

The economic impact on America's products without a new national noise policy

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The European Union is moving rapidly to implement new noise rules that may be used to block, or at least impede, the flow of U.S. products that are exported to Europe. Japan and other countries appear to be following the EU's lead. Many American industries that produce noise-generating products are not prepared to deal with the engineering and manufacturing issues involved in making their products meet the EU noise requirements. The U.S. must develop an industry/government partnership with a research component that will provide the basic technical support to industry through research, education, and technology transfer in product noise.

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1. INTRODUCTION

While development of a more effective national noise policy has been in limbo in the United States, the countries of Europe through the European Union (EU) are making significant progress in implementing their new Europe-wide noise policy. For example, regulations came into effect in 2002 requiring that sixty different types of equipment for outdoor use be labeled for their *guaranteed product noise levels* in order to be sold on the European market. Construction equipment and lawnmowers must not only be labeled, but the amount of noise they can generate is limited. The U.S. has been informed that more stringent noise requirements on an even broader range of products are soon to follow.

The promulgation of the European Directives¹ on product noise for construction and commercial lawn care equipment has raised significant issues of international trade and technology for US industry. US companies will find it more difficult to build and sell their products in Europe as a result.² Meeting the noise limits in a cost effective manner and continuing to supply a well-performing product to customers will require technical changes to their products for which U.S. industry is not prepared. And the limits of noise from these products will become even more stringent in a few years.

2. WHAT THE EUROPEAN NOISE DIRECTIVES REQUIRE

The European Noise Directives place a limit on the amount of sound power that can be emitted by the product in question. The sound power is A-weighted and is to be measured using a prescribed protocol, essentially a free-field hemispherical sound pressure procedure. Certain organizations, certified by the EU, are authorized to either make the measurements or to observe measurements while being taken in the manufacturer's facility. The stated limits for the sound power for the equipment products in question are presented in Table 1 for both January 2002 and January 2006. Generally, larger and more powerful pieces of equipment are allowed to make more noise, even

though it is often the case that it is more difficult to install sound attenuation devices on smaller units. Interestingly, leaf blowers do not have to meet a noise limit—they fall into the category that requires only noise labeling.

Since it is known that there will be a variation in the sound power radiated by products made on the same production line, the European Directives provide a procedure that takes this into account (our experience is that the standard deviation is of the order of 1.5 dB). If the manufacturer measures the average sound level by a sampling procedure, the average must fall at least 3 dB below the stated limit. Or, the manufacturer may do 100 % percent testing and all units must be below the limits in Table 1. It is likely that the latter procedure will end up being a “measure and tweak” process for valuable products or a “measure and allocate” process for less valuable items.

It is interesting that a “free field” method of measurement is specified. It is not clear why a reverberant room method is unacceptable. One can speculate that the concern for periodic components in the sound was thought to be a problem, but the free field method has its own problems of accuracy with tones, and even greater problems of convenience and cost.

3. ISSUES FOR US COMPANIES

US companies may decide not to meet the EU requirements and, instead, turn to legal and political means to try to force the EU to relent, but these efforts would not likely be successful. Companies that are able to meet the requirements will have a significant market advantage. Global markets will follow the EU lead. When the Asian market falls in line with the EU, as is likely, the EU requirements will become global. Companies cannot decide to serve only a limited market, particularly in consumer products, since the economies of scale will allow successful companies to out-develop and undercut a competitor with a smaller market share. Companies that cannot compete abroad will be in danger of being out-designed and undercut in price, with the loss of markets both abroad and at home.

A. Loss of Sales

The new European Directives on product noise have set requirements that will restrict sales and change marketing plans

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TABLE 1– Limits on A-weighted sound power levels on specified equipments (from EU Noise Directives)

Type of Equipment	Net Installed Power P (in kW)		Permissible sound power level in dB / 1 pW	
	Electric Power P _{ei} in kW	Mass of Appliance <i>m</i> in kg Cutting Width <i>L</i> in cm	Stage I as from 3 January 2002	Stage II as from 3 January 2006
Compaction machines (vibrating rollers, vibrating plates, vibratory hammers)	P ≤ 8		108	105
	8 < P ≤ 70		109	106
	P > 70		89 + 11 1g (P)	86 + 11 1g (P)
Tracked dozers, tracked loaders, tracked excavators-loaders	P ≤ 55		106	103
	P > 55		87 + 11 1g (P)	84 + 11 1g (P)
Wheeled dozers, wheeled loaders, dumpers, graders, loader-type landfill compactors, combustion-engine driven counterbalanced lift trucks, mobile cranes, compaction machines (non-vibrating rollers), paver finishers, hydraulic power packs	P ≤ 55		104	101
	P > 55		85 + 11 1g (P)	82 + 11 1g (P)
Excavators, builder's hoists for the transport of goods, construction winches, motor hoes	P ≤ 15		96	93
	P > 15		83 + 11 1g (P)	80 + 11 1g (P)
Hand-held concrete breakers and picks	<i>m</i> ≤ 15		107	105
	15 < <i>m</i> < 30		94 + 11 1g (P)	92 + 11 1g (<i>m</i>)
	<i>m</i> ≥ 30		96 + 11 1g (P)	94 + 11 1g (<i>m</i>)
Tower cranes			98 + 1g (P)	96 + 1g (P)
Welding and power generators	P _{ei} ≤ 2		97 + 1g (P _{ei})	95 + 1g (P _{ei})
	2 < P _{ei} ≤ 10		98 + 1g (P _{ei})	96 + 1g (P _{ei})
	P _{ei} > 10		97 + 1g (P _{ei})	95 + 1g (P _{ei})
Compressors	P ≤ 15		99	97
	P > 15		97 + 2 1g (P)	95 + 2 1g (P)
Lawnmowers, lawn trimmers/lawn edge trimmers	L ≤ 50		96	94
	50 < L ≤ 70		100	98
	70 < L ≤ 120		100	98
	L > 120		105	103

for the sales of existing US products in Europe. Industry refers to this as a cost due to “loss of sales”. Initially, there will be a cost of billions of dollars in lost sales overseas because some companies are not able to address the EU product noise requirements in a timely manner, if at all. As indicated above, eventually they may lose their home markets to other companies that are better prepared, resulting in the permanent loss of jobs in the USA.

B. Costs for demonstrating compliance

In addition, the testing to demonstrate compliance introduces another category of costs. The testing activities require trained personnel that companies may not have on their staffs. The facilities that are needed to facilitate the measurements according to national and international standards may not be in place and will have to be built. Both capital and labor costs are involved. We already have some basis for building what is needed in relatively short order. Many companies currently have laboratory facilities that are satisfactory for product development noise evaluations but do not have production line systems. Some industries have been working for years on the noise emissions of their products, and have not only the necessary facilities, but also the trained staffs that are necessary for product noise testing.

For example, the U.S. computer industry (not affected by the current European Directives) through its trade association

has been active in product noise control for the past several decades. All of the major companies in the computer industry currently have specialized facilities for product noise evaluations. The industry has its own product noise test code that has been incorporated into both American National Standards as well as standards of the International Organization for Standardization (ISO). The computer companies have staffs that are dedicated to work on product noise. Other American industries also have programs in product noise, but some industries have done little to meet European requirements.

A unified national test code for product noise would likely be an element of a new National Noise Policy (NNP) in the U.S. A Federal agency to assist industry in calibrating the test facilities for product evaluations is already established. The National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce has such a program in place. It is the National Voluntary Laboratory Accreditation Program (NVLAP) which provides accreditations for industrial and other commercial laboratories to ensure that the product evaluations of these laboratories comply with the requirements of the test codes specified by American and international standards. But having NVLAP accreditation and awareness of European standards will not be sufficient for certification of compliance with EU Noise Directives.

C. Development of noise compliant products

Engineers in this country firmly believe that noise levels in our society should be reduced, not by litigators, but by engineering efforts that consider the needs of society. Enabling American industry to find viable engineering solutions to reduce the noise emitted by machinery, equipment, and vehicles can reduce the noise exposure of the American public most cost-effectively. Compulsory regulations have in the past created adversarial relationships between industry, government, and the public, resulting in valuable resources being spent on litigation instead of developing and incorporating noise control solutions into products at an early stage of product design. Noise control by design will enhance the competitive position of U.S. industry in the world market by facilitating the development of products that satisfy the EU noise emission requirements (which are likely to become the de facto world-wide requirements), and will insure against a loss of market share.

American companies will need the technical knowledge, design capabilities, and trained personnel to innovate and build products that meet various noise requirements. Many industries do not have experience in dealing with noise issues. The EU has organizations like the Centre Technique des Industries Mécaniques (CETIM), the Fraunhofer Institutes, and universities supported by government and industry, to provide the technical infrastructure. The US must develop a NNP with a research component that will provide the basic technical support to industry through research, education, and technology transfer in product noise.

At present, most American companies that make consumer products are woefully unprepared to deal with the engineering and manufacturing issues involved in making their products meet the EU noise requirements. The EU regulations for some products are so stringent that totally new designs will have to be developed. The engineering needed to design products that are compliant to the Directives does not exist in these companies. A particular example is given below for lawnmowers, one of the many products subject to the EU noise regulations. In addition, many other types of equipment used by the commercial construction trades are subject to noise limits, with still other types subject, at this time, to noise marking (test and identification) requirements.

Product development does not necessarily represent a new cost since companies always have several new models in the design pipeline at any given time. The basic issue here is concerned with an implicit opportunity cost. It relates to whether or not the technical infrastructure for quiet product design exists and is available to industry. As noted above, in Europe there are research organizations in several countries with a basic mission to provide technical support to industry. US industry correctly wants to keep product design within its own purview, but knowledge about basic noise generation in mechanical components like gear-trains, motors, and whirling fan-blades can support the design activities without intruding into issues of proprietary information. The research to generate that information is likely to be beyond the capabilities of American industrial companies. In the USA, this basic research is considered more the province of universities and national

and private research laboratories.

There are already a number of American universities offering specialized instruction and degrees in acoustics, vibration, and noise control engineering. These subjects are of considerable interest to students as is evidenced by the number graduating today in this expanding field. The adoption of a National Noise Policy with a product noise component will stimulate more universities to augment the preparation of engineers dedicated to this important work. There is little doubt that the universities would be able to satisfy the national need for specialists in product noise engineering. These universities also have active programs of research in noise generation, radiation, and propagation. They are a ready resource for providing the technical infrastructure to support the development of quiet products.

The first Directives promulgated by the European Union with regard to product noise of outdoor equipment went into effect in January 2002. Some products are now required to report their sound power levels, and others have to meet preset limits on sound power. In the latter case, the products that companies wish to sell in Europe will have to be tested for their noise output, and if they do not meet the restrictions, they cannot be sold in Europe. Generally, the types of equipment involved are for commercial use and include common types of construction equipment. One included category is lawnmowers and trimmers. The size ranges of these include the types sold for both consumer and commercial usage. In some cases, there is a serious question whether these equipment products can comply with the Directives and still do their job. The U.S. companies that market these products are likely to have great difficulty in selling products that are both effective and compliant. In January of 2006, the limits on allowable radiated sound will be reduced further.

4. EXAMPLE OF THE COMPLIANCE PROCESS—LAWNMOWERS

Most of the major players in the commercial lawnmower market sell their products internationally. Those who are based in the U.S. have a strong international position and will expect to sell their products in Europe and in Asia. They need to be concerned that the EU Noise Directives may well be a harbinger of similar restrictions on product sound, not only in Europe, but also in other major and developing markets. Referring to Table 1, we see that the allowed sound levels for mowers depend on the width of the cutting track. There is a very large variation in this track for commercial mowers as used by golf greens-keepers, landscapers, and parks managers.

A rotary mower of the type used by the latter two groups is shown in Fig. 1. It has a cutting width of about 2 meters and falls in the $L_w(A) \leq 105 \text{ dB}$ limit (this illustration is reproduced from the manufacturer's catalog and is unrelated to the data example to follow). Mowers in this class therefore are limited to an *average* allowed sound power level of 102 dB.

A hypothetical example of sound power data for a mower as used by landscapers is shown in Fig. 2. Although hypothetical, we believe the example to be reasonable. The major "sources" of radiated sound are the engine (intake,



Fig. 1— Landscaper's mower exceeding L (cutting track) = 1.2 m from manufacturer's literature. This mower is NOT used for data presented in the hypothetical case of Figs. 2 and 3.

exhaust, and structural), the mowing deck (radiated both upward and downward) and the aerodynamic radiation by the moving blade and fixed surfaces. We see that the aerodynamic noise dominates, but the other two sources make a significant contribution to the overall noise.

A "balanced design" would lead to making all three sources equal contributors to the overall sound. If the limit is 102 dB, then each source should produce 97 dB. This will require a reduction in the sound for each source as shown in Fig. 3 (Fig. 3 also shows the reduction needed if 100 % sampling is used and the allowed limit is 105 dB). The reductions in sound radiated by the engine and the deck structure, although significant, are readily achievable by conventional noise reduction methods.

The source requiring the greatest attenuation is aerodynamic radiation by almost 9 dB. Since the sound power radiated by aerodynamic forces varies as V^6 , the obvious solution is to slow down the blades. With a V^6 dependence, each 1 dB reduction requires a 4% reduction in speed. A 9 dB reduction will require a 36% reduction in speed. With the blades moving this slowly, the mower won't cut grass!

5. THE INCE STUDY OF A NATIONAL NOISE POLICY

A. The solution—science or lawyers?

The situation posed by the EU Noise Directives is somewhat reminiscent of the product noise efforts of the US Environmental Protection Agency (EPA) in the 1970s, which could be summarized as "we have the technology, let's get on with the job". To the contrary, US manufacturers of mowing

A-weighted sound power level (L_w dB re 1pW)		$L_w(A)$ in dB
Blade noise—Tones and broadband aerodynamic noise		105
Engine noise		102
Deck radiation	Top surface	99
	Underneath	96
Total		101
Exhaust noise		92
Summed total:		108

Fig. 2— Component noise source ranking (hypothetical example).

equipment do not have the technical knowledge, facilities, or personnel to reduce aerodynamic noise by 9 dB while maintaining cutting performance. The task requires basic R&D of a type that the national laboratories and research organizations normally carry out. In Europe, examples of such laboratories that directly support industry were discussed above.

In the 1970s, the response of US industry to EPA initiatives was to turn to their lawyers and away from their engineers. They may well adopt such an approach to the EU (restraint of trade might be a valid legal issue). But the success of such an approach may be very different in the current situation. European manufacturers, with the backing of national laboratories and universities accustomed to providing R&D for industry, may be in much better shape to meet the noise limits that the EU Noise Directives require. U.S. industry is likely to have a much more difficult time.

Support of research by the National Science Foundation and other government agencies may help in meeting the January 2006 deadline for the more stringent EU requirements. It is time for supporting agencies to realize that the solution to "mundane" problems like the sounds of lawnmowers and other products involve issues of design and understanding that are every bit as challenging as the latest concerns in information and nano-technology. It is time for us to "get on with the job", precisely because we don't have the technology.

In recognition of this problem, INCE/USA has initiated a study of the impact of the European Directives on U.S.

Balanced design with 3 important sources: To meet a requirement of 102 dB
Blade noise = engine noise = deck vibration radiation = 97 dB

Significant reductions for all 3 sources are required

Blade noise	8.0 dB reduction
Engine noise	5.0 dB reduction
Deck vibration radiation	4.0 dB reduction

With no allowance for unit to unit variability—balanced level at 100 dB

Blade noise	5.0 dB reduction
Engine noise	2.0 dB reduction
Deck vibration radiation	1.0 dB reduction

Fig. 3— Balanced noise reduction (hypothetical example).

industry. One part of that impact is the economic cost of meeting the noise limits. Another is to determine how the technical infrastructure can be built without intruding upon the private product design and development activities within the product companies themselves.

INCE/USA has therefore initiated a study of the need for a National Noise Policy. The outcome of this study will be a report to Washington-based national organizations that are involved with the development of future policies, including the U.S. Congress. As part of this program, the study team also intends to meet with members of the Congress to discuss how the INCE study can be most effective, how its report can have the greatest utility to Congress, and how the legislative process can be supported.

B. Quantifying the costs to US industry

The potential cost to U.S. industry of failing to comply with European Directives requiring stringent noise limits on goods imported into Europe is large. Potentially, it means that much of the machinery and other noise-producing goods manufactured in America will be locked out of the European market. To some American producers, such as dishwasher manufacturers, this will not pose much of a hardship as American dishwashers have only a tiny fraction of the European market. The European public is much more demanding of high-quality, quiet consumer products than is the U.S. domestic market, and American manufacturers of dishwashers have paid scant attention in the past to the noise of their products. On the other hand, Asian and emerging markets often take their lead from Europe, resulting in lost market share for U.S. producers. Also, U.S. manufacturers of heavy construction equipment are well aware of the European requirements and have active programs to satisfy the noise limits prescribed by the European Directives. The bottom line is that those American manufacturers who either want to expand or hold onto their European markets will be forced to have their products comply with the European requirements.

It should be clearly recognized that the European product noise requirements are potential trade barriers to American products. Trade relations between the U.S.A. and the countries of the European Union are frequently tense. Much of European manufacturing and agriculture is subsidized directly or indirectly, and goods produced without government subsidies imported from outside the European Union present a challenge to European manufacturers. The noise issue is more or less ideal as an effective trade barrier. European testing and evaluation laboratories are well equipped to characterize American manufactured goods as not meeting European requirements.

C. Contacts with industry

The INCE/USA study team is aware of and very sensitive to concerns that industry has regarding issues of proprietary product design and development. U.S. industry does not want the government to support product design and development. But design and development rest upon a technological infrastructure of physical understanding and engineering methods. Although the generation, transmission, and radiation

of sound by the mechanisms and structures that are common to many products are well enough understood in a general sense, the application of these theories to the modeling and solution of practical product noise problems is inconsistent, at best. Apart from a few success stories, significantly more development of noise control engineering methods is needed in order for industry to produce the best designs. Federal support of research by the National Science Foundation, the Department of Commerce, the Environmental Protection Agency, and others can build the needed infrastructure. We expect that the INCE/USA study will recommend such a program.

But the Washington-based policy developers and the Congress are more likely to support a new NNP initiative if it can be demonstrated that these noise issues have a significant economic impact on US industry. In some informal discussions with industry representatives, there is reason to believe that the European Directives are already resulting in major costs to US industry. As a way to document that impact, an early part of the study will involve a series of interviews with industry representatives regarding the technological and economic impact of the directives.

The interviews with industry representatives will be concerned with the following questions:

1. How, in general, has your company responded to the European Directives in terms of technical and business activities and plans?
2. How well prepared is your company to meet the technical issues relating to modification or design of your products to meet the noise limits?
3. Are there particular products that you sell or had planned to sell in Europe that you may delay or not introduce at all into that market as a result of the directives?
4. Can you estimate the cost of the directives to your company in terms of person-years, facilities, and loss of sales?
5. Do you support the concept of a National Noise Policy that would have as a major ingredient basic research in product noise issues?

D. Contacts with trade associations

Contacts with trade associations are important, but it must be recognized that the interest of a particular trade association in a National Noise Policy will strongly depend on its views of international trade. The trade association for the computer industry is deeply involved in international trade and likely will view the adoption of a NNP as a major step forward. The trade association for the lawn-care industry, the Outdoor Power Equipment Institute, or OPEI, on the other hand, has in the past taken positions against noise requirements. Their support for a NNP may be less strong.

E. Contacts with congress, local and state officials

These contacts are vital to the success of any effort related to the adoption of a National Noise Policy. Both elected and appointed representatives of governmental organizations, national and local, are the spokespersons for the general public. They must be convinced that a NNP is necessary for

the country and support its development in every possible way. Officials will look to government agencies for supporting information on noise issues. Within just the last few years, cooperation between Federal agencies with regard to noise policy has increased greatly. For example, the U.S. Trade Office of the Department of Commerce now closely consults with the Environmental Protection Agency (EPA) on noise issues in trade agreements. This effort is to be applauded and encouraged. Still, much, much more is needed.

F. Industry/government partnerships

The available forums in which industry and government can cooperate must be expanded and activated with regard to noise issues. The U.S. Department of Commerce, through the International Trade Administration, sponsors Industry Sector Advisory Committees (ISACs) that foster industry/government partnerships on trade issues. Several relevant committees include ISAC 1 for aerospace, ISAC 2 for capital goods, ISAC 5 for electronics, instrumentation and medical equipment, and ISAC 16 for transportation, construction, mining and agricultural equipment. It is crucial to increase the awareness of these groups of the importance of noise issues in global trade to garner further support for NNP within initiatives.

6. PRESENTATION OF INFORMATION GAINED

For the reasons discussed here in detail, America needs a new and improved National Noise Policy. A Study Team of the Institute of Noise Control Engineering (INCE/USA) has been tasked to make a detailed study of this need and to propose a course of action that could lead to the adoption of such a policy. To assure our quality of life and to minimize the economic impact of potential trade barriers, the Study Team is recommending that a unified National Noise Policy (NNP) be developed and then implemented in the immediate future. This cannot be accomplished without the participation and cooperation of representatives of all the concerned parties (the people, their government, and American industry).

A. Presentations to the congress and the executive branch

The follow up to the completion of the study team's report is critically important. It is imperative that a number of "champions" be identified on the national scene. These are individuals in the Congress and the Executive Branch of the Federal government who not only support a National Noise Policy, but also are willing and able to carry through on its adoption. This will not be a simple task, as they must overcome the doubters who may oppose the adoption of such a policy.

7. CONCLUSIONS

The INCE Study Team on National Noise Policy regards this issue as critical for U.S. industry and our economy. It is essential that the situation with regard to the effect of product noise on international markets be both understood and anticipated. Once the Study Team completes its report, the next steps will be to work with the various groups involved - industrial, educational, scientific, professional, legislative, and executive—to plan for a coordinated, effective U.S. National Noise Control Program. This will involve many participants beyond those involved in the current INCE study.

The INCE Study Team finds that the economic impact on America's products, without a much improved National Noise Policy, will be severe. A National Noise Policy is needed that has as one of its key components an industry/government partnership to assist American industry in acquiring the basic knowledge that is needed to produce quiet products for the future and to keep America's manufactured goods competitive in world markets.

8. REFERENCES

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