).</p> <p>This standard details specific design features for reducing noise at source, and there is a requirement for instructions to include noise levels and safety measures to be taken. The size and nature of this equipment means noise emission data will need to be obtained during field measurements. It will be interesting to see how manufacturers have obtained the declared noise emission data, considering the lack operating conditions specified either in this standard or in BS EN 12629-1.</p>
Machines for the manufacture of constructional products from concrete and calcium-silicate - manufacture of prestressed products	<p><i>BS EN 12629-7: 2004 + A1: 2010</i>  This standard applies to machines for the manufacture of constructional products from concrete and calcium-silicate (eg pre-stressing bed, bed sweeper, spinner, vibrodistributor, etc.) The size and nature of this equipment means noise emission data will need to be obtained during field measurements. It will be interesting to see how manufacturers have obtained the declared noise emission data.</p>
Floor cutting-off machines	<p><i>BS EN 13862: 2001 + A1: 2009 (and also Directive 2000/14/EC)</i>  This standard covers pedestrian controlled floor sawing machines having power feed, manual feed or hand feed for sawing, grooving and milling floor surfaces made of concrete, asphalt and similar mineral building materials where the main power is supplied by electric or internal combustion prime engine. These machines are designed for use with rotating cutting-off wheels for wet and dry cutting.</p> <p>The standard includes general advice on noise reduction at the design stage, and notes that machines intended to be fitted with a combustion engine shall be designed with an exhaust silencer. There is a requirement for information on noise emission levels at no load in accordance with the noise test code included as an annex in the standard. Sound pressure levels and sound power levels are obtained at no load and maximum tool speed. The noise test code recognises that noise emission values encountered when machines operates under load can be higher than those measured using this test code. This information should be made clear to the user (residual risk should be addressed). Note: This standard was amended in 2010 and now includes a vibration test code with operating conditions (cutting through concrete slab), however the noise test code has not been amended to include more realistic operating conditions.</p> <p>This machine is included for further investigation because it is commonly used. It is also a machine that HSE recommends as an alternative to hand-held tools designed to do the same job.</p>

Machine type	Comments
Transportable circular saw benches	<p><i>BS EN 61029-2-1: 2010 (and also Directive 2000/14/EC)</i></p> <p>This standard applies to transportable circular saw benches intended for cutting wood and analogue materials with a blade diameter not exceeding 315 mm. It does not apply to circular saws used to cut steel, iron, brass or food. Note: EN 1870 covers circular saw benches other than transportable or hand-held electric tools.</p> <p>This machine has been included for further investigation because although the safety standard covers a similar type of machine (ie transportable motor-operated electric tools) as BS EN 12418, noise emission data is obtained using what appears to be more realistic operating conditions – ie the tool is cutting through a piece of chipboard.</p>
Cold flat rolling mills	<p><i>BS EN 15094: 2008</i></p> <p>This standard applies to machinery and equipment where metal is cold rolled to flat products (eg coiled strip, heavy plates).</p> <p>This machine has been included for further investigation because the safety standard contains comprehensive guidance on noise control measures, both during the design stage and secondary measures. Specific examples of exemplary noise reduction measures are included for each of the main noise sources of cold flat rolling mills. A noise test code is included in an annex with a method for measuring A-weighted sound pressure levels at workstations and specified measuring points (due to the size and complexity of the machinery). Measurements will always be made after commissioning is completed and they shall be made under defined representative operating conditions for the main part of the production with regard to the material being processed.</p>
Food processing machines – automatic back splitting machines	<p><i>BS EN 15166: 2008</i></p> <p>BS EN 15166 applies to automatic back splitting machines used in slaughterhouses, which are fitted with a cutting device and are driven by electric, hydraulic and/or pneumatic energy. This type of machine often forms part of a production line, and the manufacturer might pass the responsibility to the purchaser to apply noise control measures in-situ.</p> <p>This standard only contains general noise control advice. There is a noise test code specifying measurement details for sound pressure levels and sound power levels. Noise emission data is obtained with the machine running with no load.</p>
Can crushing/ compactors/balers	<p>There are currently no standards covering these types of machines. Three European standards are being developed by the standards committee MCE/003/16 Recycling Machines, covering horizontal balers, vertical balers, and horizontal compactors. The draft standard for the horizontal balers is in the most advanced stage of development. This draft safety standard should be available for public consultation very soon.</p> <p>These machines, in particular those used for crushing cans, has been included for further investigation because of growth in the recycling industry.</p>
Yarn twisting/processing machinery	<p>An example of one type of textile machine was selected for inclusion in this study because a series of noise test codes exist for these machines. Yarn twisting/processing machinery was selected, which is covered by BS EN ISO 9902-4 Textile machinery. Noise test code. Yarn processing, cordage and rope manufacturing machines; BS EN ISO 11111-4 Textile machinery. Safety requirements. Yarn processing, cordage and rope manufacturing machinery) is the relevant safety standard.</p>

<b>Machine type</b>	<b>Comments</b>
	Standard methods are referenced for measuring sound power levels and sound pressure levels. Operating conditions are specified, so that the machine is tested in its operating condition and it is possible to include in the measurement all significant noises generated by the machine.

## APPENDIX C

### NOMAD assessment grid for analysing noise emission data included in machinery instructions

Question number	Question
Q1	Does the manual provide information or data about noise?
Q2	Does the manual provide numerical values of emission sound pressure?
Q3	If the value of sound power is required, is it there?
Q4	Does the manual provide any information to the user (warning, instructions for safe use)?
Q5	Are the values traceable to a measurement method?
Q6	Are the values traceable to operating conditions?
Q7	If the manual refers to 2006/42/EC, are uncertainties in numerical values given?
Q8	Are the values given credible (order of magnitude considering operating conditions to which they are traceable)?
Q9	Credibility – do all values provide the users with relevant information about actual risk?
Q10	Are clear and relevant instructions for safe use given (eg information on measures to reduce noise emission, maintenance requirements)?
Q11	Is clear and relevant expected information on hearing protection given?
Q12	Instead of sound power, are values of sound pressure at points around the machine given?
Q13	Is the text in the user's language understandable and meaningful?
Q14	Is noise terminology correct?
Q15	Are units correct?
Q16	If type B-standards are referred to for emission sound pressure, are they the right ones?
Q17	If type B-standards are referred to for emission sound power, are they the right ones?
Q18	If type C-standards are referred to, are they the right ones?
Q19	Is the machine under 2000/14/EC?
Q20	If the machine is under 2000/14/EC, does the manual provide the guaranteed AND the measured values of sound power?







# Survey of noise emission and risk information supplied with a range of work machinery

Previous work has shown that the noise emission data provided by the manufacturers can be of variable quality and be based on standards that no longer exist. In some cases no noise emission data are provided at all. The Health and Safety Executive (HSE) needs to be in a position to challenge or support the validity of noise emission data or other information provided by manufacturers, to offer robust advice to dutyholders on the management of noise exposure based on this information, and facilitate the promotion of low noise machinery on a general or machine specific basis.

The aim of the project was to assess the suitability of information on noise emission required under the Supply of Machinery (Safety) Regulations and the Noise Emission in the Environment by Equipment for Use Outdoors Regulations for workplace risk assessment. The noise information provided by manufacturers and suppliers of a wide range of machine types for which noise declaration is required was assessed.

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