I-INCE TSG-10 Buy Quiet Report

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Rev 0.98 – August 26, 2018

Revision history

Version	Date	Modifications
0.1	September 5, 2013	Initial draft created, based on the paper by G. Maling, Buy Quiet Symposium, 2009
0.50	August 9, 2015	Updated draft with feedback, new and additional data sources
0.90	June 30, 2017	Updated with 2016 Buy Quiet Symposium material and recommendations
0.95	March 22, 2018	Updated with feedback
0.98	August 26, 2018	Updated with feedback

Contents

1. Objective of TSG-10

The objective of I-INCE Technical Study Group 10 (TSG-10) is to make “Buy-Quiet” programs known to purchasers of equipment to which workers are exposed (such as for the construction industry) and to professional buyers. Related programs for industry and consumers such as labeling, declarations, and noise ratings are not covered by TSG-10. This report outlines guidelines for “Buy-Quiet” programs to limit occupational noise and to assist professional buyers of industrial equipment. Since its formation, TSG-10 has co-organized several Buy Quiet sessions at international conferences and co-organized with the German BAuA a dedicated Buy Quiet Symposium alongside InterNoise 2016 in Hamburg, Germany. This final report outlines its findings, guidelines for Buy Quiet programs, and recommended actions and next steps.

2. Scope of TSG-10

The concept was developed in the United States and Europe to guide the purchasing of low-noise industrial products. In the United States, a program was developed for the National Aeronautics and Space Administration (NASA) facilities and promoted in other governmental organizations by the National Institute of Occupational Safety and Health (NIOSH). In Europe, in 1989 a European Directive facilitating the free movement of goods and products in the European Union set up essential health and safety requirements including requirements on noise emission of machines. The aim was to create a transparent machine market in terms of noise emissions by obliging machine manufacturers to provide information on noise emission values. This should enable the entrepreneur, i. e. the purchaser of machines, to select and procure the quietest machine by comparing the noise emission values, thus finally resulting in a reduced noise exposure of workers. This "Buy-Quiet" concept was intensively promoted by the French (INRS) and German (BAuA) occupational health and safety institutes for many years and was put again on top of the agenda by the UK (HSE).

Globally the “Buy-Quiet” concept offers a significant improvement in the acquisition of low-noise machines. At present the “Buy-Quiet” concept is not well-established in the noise control community where it should become a major motivator for R&D and for use in consulting practices. A change of attitude is needed to inform and convince professional purchasers worldwide that they can buy quieter products for the control of occupational noise. It has been shown [7, 3] that there is a long-term cost of noisy products that must be borne by the buyer; and, therefore, buyers have a market interest in the procurement of low-noise products. Related programs for industry and consumers such as labeling, declarations, and noise ratings will not be covered by TSG10. The activities of TSG10 are limited to occupational noise and to assist professional buyers of commercial and industrial equipment, although the concepts could be applied to other segments as well.

3. Introduction

There are several drivers for low-noise machinery, equipment, appliances and consumer products. A European Union Directive on outdoor noise equipment (2000/14/EC) places a labelling requirement on 57 different types of equipment including the requirement on 22 types of equipment to observe limit values all based on the guaranteed sound power level. In addition, the current EU Machinery Noise Directive (2006/42/EC) requires manufacturers of equipment to design machines to lowest noise emission levels and to declare the noise emission of machinery using the emission sound pressure level at workstations and additionally the sound power level under certain conditions. More recently, a new EU Directive on Energy related Products was introduced, implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to eco-design requirements for computers and computer servers. The document states no limits for noise, but a need to publish noise emission information from 1 July 2014. As part of this effort, the manufacturers provide in the technical documentation and make publicly available on free-access websites the following information: noise levels (the declared A-weighted sound power level) of the computer and the measurement methodology used.

In order to compliment these requirements for manufacturers and importers of machines, employers in Europe are required by the EU Directive Physical Agents noise 2003/10/EC not only to observe noise exposure action and limit values but also to reduce the noise from machines by selecting quiet machines when procuring new ones in order to reduce noise at workplaces.

Besides Europe, there are of course many other countries in the world with requirements for noise immissions in factories. Therefore purchasing quiet industrial machinery will, when this machinery is installed, help employers to meet the noise immission requirements.

While in the case of machines for industrial applications, a low noise emission is unfortunately not yet a top priority for the customer, this is completely different for consumer products. In fact, there is considerable demand for quiet household appliances such as dishwashers, washing machines or vacuum cleaners. As a consequence, significant progress has been made in the last ten years in the design of low-noise dishwashers and other household appliances. In addition, some countries such as Korea, China and India are now placing noise emission requirements on consumer products. At a recent symposium in Lisbon, Portugal, one rationale in developing countries for quiet consumer products was mentioned: in some countries, people sleep in a room with their refrigerators.

For industrial products, it is very expensive to retrofit machines in the field. In addition, the retrofits may have unintended consequences; for example, if a machine enclosure is poorly designed, it may affect the productivity of workers. These issues are better addressed by the manufacturer of the equipment before it is sold and installed.

In this document, we address buy-quiet programs from the viewpoint of an industrial buyer and seller in communication with each other, so that measurement standards, noise emission standards, test and operating conditions, and verification of noise emission can be discussed. Buy-quiet for consumer products is a different issue because the manufacturer and buyer are not in communication, and sales

persons are rarely familiar with noise specifications. In this case noise labeling is an essential part of the buy-quiet process, but is not discussed in this document.

4. Why Buy Quiet and the current status in practice

The regulations described above as well as the long-term costs of noise indicate that market forces between sellers and buyers must be made to work. Currently there is not a clear understanding between these parties in a number of areas. For the buyer, the long-term costs of noise are usually not well-understood. Also, there is a poor understanding of the noise emission characteristics, like the sound power level given in dB(A), which is often mixed with normal sound pressure levels or even worse with noise exposure levels. Moreover, the importance of noise emission test codes, of reliable noise emission declarations and how machinery noise emission can be put in a purchase specification is often unknown. In the report, Technology for a Quieter America (NAP, 2010), the reasons for a "buy quiet" program were presented:

- In areas with hazardous noise levels, the noise hazard can be reduced, saving the costs of a hearing conservation program
- Speech communication in low-noise workplaces is much better than in high-noise workplaces. In addition, because no hearing protection is necessary, desired sounds such as announcements via public address systems are not attenuated
- Low-noise workplaces promote safety (e.g. alarms are clearly audible)
- Low-noise workplaces make it easier for workers to concentrate and reduce fatigue
- Low-noise workplaces are more productive and more comfortable

A very good summary of the situation was prepared in advance of the Paris symposium, and it is reproduced below.

"Over the last three decades much progress has been made by acousticians and noise control engineers to determine the noise emissions of products in a standardized manner. These include household appliances, machines and equipment, power tools, IT products etc.. However, the noise labels or ratings currently used are neither understood by the public nor widely available to them. There is a global lack of understanding by manufacturers, suppliers, and potential users alike. The EU has developed an energy label for products that is simple, well understood, and widely available. It has proven to be an effective incentive to encourage the consumer. This information has induced major reductions in product energy consumption over the last 15 years. In a similar way, providing simple, understandable noise information to the general public should ultimately increase the availability of low noise products.

"The complexity of existing noise ratings along with their relative scarcity has not induced the user to develop a "buy quiet" attitude nor has it stimulated competition needed to produce quieter products and thus encourage low noise design. The reasons for this are varied:

- Complexity of the dB scale and frequency dependence,
- Confusion between sound power, sound pressure, and other metrics being used to characterize the noise,
- Statistical quantities and procedures to determine values to declare,
- Complexity of test codes including dependence of noise on operating and installation conditions,
- Information generally presented as informative rather than comparative, product families, and

- Limited information on product noise released by manufacturers and suppliers.

"The objectives of the symposium are to stimulate noise ratings and to provide manufacturers with the information needed to design low noise products.

- Confirm the need for meaningful product noise ratings,
- Reiterate and list the benefits of providing information to consumers and other stakeholders,
- Discuss the lack of a "buy quiet" attitude for products and machines used in all activities (at home, during leisure, at work, in industry,) and among all buyers (individual consumers, professional buyers, stakeholders, and advertising media),
- Discuss the pros and cons of existing noise ratings,
- Propose and discuss designs for comprehensive and uniform product noise ratings that will serve the needs of manufacturers and suppliers, and
- Propose and discuss design for simplified product noise rating schemes that will assist consumers in making purchasing decisions."

As stated in the objective and scope for TSG10, the labeling and product noise rating schemes are not part of this TSG10 report, but references are provided in this document.

Due to the early implementation of the "Buy Quiet" concept in the European Common Market and now the European Union legislation, one could assume that the concept is well established in Europe. However, occasional random samples from European market surveillance authorities showed that one of the essential prerequisites for the concept to function, namely reliable noise emission data from machine manufacturers, were not fulfilled. As a result, a comparison of the noise emission of machines from different manufacturers seemed is unlikely to be successful for the selection of quiet machines. In order to gain a better overview of the quality of the noise emission declarations, 12 European Member States launched a joint study. The NOMAD project aimed at checking the noise-related quality of information in the instructions supplied with machinery in Europe which was offered for purchase. The project collected more than 1 500 instructions from machines covering 40 broad machine-families and from 800 different manufacturing companies. These instructions were analyzed to determine compliance with the requirements of the European Machinery Directive. The general state of compliance of machinery instructions in relation to noise emission was found to be very poor: 80% of instructions did not meet legal requirements, 16% were acceptable and only 4% were fully complying with the legal requirements. See http://www.hse.gov.uk/noise/nomad-report.pdf. Instructions were not compliant because of one or more of the following reasons:

- Quantitative data missing
- Poor or no traceability of noise emission values to a measurement method and operating conditions
- Lack of credibility of noise emission values
- Lack of residual risk information
- Incorrect noise terminology

The reasons for these bad results are many, but fortunately not unknown. For example, it is known that

- Manufacturers see no benefit from designing quiet machines due to a missing market for these products
- Noise test codes appear to be too complicated and their application too expensive
- Some machine manufacturer associations do not embrace these efforts
- Market surveillance in the field of noise emission is non-existing
- Purchasers do not ask for noise emission values to choose quieter machines and concentrate instead on other performance parameters
- dB(A) values are confusing for purchasers and manufacturers
- Labor inspectors are not familiar with noise emission
- Purchasers ignore the financial benefit gained by "Buy Quiet"

A link to the European list of harmonized standards supporting the European Machinery Directive is given in:

https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/machinery_en

As a result of the study, it was decided to raise awareness and make all stakeholders work together for improving the unsatisfactory situation. In order to make it more binding, EU Member States adopted an action programme with the following actions:

- Information of all stakeholders on legal requirements; Information campaigns
- Drafting of guidance documents for major stakeholders
- Targeted market surveillance campaigns
- Training of labor inspectors and market surveillance personnel
- Better involvement of Notified Bodies (test houses)
- Improvement of standards regarding "information" for use and "noise test codes"

5. Current "Buy Quiet" efforts

Considerable progress is being made by governments and by corporations in the implementation of "buy quiet" programs. In the United States, the National Aeronautics and Space Administration (NASA) has a web site devoted to the implementation of a program. This site is currently located at http://buyquietroadmap.com/. NASA field centers and facilities are required to maintain buy-quiet programs, and this site contains a very useful roadmap for implementation of such programs. A further explanation of the program was given by Cooper (2009, 2013).

Also, in the U.S.A., the National Institute for Occupational Safety and Health (NIOSH), part of the Center for Disease Control and Prevention (CDC), is active in the Buy Quiet area. See for example http://www.cdc.gov/niosh/topics/buyquiet/default.html. NIOSH has led efforts to promote Buy Quiet, such as developing a NIOSH Power Tools Database to make noise data available to tool buyers, users, and manufacturers of powered hand tools. The power tools database can be used as a model for building a more comprehensive database of equipment and machinery noise levels and making the information readily available to the public. The NIOSH Buy Quiet Workshop held in 2011 was a National Occupational Research Agenda (NORA) activity, jointly organized by the NORA Construction Sector and Manufacturing Sector Program Programs, and the NIOSH Hearing Loss Prevention Cross-sector Program. The purpose of the workshop was to look at whether Buy Quiet programs are feasible, how they might function, and to explore steps to ensure success at program implementation. A workshop goal was to promote the wider adoption of current and future engineering controls for noise on machinery and equipment and to motivate the Construction and Manufacturing industries to develop and begin Buy Quiet programs.

As indicated before, in Europe there are several efforts with respect to Buy Quiet. The Outdoor Noise Directive on equipment to be used outdoors and especially the Machinery Directive with essential requirements on noise emission have been around for quite a while (2000 and 1989 respectively). More recently, in 2014, the Directive on Energy Related Products (ErP) went into effect for computers and servers, requiring manufacturers to publish noise emission values. All these Directives are important instruments in making noise information available to the public. A similar program has also been proposed in South Korea for vacuum cleaners, washers and dryers.

Internationally, CAETS, the International Council of Academies of Engineering and Technological Sciences, has a very active Noise Control Technology Committee (NCTC http://www.caets.org/cms/7123/9996.aspx) to provide active science-based support for noise control policymakers on technological options for a quieter world. Several sessions were organized on this topic, and there is active collaboration with European Union representatives to influence noise policy.

On the technical side, several technical papers were presented at the INTER-NOISE 2009 congress in Ottawa, Canada. Nelson (2009) describes the NASA buy-quiet roadmap and the history of the NASA program and Cooper et. al. (2013) describes the status of the NASA buy-quiet web based tool. There may be additional costs to purchase low-noise equipment. Therefore, a key element in buy-quiet program is identification of the cost of not implementing such a program, and the above paper addresses costs in terms of disability, the cost of hearing aids, and the costs of hearing conservation programs as well as hearing protective devices.

At the InterNoise conference in 2011 in Osaka, papers were presented on buy quiet attitudes by Lang (2011), an I-INCE symposium by Tourret (2011), products noise ratings (PNR) by Nobile (2011), European initiatives and strategy by Kurtz (2011), the impact of noise in soundscapes, and preparatory work to introduce noise labeling systems in Japan by Omura (2011).

A focused session on Buy Quiet at InterNoise 2012 in New York, included work by Haynes et. al. (2012) that outlined the UK Buy Quiet efforts, a description of the Quiet Mark by Elliot (2012), the product noise rating as applied to hair dryers by Nobile (2012), the NIOSH program on Buy Quiet by Hayden et. al. (2012), and the preparation of noise specifications for Buy Quiet programs by Maling (2012).

The Buy Quiet session at InterNoise 2013 in Innsbruck was mainly focused on noise declarations, and how they can be improved and made more useful, as outlined in the papers by Nobile (2013), Kurtz (2013) and Haynes (2013).

At InterNoise 2014, there was more work on technical aspect of noise declarations, see Shanks (2014), the ambiguity of the airborne emission sound power level by Kurtz (2014), and a description of New York City's new noise code by Shamoon (2014).

One major buyer of industrial equipment has specified that the noise level measured at one meter shall not exceed 80 dBA (Bruce et al., 2009). To implement this requirement, the measurement method must be specified in detail and the operating conditions for the equipment must be defined. This limit was chosen because "Research suggests that limiting the sound levels in a working environment to an A-weighted sound level of 85 dB would reduce the likelihood of employees incurring hearing loss due to noise. If the A-weighted sound pressure level of each equipment item were limited to 80 dB, then the vast majority of industrial areas would be less than 85 dB."

Another example of an industrial noise label was given by Young and Herreman (2013), where noise values were provided to purchasers of dishwashers in the U.S.A. This was a voluntary initiative by the reseller of the products, and required manufacturers to provide this information for sale in their stores. In the United States, the concept of the Product Noise Rating (PNR), as developed by Nobile (2011), is also still being developed.

A plenary on engineering a Quieter America was given at InterNoise 2015 by William Lang and George Maling. In 2016 a dedicated Buy Quiet Symposium was organized by TSG-10 after InterNoise 2016 in Hamburg, as will be discussed in detail in one of the following sections. This was followed by a Buy Quiet session at InterNoise 2017 in Hong Kong. Papers were presented on Buy Quiet Options for the Mining Equipment Industry by Camargo (2017), the usefulness of noise information provided with work equipment in Europe by Brereton (2017), a new approach to support "Buy Quiet" by Kurtz (2017) and the simplification of measurement procedures by Arendt (2017).

As a first outcome of the NOMAD study and the adopted European action plan to improve the unsatisfactory situation, a Guide for Manufacturers was finalized by the ADCO Machines NOMAD Task Force [89]. The guide is for machinery manufacturers. It is to help manufacturers meet their legal duties to declare noise emission in the instruction manual (and in the technical sales literature) according to the

requirements of the Machinery Directive 2006/42/EC (MD). It includes situations in which the Noise Emission in the Environment by Equipment for Use Outdoors Directive 2000/14/EC applies. This guide has been produced by the MD ADCO NOMAD Task Force and was endorsed by the MD ADCO on 28th May 2015. It does not replace the requirements of the Directives but supports manufacturers to meet the requirements. The title of the guide reads:

Guide for manufacturers: On how to report noise emission in instruction manuals and other literature (Fig. 1). The guide for manufacturers is a multilingual one being in German, English, French, Spanish, Dutch and Swedish.

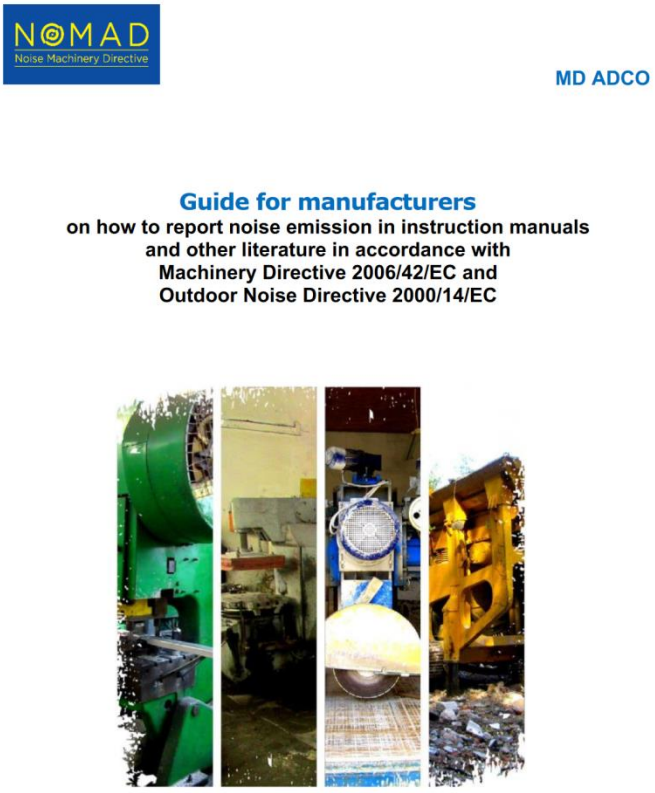

Figure 1: Multilingual Guide for manufacturers on how to report noise emission in instruction manuals and other literature in order to comply with legal requirements in Europe

The guide can be downloaded from the BAuA webpage:

https://www.baua.de/EN/Service/Publications/Report/NOMAD-Guide.html

6. Buy Quiet guidelines

There are a number of steps that should be followed in the implementation of a "Buy-Quiet" program in an industrial organization. One critical item is the support of management for the program. Management must realize that there is a long-term cost of noisy products that must be borne by the buyer and, therefore, that buyers have a market interest in the procurement of low-noise products, and that cost is always a factor. Such costs are not always obvious at the time of purchase, for example the medical costs associated with long term hearing loss.

6.1 Research

Both buyer and seller must recognize that there is technology available to reduce the noise of machinery and equipment. Today, much of this information, while accessible, may not be easily accessible to buyers and sellers. Thus, especially on the part of the manufacturer, research must be done. Information available includes handbooks which cover machinery noise reduction, some government reports, information in the U.S. from the National Institute for Occupational Safety and Health, a booklet on principles of noise reduction produced by the late Stig Ingemansson, and a very large number of papers published in the proceedings of the INTER-NOISE congresses and, in the U.S., the NOISE-CON proceedings. In addition, there have been many papers published in Noise Control Engineering Journal. Summary articles appear in the U.S. "Technology for a Quieter America" report and in an article by Robert Bruce (Bruce, 2007) which appeared in The Bridge, a publication of the National Academy of Engineering. Some ISO standards and recommended practices also provide helpful information on noise control by design such as the ISO/TR 11688 parts 1 and 2.

6.2 Databases

The NASA site referenced above lists several databases on machinery noise emissions.

6.3 Selection of a noise emission standard and specification

The buyer and the seller of machinery must agree on the measurement method to be used in any procurement document. In general, it is the responsibility of the manufacturer to select the measurement method and the metric because in many industries there are standard and widely-used test methods. A number of noise emission standards are listed in the Technology for a Quieter America report referenced above and Appendix A of this document.

Due to the "New Approach" standards in Europe support European Directives. Therefore almost 950 machinery specific European safety standards, so called C-standards have been published. They mostly include noise test codes, or are separate noise test codes. In many cases they have been prepared at the ISO or IEC level with special European modifications. They provide all the information necessary to carry through noise emission measurements and declarations. These standards contain information about which operating and mounting conditions are required for the test and which B-standard (basic noise emission measurement standard) has to be applied to determine the emission sound pressure level and the sound power level. They are listed as harmonized standards in the Official Journal of the European Union and their application provides presumption of conformity with the legal requirements. Their

application is not mandatory but they help machine manufacturers to prove their conformity with the essential requirements of the directives.

6.4 Operating conditions

The specification of suitable operating conditions is of particular importance for the definition of machine-specific noise emission measurement procedures in standards. A comparison of noise emission values of different machines of the same type only makes sense if the specified operating conditions describe the noise emission of the machine well in practice. The specification of operating conditions in noise test codes is therefore often not easy, since the operating conditions should simultaneously provide the best possible description of the noise emission in practice and should also be easily reproducible, cost-effective and easy to implement. For example, Nelson (2009) writes of a gearbox which was tested unloaded, and when the gearbox was installed and operated under load, there was a very significant increase in noise emission.

6.5 Noise emission measurement and verification

It is very important that a manufacturer has facilities that can be used to make measurements according to the standard agreed to by both the buyer and the seller. For the buyer, there must be confidence that the measurements are made strictly according to the standard. In Europe there is a system of "notified bodies" which will at least for some of the machines examine test data and certify that the equipment meets certain European requirements. However, laboratory accreditation, that is, accreditation that a laboratory meets all of the requirements of the standard being used, is very important. In the United States, the National Institute of Standards and Technology (NIST) operates the National Voluntary Laboratory Accreditation Program (NVLAP) in which the procedures that a laboratory uses follow a particular standard or a noise emission standard for buy-quiet evaluations. NIST also accredits the laboratory as being competent to make measurements according to the standard.

In some cases a buyer will want in situ verification of the manufacturer's measurements. This is a very difficult issue and one that may cause considerable friction between buyer and seller. As mentioned above, there will be cases where some noise is the responsibility of the buyer and not the seller. In other cases in situ verification clearly involves the difference between noise emission and noise immission. The manufacturer of noisy equipment generally has no control over the acoustical characteristics of the room in which the equipment is to be installed and the proximity of other equipment which influences the immission noise level in the factory. Some of the difficulties in making in-situ noise measurements have been described by Bommer and Bruce (1989). Fortunately specific basic noise emission measurement standards have been developed since then, which allow an adequate correction for environmental noise and background noise!

7. Buy Quiet Symposium 2016

Following the first Buy Quiet symposium in 2009 in France, a second dedicated Buy Quiet symposium was organized on August 25, 2016, immediately following InterNoise 2016 in Hamburg, Germany. The symposium was made possible by support from I-INCE (International Institute of Noise Control Engineering) and BAuA (Bundesanstalt fur Arbeitsschutz and Arbeitsmedizin). The target audience included manufacturers as well as employers using and purchasing machines, acousticians and both health and safety and environmental protection executives being interested in developing a successful concept supporting a buying quiet attitude to reduce excessive noise.

7.1 Objective

The major objective of the symposium was to initiate a new discussion on how to improve the "Buy Quiet" purchasing attitude. This included topics like:

- The implementation of legal requirements on noise emission in practice
- Manufacturer´s experience with the development and promotion of low noise products
- Existing and required further key elements to foster a "Buy Quiet" attitude
- Advantages for both manufacturers and purchasers in the application of noise emission information
- New strategies, concepts for legal requirements, declarations, labels

7.2 Program

The technical program for the symposium was divided into 6 different sections:

- Welcome address, introduction to the topic and what happened since the first symposium in Paris
- Experience with noise emission declarations and labels
- Is the development and promotion of low noise products of any advantage for manufacturers?
- Key elements allowing to "Buy quiet"
- Advantages of product noise information
- How to improve "Buying Quiet" (round table discussion)

7.3 Website

A website was established with information on the symposium and all the presentations. See:

- http://www.bruit.fr/buyquiet/

7.4 Presentations

All the presentations of the symposium are posted on the Buy Quiet website. A list of presentations is given below and in the references:

Section 1: Welcome address, introduction to the topic and what happened since the first symposium in Paris

- Patrick Kurtz, BAuA; Jean Tourret, INCE/Europe

Section 2: Experience with noise emission declarations and labels

- Outcome of the NOMAD market surveillance action, Jean Jacques, Consultant; Patrick Kurtz, BAuA
- Information Technology Industry, Marco Beltman, Intel
- Blue Angel, Christian Fabris, UBA
- Machinery noise limits and incentives for noise reduction, Michael Dittrich, TNO
- Household appliances, experience with noise emission declarations and labels, Gerhard Fuchs, BSH Hausgeräte GmbH

Section 3: Is the development and promotion of low noise products of any advantage for manufacturers?

- Powerful and quiet garden machinery, Fabian Pöhler, Stihl
- US industry experience, George Maling, INCE-USA, Robert Hellweg, Hellweg Acoustics
- Motivation, classical methods, and novel approaches, Joachim Bös, TU Darmstadt
- Lawn Mowers, Xavier Carniel, CETIM

Section 4: Key elements allowing to “Buy quiet”

- Legal requirements and standards, Patrick Kurtz, BAuA; Jean Jacques, Consultant
- Specifications and operating conditions, Jeff Schmitt, ViAacoustics
- Comparison of products, Robert Hellweg, Hellweg Acoustics; Patrick Kurtz, BAuA

Section 5: Advantages of product noise information

- Encouraging purchasers of work equipment to Buy Quiet, Paul Brereton, HSE
- Noise exposure forecast at work places, Wolfgang Probst, Datakustik
- Incentives for purchasers and manufacturers, Christopher Page; Ray Fischer, Noise Control Engineering

7.5 Findings

The symposium was well attended, with over 60 participants from academia, industry, non-profit and government organizations. At the start of the Symposium, a questionnaire was handed out to participants, which helped guide the discussion in the afternoon. Following the presentations and discussions, the following high level findings were made:

1. **Buy Quiet is working for the consumer segment, but not for the industrial segment**

   During the presentations, several successful examples were presented for consumer products. For example, simple noise ratings on household appliances such as dishwashers have driven noise levels down. Manufacturers required simple noise ratings to be displayed at the point of sale, or noise levels were required by eco-labels and purchase specifications. The IT industry has voluntarily developed noise test codes and supplied noise levels, resulting in a significant drop of equipment noise over time.

   In the industrial segment, the situation is very different, even though there is legislation for example in the form of the Machinery Directive. The NOMAD surveillance demonstrated that a significant portion (80%) of the noise emission declarations were itself in fact totally incorrect.

   In principle, the current status of "Buy Quiet" is not uniform. As an illustration, when asked about the success of Buy Quiet in the questionnaires, 80% of the respondents from the consumer segment indicated that the approach was successful in their markets. For the industrial segment, 100% of respondents stated it did not work in their segment. In addition, 100% of the respondents from the consumer segment stated that specific test codes were available, whereas only 50% of the respondents from the industrial segment did.

2. Common factors in Buy Quiet for consumer segment

When analyzing the successful programs in the consumer space, there are common elements that were identified to drive the success:

- *Consumer demand*: the information provided to consumers has created demand for quieter products, and has spurred competition and innovation. This includes eco labels & purchase specifications: voluntary programs that have created demand for products that are eco friendly
- *Simplicity*: the ratings, provided for many consumer products, are simple and easy to understand, and can be presented alongside other information to make an informed purchase decision.
- *Industry collaboration*: in some cases industry trade associations have pro-actively worked to put in place noise test codes and provide information to the public, even in the absence of regulatory requirements.
- *Cost benefit of noise control*: for example reduced medical costs/accident/productivity improvements in high noise cases leads to additional noise investments up front

3. Elements needed to make Buy Quiet successful in other segments

Based on the presentations, questionnaires and round table discussion, the following factors are proposed to improve Buy Quiet for other segments, such as the industrial segment:

- *Education*: both technical and economic education is required. The long term costs for noise exposure or hearing loss and the associated costs are often times not considered. Decisions are made on short term projections and economic factors. It is imperative that the long term costs, including medical expenses and productivity, are understood. Programs, such a developed by NIOSH, are an important element in this. In addition, low noise sometimes was sometimes equated to low performance by customers. The fundamental shift towards electric and battery operated devices and cars may help alleviate this, but education is needed to show that low noise options with equal performance are available.
- *Collaboration*: industry is often best served by pro-actively addressing challenges and developing industry test codes, guidelines and making information readily available.
- *Economic incentives*: the cost of noise control, for example medical costs, are often covered by different parts of organizations. Decisions are made based on partial information, where long term costs may be passed on to others. As a remedy, large organizations or insurers could offer economic incentives for Buy Quiet programs to reduce hearing loss and increase productivity. Also, rebates or tax incentives could be used to spur innovation.
- *Legislation and market surveillance*: the NOMAD study has shown that even though in some cases there is legislation in place, more is needed to make Buy Quiet successful. This could include elements such as market surveillance.

8. Conclusions and recommendations

In this TSG-10 report, the rationale behind development of Buy Quiet programs is explained, an overview of the work and papers on Buy Quiet initiatives is presented, and guidelines for Buy Quiet programs are outlined. As a conclusion to the TSG-10 work, a dedicated Buy Quiet symposium was held alongside InterNoise 2016 in Hamburg, Germany.

The concept of Buy Quiet is working in the consumer segment, but not in the industrial segment. For consumer products such as dishwashers, simple noise ratings on household appliances have driven noise levels down. Manufacturers required simple noise ratings to be displayed at the point of sale, or noise levels were required by eco-labels and purchase specifications. The Information Technology industry has voluntarily developed noise test codes and supplied noise levels, resulting in a significant drop of noise over time. As outlined in section 7.5, the key aspects in making the consumer segment successful are 1) customer demand, 2) simplicity, 3) industry collaboration and 4) cost benefit of noise control. In the industrial segment, the situation is very different and Buy Quiet programs are generally not considered to be successful. In order to address this, it is recommended to focus on 1) education, 2) collaboration, 3) economic incentives and 4) legislation and market surveillance.

I-INCE could play a key role in this, by establishing dedicated follow up groups on education of the long term implications of noise (control) for productivity, well-being and hearing loss, and studying the use of economic incentives to spur demand and innovation. As outlined before, low noise was sometimes equated to low performance by customers. The fundamental shift towards electric and battery operated devices and cars may help alleviate this, but education is needed to show that low noise options with equal performance are available. Also, I-INCE could engage with industry and government on collaboration, industry test codes, legislation and market surveillance aspects.

References

1. Bommer and Bruce, 2009. Bommer, A.S. and Bruce, R.D., Making shop noise tests under difficult circumstances. Paper in09-771, Proc. INTER-NOISE 2009, the 2009 International Congress on Noise Control Engineering, Ottawa, Canada
2. Bruce et al., 2009. Bruce, R.D., Bommer, A.S., Lefkowitz, K.A., and Levesque, B.R., A new approach to noise control in the workplace. Paper in09-011, Proc. INTER-NOISE 2009, the 2009 International Congress on Noise Control Engineering, Ottawa, Canada
3. Cooper, 2009. Cooper, B.A., Development and implementation of policy-compliant site-specific buy-quiet programs at NASA. Paper in09-050, Proc. INTER-NOISE 2009, the 2009 International Congress on Noise Control Engineering, Ottawa, Canada
4. Kurtz, 2009. Concepts for promoting the acquisition of quiet machines, Proc. INTER-NOISE 2009, the 2009 International Congress on Noise Control Engineering, Ottawa, Canada.
5. NAP, 2010. Technology for a quieter America. A report produced by the National Academy of Engineering (USA) and published by the National Academies Press. http://www.nap.edu/catalog.php?record_id=12928
6. Nelson, 2009. Nelson, D.A., A buy-quiet program incorporating career-cycle noise costs. Paper in09_154, Proc. INTER-NOISE 2009, the 2009 International Congress on Noise Control Engineering, Ottawa, Canada.
7. Beth Cooper, David A. Nelson and Amy Gelfand, 2013 Buy-Quiet Roadmap: a web-based application supporting procurement of low-noise equipment in the context of a hearing conservation program, NoiseCon 2013
8. Crystal Young and Kevin Herreman, Product Noise Rating (PNR) as applied to dishwashers: A test case, NoiseCon 2013
9. Kevin Herreman and Crystal Young, Value of a sound rating for dishwashers, NoiseCon 2013
10. “Technology for a Quieter America”, National Academy of Engineering, Committee on Technology for a Quieter America, 2010, TQA report, http://www.nap.edu/catalog.php?record_id=12928
11. Hayden, C., Ford, R., and Zechmann, E. “Advanced tools for buying quiet products.” Paper IN12_1173, Proc. INTER-NOISE 2012, New York, NY USA, August 19-22, 2012
12. American National Standard S1.16-1992 (R2012), Guidelines for the Specification of Noise of New Machinery. Published by the Acoustical Society of America. See http://asastore.aip.org/shop.do?cID=10&pID=88
13. W. Lang, J. Tourret, Quieting the world by fostering a “Buy-Quiet” attitude among product purchasers, Buy Quiet Symposium 2011, France
14. Denis Pohl, Multi-criteria policy instruments addressing noise, Buy Quiet Symposium 2011, France
15. Patrick le Dévéhat, How the EU energy label has induced a breakthrough in energy efficiency and product performance of household appliances in less than 2 decades, Buy Quiet Symposium 2011, France
16. Jing Tian, Fenglei Jiao, Yadong Lu, How developing and promoting low noise products can boost market share and profitability for manufacturers: household appliances, Buy Quiet Symposium 2011, France

17. Fabian Gwosdz, How developing and promoting low noise products can boost market share and profitability for manufacturers: Leaf blowers, Buy Quiet Symposium 2011, France
18. Lionel Audouy, David Leray, How developing and promoting low noise products can boost market share and profitability for manufacturers: Air conditioners, Buy Quiet Symposium 2011, France
19. Tony Turner, How developing and promoting low noise products can boost market share and profitability for manufacturers: Wood chippers, Buy Quiet Symposium 2011, France
20. Gloria Elliot "Quiet deliveries": collaboration between the public and manufacturers for the development of low noise vehicles delivering out of hours without disturbing residents, Buy Quiet Symposium 2011, France
21. Patrick Cellard, The different types of information available to characterize the noise of products, Buy Quiet Symposium 2011, France
22. Robert Hellweg, Comprehensive product noise declarations for noise planning and commerce, Buy Quiet Symposium 2011, France
23. Patrick Kurtz, Jean Jacques, Product noise emission information in Europe under the Machinery Directive - Purpose, requirements and the current practice, Buy Quiet Symposium 2011, France
24. Bernd Merz, The revised Machinery Directive - more information on noise for purchasers, Buy Quiet Symposium 2011, France
25. Matthew Nobile, Towards simplified product noise ratings for the general public, Buy Quiet Symposium 2011, France
26. Fabian Gwosdz, A Simplified noise labeling - Critical discussion, Buy Quiet Symposium 2011, France
27. Matthew Nobile, The need for range-of-levels information, Buy Quiet Symposium 2011, France
28. Fabian Gwosdz, How standards can deliver reliable data for noise reference: Example of an ISO technical report, Buy Quiet Symposium 2011, France
29. Patrick Kurtz, Past experience in establishing the German VDI ETS guideline, Buy Quiet Symposium 2011, France
30. Michael Dittrich, The NOMEVAL project, evaluation of outdoor machinery noise, Buy Quiet Symposium 2011, France
31. Bernd Merz, Outdoor machinery: the evolution of the 2000/14 Directive, Buy Quiet Symposium 2011, France
32. Chuck Hayden, Development of databases in cooperation with US manufacturers of large construction equipment, Buy Quiet Symposium 2011, France
33. Jean Jacques, Patrick Kurtz, Practical experience with the quality of noise emission declarations, Buy Quiet Symposium 2011, France
34. Patrick Cellard, The shared responsibility in providing precise information on noise levels between test laboratories, manufacturers, and authorities, Buy Quiet Symposium 2011, France
35. Gustav Schütz, Examples of current noise declarations and how they are being improved: the New EU labels for Household appliances, Buy Quiet Symposium 2011, France
36. Marco Beltman, Examples of current noise declarations and how they are being improved: IT industries, Buy Quiet Symposium 2011, France
37. Robert Hellweg, Introduction to endorsement labels, Buy Quiet Symposium 2011, France
38. Christian Fabris, The “Blue Angel”—History, success, and specific problems, Buy Quiet Symposium 2011, France

39. Val Weedon, The “ssSH Mark awarded by UKNA and the “Quiet Guide, Buy Quiet Symposium 2011, France
40. George Maling, Guidelines for the establishment of a “Buy-Quiet” program in the US and abroad, Buy Quiet Symposium 2011, France
41. Paul Brereton, Sarah Hayes, Why the "Buy-Quiet" approach is promising in the management of occupational noise risks, Buy Quiet Symposium 2011, France
42. Patrick Kurtz, The application of legally-required noise emission declarations by purchasers - 20 years of experience with a buying aid for purchasers in Germany, Buy Quiet Symposium 2011, France
43. John Macpherson, “Buy-Quiet” environmental noise policy for Australia, Buy Quiet Symposium 2011, France
44. Alice Debonnet-Lambert, The impact of the “Golden Decibel” on the promotion of low noise products in the last 20 years, Buy Quiet Symposium 2011, France
45. Gloria Elliot, Noise Abatement Society (NAS) “Quiet Mark” initiative, Buy Quiet Symposium 2011, France
46. Paul Brereton, Sarah Hayes, The practical development of the HSE “Buy-Quiet” project, Buy Quiet Symposium 2011, France
47. Philippe Mercier, Purchasing low-noise equipment in municipalities, Buy Quiet Symposium 2011, France
48. Hans Wendschlag, EU ‘green’ Public Procurement a key requirement for IT products, Buy Quiet Symposium 2011, France
49. Gloria Elliott, How other non-governmental organizations could play a role, Buy Quiet Symposium 2011, France
50. Christiane Böttcher, The role of a consumer association: Christiane Böttcher, Buy Quiet Symposium 2011, France
51. Sebastian Wschiansky, Involving the retail sector and setting requirements on product noise levels, Buy Quiet Symposium 2011, France
52. Matthew Nobile, How trade associations could develop test codes for their family of products for measuring noise levels and publishing the levels in a uniform manner for a level playing field, Buy Quiet Symposium 2011, France
53. Tor Kihlman, How I-INCE and CAETS could be involved in the “Buy-Quiet” campaign, Buy Quiet Symposium 2011, France
54. William W. Lang, Quieting the world by inducing a "Buy-Quiet" attitude among product purchasers, InterNoise 2011, Osaka, Japan
55. Jean Tourret, Prospectus on "BUY-QUIET 2011" I-INCE Symposium, InterNoise 2011, Osaka, Japan
56. Matthew A Nobile PNR: A simplified product noise rating method for the general public, InterNoise 2011, Osaka, Japan
57. Patrick Kurtz "Buy quiet!", a European strategy in the field of machinery, InterNoise 2011, Osaka, Japan
58. Takashi Omura, Preparatory Work for Introducing Noise Labeling Systems in Japan, InterNoise 2011, Osaka, Japan
59. Jamie Mackrill, Exploring a cardio-thoracic hospital ward soundscape in relation to restoration, InterNoise 2011, Osaka, Japan

60. Matthew Nobile, Product noise declarations: Focusing on the mean instead of the statistical upper limit, InterNoise 2013, Innsbruck, Austria
61. Sarah Haynes, Paul Brereton, Jacqueline Patel, Development of the UK – Buy Quiet – project to promote production and purchase of quiet industrial machinery, InterNoise 2012, New York, U.S.A.
62. Matthew A. Nobile, Determination of the product noise rating (PNR) for hair dryers: a test, InterNoise 2012, New York, U.S.A.
63. Gloria Elliot, Quiet Mark: giving consumers the choice to buy quiet, InterNoise 2012, New York, U.S.A.
64. Charles Hayden, Rod Ford, Edward Zechmann, Advanced tools for buying quiet products, InterNoise 2012, New York, U.S.A.
65. Patrick Kurtz, What can be done to improve the current poor noise emission declaration practice?, InterNoise 2013, Innsbruck, Austria
66. Sarah Haynes, Making sense of machinery noise information, InterNoise 2013, Innsbruck, Austria
67. Emma Shanks, Sound pressure level and sound power level declarations: navigating the maze, InterNoise 2014, Melbourne, Australia
68. Patrick Kurtz, Is the airborne sound power level of a source unambiguous?, InterNoise 2014, Melbourne, Australia
69. Charles Shamoon, Tae Hing Park,New York City's New Noise Code and NYU's Citygram-Sound Project, InterNoise 2014, Melbourne, Australia
70. William W. Lang and George C. Maling, Jr , Where We Go From Here to Engineer a Quieter America, InterNoise 2015, San Francisco
71. Jean Jacques, Patrick Kurtz,Outcome of the NOMAD market surveillance action, Buy Quiet Symposium 2016, Hamburg, Germany
72. Marco Beltman, Information Technology Industry, Buy Quiet Symposium 2016, Hamburg, Germany
73. Christian Fabris, Blue Angel, Buy Quiet Symposium 2016, Hamburg, Germany
74. Michael Dittrich, Machinery noise limits and incentives for noise reduction, Buy Quiet Symposium 2016, Hamburg, Germany
75. Gerhard Fuchs, Household appliances, experience with noise emission declarations and labels, Buy Quiet Symposium 2016, Hamburg, Germany
76. Fabian Pöhler, Powerful and quiet garden machinery, Buy Quiet Symposium 2016, Hamburg, Germany
77. George Maling, Robert Hellweg, US industry experience, George Maling, Buy Quiet Symposium 2016, Hamburg, Germany
78. Joachim Bös, Motivation, classical methods, and novel approaches, Buy Quiet Symposium 2016, Hamburg, Germany
79. Patrick Kurtz, Jean Jacques, Legal requirements and standards, Buy Quiet Symposium 2016, Hamburg, Germany
80. Jeff Schmitt, Specifications and operating conditions, Buy Quiet Symposium 2016, Hamburg, Germany
81. Robert Hellweg, Comparison of products, Buy Quiet Symposium 2016, Hamburg, Germany
82. Paul Brereton, Encouraging purchasers of work equipment to Buy Quiet, Buy Quiet Symposium 2016, Hamburg, Germany
83. Wolfgang Probst, Noise exposure forecast at work places, Buy Quiet Symposium 2016, Hamburg, Germany

84. Christopher Page; Ray Fischer, Incentives for purchasers and manufacturers, Buy Quiet Symposium 2016, Hamburg, Germany
85. Camargo, Hugo; Thompson, James Kent; Azman, Amanda, The Development of Buy Quiet Options for the Mining Equipment Industry, InterNoise 2017, Hong Kong
86. Brereton, Paul; Patel, Jacqueline, How useful is noise information provided with work equipment supplied in Europe?, InterNoise 2017, Hong Kong
87. Kurtz, Patrick, A new approach to support “Buying quiet”, InterNoise 2017, Hong Kong
88. Arendt, Ilka; Kurtz, Patrick. Simplification of measurement procedures as a prerequisite for the provision of reliable noise emission declarations - several problems regarding to ISO 3744, InterNoise 2017, Hong Kong
89. NOMAD Guide for manufacturers: On how to report noise emission in instruction manuals and other literature, https://www.baua.de/EN/Service/Publications/Report/NOMAD-Guide.html
90. NOMAD report http://www.hse.gov.uk/noise/nomad-report.pdf
91. European harmonized standards supporting the European Machinery Directive, https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/machinery_en

Appendix A: standards and noise test codes

A.1 International Standards Committees with an Interest in Noise

The following committees of the International Organization for Standardization (*http://www.iso.org*) have an interest in noise or sound:

- TC 4 Roller bearings
- TC 21/SC 3 Equipment for fire protection and fire fighting/fire detection and alarm systems
- TC 22/SC 22 Motorcycles
- TC 23/SC 2 Tractors and machinery for agricultural forestry/common tests
- TC 23/SC 3 Tractors and machinery for agricultural forestry/safety and comfort
- TC 23/SC 17 Tractors and machinery for agricultural forestry/manually portable forest machinery
- TC 36 Cinematography
- TC 39/SC 6 Machine tools/noise of machine tools
- TC 43/SC 1 Acoustics/noise
- TC 43/SC 2 Acoustics/building acoustics
- TC 60 Gears
- TC 70 Internal combustion engines
- TC 72/SC 8 Textile machinery and accessories/safety requirements for textile machinery
- TC 86 Refrigeration and air conditioning
- TC 86/SC 3 Testing and rating of factory-made refrigeration systems (excluding systems
- covered by Subcommittees 5, 6, and 7)
- TC 86/SC 5 Refrigeration and air conditioning/testing and rating of household refrigeration
- appliances
- TC 86/SC 6 Factory-made air-cooled air-conditioning and air-to-air heat pump units
- TC 108/SC 2 Measurement and evaluation of mechanical vibration and shock as applied to
- machines, vehicles, and structures
- TC 115 Pumps
- TC 117 Industrial fans
- TC 118/SC 3 Compressors and pneumatic tools, machines, and equipment/pneumatic tools and
- machines
- TC 118/SC 6 Compressors and pneumatic tools, machines, and equipment/air compressors and
- compressed air systems
- TC 127/SC 2 Earth-moving machinery/safety, ergonomics, and general requirements
- TC 131/SC 8 Fluid power systems/product testing
- TC 160/SC 2 Glass in buildings/use considerations
- TC 188 Small craft

IEC (http://www.iec.ch) noise emission standards are mainly in the areas of household appliances , hand-held and transportable electrically powered tools plus gardening tools and other rotating equipment. As mentioned above, generic standards for determination of noise emissions are produced by ISO TC 43/SC 1, Noise. These documents relate either to the determination of sound power level or the determination of emission sound pressure level, and these two topics are separated in the listing below. In addition, ISO TC 43/SC 1 publishes standards related to specific types of equipment and standards related to declaration and verification of noise emissions. These documents are also listed below. There are four noise emission standards from ISO TC 43/SC 2, Building Acoustics, and then a very large number of standards for different types of machinery. These are listed below. A number of technical committees produce IEC standards related to noise. These are also listed below.

A.1.1 ISO Standards from ISO TC 43/SC 1

Measurement Methods—Sound Power

- ISO 3740:2000 Acoustics -- Determination of sound power levels of noise sources -- Guidelines for the use of basic standards
- ISO 3741:2010 Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Precision methods for reverberation test rooms
- ISO 3743-1:2010 Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for small movable sources in reverberant fields -- Part 1: Comparison method for a hard-walled test room
- ISO 3743-2:2018 Acoustics -- Determination of sound power levels of noise sources using sound pressure -- Engineering methods for small, movable sources in reverberant fields -- Part 2: Methods for special reverberation test rooms
- ISO 3744:2010 Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for an essentially free field over a reflecting plane
- ISO 3745:2012 Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Precision methods for anechoic rooms and hemi-anechoic rooms
- ISO 3746:2010 Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Survey method using an enveloping measurement surface over a reflecting plane
- ISO 3747:2010 Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering/survey methods for use in situ in a reverberant environment

Measurements Methods —Sound Power Using Sound Intensity

- ISO 9614-1:1993 Acoustics -- Determination of sound power levels of noise sources using sound intensity – Part 1: Measurement at discrete points

- ISO 9614-2:1996 Acoustics -- Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning
- ISO 9614-3:2002 Acoustics -- Determination of sound power levels of noise sources using sound intensity – Part 3: Precision method for measurement by scanning

Measurement Methods—Emission Sound Pressure Level

- ISO 11200:2014 Acoustics -- Noise emitted by machinery and equipment -- Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions
- ISO 11201:2010 Acoustics -- Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections
- ISO 11202:2010 Acoustics -- Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections
- ISO 11203:1995 Acoustics -- Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level
- ISO 11204:2010 Acoustics -- Noise emitted by machinery and equipment -- Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections
- ISO 11205:2003 Acoustics -- Noise emitted by machinery and equipment -- Engineering method for the determination of emission sound pressure levels in situ at the work station and at other specified positions using sound intensity

Other Standards Related to Declaration and Verification

- ISO 4871:1996 Acoustics -- Declaration and verification of noise emission values of machinery and equipment
- ISO 9296:2017 Acoustics -- Declared noise emission values of information technology and telecommunications equipment
- ISO 11689:1996 Acoustics -- Procedure for the comparison of noise-emission data for machinery and equipment
- ISO 12001:1996 Acoustics -- Noise emitted by machinery and equipment -- Rules for the drafting and presentation of a noise test code
- ISO 7574-1:1985 Acoustics -- Statistical methods for determining and verifying stated noise emission values of machinery and equipment -- Part 1: General considerations and definitions
- ISO 7574-2:1985 Acoustics -- Statistical methods for determining and verifying stated noise emission values of machinery and equipment -- Part 2: Methods for stated values for individual machines

- ISO 7574-3:1985 Acoustics -- Statistical methods for determining and verifying stated noise emission values of machinery and equipment -- Part 3: Simple (transition) method for stated values for batches of machines
- ISO 7574-4:1985 Acoustics -- Statistical methods for determining and verifying stated noise emission values of machinery and equipment -- Part 4: Methods for stated values for batches of machines

Emission Standards for Specific Sources

- ISO 7779:2010 Acoustics -- Measurement of airborne noise emitted by information technology and telecommunications equipment
- ISO 9295:2015 Acoustics -- Determination of high-frequency sound power levels emitted by machinery and equipment
- ISO 7235:2003 Acoustics -- Laboratory measurement procedures for ducted silencers and air-terminal units -- Insertion loss, flow noise and total pressure loss
- ISO 9645:1990 Acoustics -- Measurement of noise emitted by two-wheeled mopeds in motion – Engineering method
- ISO 11094:1991 Acoustics -- Test code for the measurement of airborne noise emitted by power lawn mowers, lawn tractors, lawn and garden tractors, professional mowers, and lawn and garden tractors with mowing attachments [Withdrawn]
- ISO 5135:1997 Acoustics -- Determination of sound power levels of noise from air-terminal devices, air terminal units, dampers and valves by measurement in a reverberation room
- ISO 14163:1998 Acoustics -- Guidelines for noise control by silencers
- ISO 1680:2013 Acoustics -- Test code for the measurement of airborne noise emitted by rotating electrical machines
- ISO 10302-1:2011 Acoustics -- Measurement of airborne noise emitted and structure-borne vibration induced by small air-moving devices -- Part 1: Airborne noise measurement
- ISO 10302-2:2011 Acoustics -- Measurement of airborne noise emitted and structure-borne vibration induced by small air-moving devices -- Part 2: Structure-borne vibration measurements

A.1.2 Standards Developed by ISO TC43/SC2, Building Acoustics

- ISO 3822-1:1999 Acoustics -- Laboratory tests on noise emission from appliances and equipment used in water supply installations -- Part 1: Method of measurement
- ISO 3822-2:1995 Acoustics -- Laboratory tests on noise emission from appliances and equipment used in water supply installations -- Part 2: Mounting and operating conditions for draw-off taps and mixing valves
- ISO 3822-3:2018 Acoustics -- Laboratory tests on noise emission from appliances and equipment used in water supply installations -- Part 3: Mounting and operating conditions for in-line valves and appliances

- ISO 3822-4:1997 Acoustics -- Laboratory tests on noise emission from appliances and equipment used in water supply installations -- Part 4: Mounting and operating conditions for special appliances

A.1.3 TC 23/SC 2, Tractors and machinery for agriculture and forestry, common tests

- ISO 7216:2015 Agricultural and forestry tractors -- Measurement of noise emitted when in motion

A.1.4 TC 23/SC 3, Tractors and machinery for agriculture and forestry, safety and comfort

- ISO 5131:2015 Tractors for agriculture and forestry -- Measurement of noise at the operator's position -- Survey method

A.1.5 TC 23/SC 3, Tractors and machinery for agriculture and forestry, safety and comfort

- ISO 5131:1996 Acoustics -- Tractors and machinery for agriculture and forestry -- Measurement of noise at the operator's position -- Survey method

A.1.6 TC 39/SC 6, Machine tools, noise of machine tools

- ISO 230-5:2000 Test code for machine tools -- Part 5: Determination of the noise emission
- ISO 7960:1995 Airborne noise emitted by machine tools -- Operating conditions for woodworking machines

A.1.7 TC 42, Photography

- ISO 10996:1999 Photography -- Still-picture projectors -- Determination of noise emissions [Withdrawn]

A.1.8 TC 70, Internal combustion engines

- ISO 6798:1995 Reciprocating internal combustion engines -- Measurement of emitted airborne noise --Engineering method and survey method
- ISO 8528-10:1998 Reciprocating internal combustion engine driven alternating current generating sets -- Part 10: Measurement of airborne noise by the enveloping surface method
- ISO 13332:2000 Reciprocating internal combustion engines -- Test code for the measurement of structure-borne noise emitted from high-speed and medium-speed reciprocating internal combustion engines measured at the engine feet

A.1.9 TC 72/SC 8, Textile machinery and accessories, Safety requirements for textile machinery

- ISO 9902-1:2001 Textile machinery -- Noise test code -- Part 1: Common requirements
- ISO 9902-2:2001 Textile machinery -- Noise test code -- Part 2: Spinning preparatory and spinning machinery
- ISO 9902-3:2001 Textile machinery -- Noise test code -- Part 3: Nonwoven machinery

- ISO 9902-4:2001 Textile machinery -- Noise test code -- Part 4: Yarn processing, cordage and rope manufacturing machinery
- ISO 9902-5:2001 Textile machinery -- Noise test code -- Part 5: Weaving and knitting preparatory machinery
- ISO 9902-6:2018 Textile machinery -- Noise test code -- Part 6: Fabric manufacturing machinery
- ISO 9902-7:2001 Textile machinery -- Noise test code -- Part 7: Dyeing and finishing machinery
- ISO 9902-7:2001/Amd 2:2014
- ISO 9902-5:2001/Amd 2:2014
- ISO 9902-4:2001/Amd 2:2014
- ISO 9902-3:2001/Amd 2:2014
- ISO 9902-2:2001/Amd 2:2014
- ISO 9902-1:2001/Amd 2:2014
- ISO 9902-7:2001/Amd 1:2009
- ISO 9902-5:2001/Amd 1:2009
- ISO 9902-4:2001/Amd 1:2009
- ISO 9902-3:2001/Amd 1:2009
- ISO 9902-2:2001/Amd 1:2009
- ISO 9902-1:2001/Amd 1:2009

A.1.10 TC 118/SC 3, Compressors and pneumatic tools, machines, and equipment, Pneumatic tools and machines

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

A.1.11 TC 118/SC 6, Compressors and pneumatic tools, machines, and equipment, Air compressors and compressed air systems

- ISO 2151:2004 Acoustics -- Noise test code for compressors and vacuum pumps -- Engineering method (Grade2)

A.1.12 TC 131/SC 8, Fluid power systems, Product testing

- ISO 4412-1:1991 Hydraulic fluid power -- Test code for determination of airborne noise levels -- Part 1: Pumps
- ISO 4412-2:1991 Hydraulic fluid power -- Test code for determination of airborne noise levels -- Part 2: Motors
- ISO 4412-3:1991 Hydraulic fluid power -- Test code for determination of airborne noise levels -- Part 3: Pumps **--** Method using a parallelepiped microphone array

A.1.13 TC 192, Gas turbines

- ISO 10494:2018 Turbines and turbine sets -- Measurement of emitted airborne noise -- Engineering/survey method

A.2 IEC Standards for Noise Emissions

A.2.1 TC 2, Rotating Machinery

- IEC 60034-9 ed4.1 Consol. with am1 (2007-07) Rotating electrical machines - Part 9: Noise limits

A.2.2 TC 5, Steam turbines

- IEC 61063 ed1.0 (1991-04) Acoustics - Measurement of airborne noise emitted by steam turbines and driven machinery

A.2.3 TC 65B, Measurement and control devices

- IEC 60534-8-1 ed2.0 (2005-09) Industrial-process control valves - Part 8-1: Noise considerations - Laboratory measurement of noise generated by aerodynamic flow through control valves
- IEC 60534-8-2:2011 Industrial-process control valves - Part 8-2: Noise considerations - Laboratory measurement of noise generated by hydrodynamic flow through control valves
- IEC 60534-8-3 ed3.0 (2010-11) Industrial-process control valves - Part 8-3: Noise considerations - Control valve aerodynamic noise prediction method
- IEC 60534-8-4:2015 Industrial-process control valves - Part 8-4: Noise considerations - Prediction of noise generated by hydrodynamic flow

A.2.4 IEC TC 59, Household and similar electrical appliances

- IEC 60704-1 ed3.0 (2010-02) Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 1: General requirements
- IEC 60704-2-1:2014 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-1: Particular requirements for vacuum cleaners
- IEC 60704-2-2:2009 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-2: Particular requirements for fan heaters
- IEC 60704-2-3:2017 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-3: Particular requirements for dishwashers
- IEC 60704-2-4:2011 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-4: Particular requirements for washing machines and spin extractors
- IEC 60704-2-5:2005+AMD1:2014 CSV Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-5: Particular requirements for electric thermal storage room heaters
- IEC 60704-2-6:2012 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-6: Particular requirements for tumble dryers
- IEC 60704-2-7 ed1.0 (1997-09) Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2: Particular requirements for fans
- IEC 60704-2-8 ed1.0 (1997-02) Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2: Particular requirements for electric shavers

- IEC 60704-2-9 ed1.0 (2003-06) Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-9: Particular requirements for electric hair care appliances
- IEC 60704-2-10:2011 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-10: Particular requirements for electric cooking ranges, ovens, grills, microwave ovens and any combination of these
- IEC 60704-2-11:1998 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-11: Particular requirements for electrically-operated food preparation
- IEC 60704-2-13:2016 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-13: Particular requirements for range hoods and other cooking fume extractors
- IEC 60704-2-14:2013 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-14: Particular requirements for refrigerators, frozen-food storage cabinets and food freezers
- IEC PAS 60704-2-15:2008 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2-15: Particular requirements for household food waste disposers
- IEC 60704-3:2006 Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 3: Procedure for determining and verifying declared noise emission values

A.2.11 IEC TC88, Wind turbines

- IEC 61400-11:2012+AMD1:2018 CSV Wind turbines - Part 11: Acoustic noise measurement techniques