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MACHINERY SAFETY DIRECTIVE 89/392/EEC - IMPLICATIONS FOR UK INDUSTRY

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INTRODUCTION

In 1993, all manufacturers and suppliers of machinery in the UK will be subject to further legislation covering noise from the products they manufacture or sell in Europe, as a result of the Machinery Safety Directive (89/392/EEC) and its Amendment (91/368/EEC).

The aim of the Machinery Safety Directive is to harmonise requirements for machinery sold within the European Community, facilitating trade between all member states when the 'single market' comes into effect in 1992. The amending Directive brings most mobile machinery and lifting equipment within the coverage of 89/392/EEC. Failure to comply with the requirements of the Directive will be made a civil offence.

A few types of machine, particularly road vehicles and construction equipment, have been covered for many years by specific noise Directives. Most manufacturers of such machine types are large companies with considerable design and development resources. The Machinery Safety Directive will bear on all types of machinery, and on their manufacturers and suppliers, large and small. How is UK industry equipped to cope with this new Directive?

The authors have recently carried out a study, on behalf of the DTI, to assess how the Machinery Safety Directive will affect machinery manufacturers in the UK. Information was obtained directly from industry and interested bodies by:

- Circulating questionnaires to about 450 machinery manufacturers, selected at random, to assess their awareness of the Directive and its possible implications, and the quality of technical resources available to them.
- Interviewing senior engineering staff in over 40 firms and examining examples of their products.
- Consulting representatives of trade associations, consultants, research associations and the HSE.

This paper examines key questions raised in the course of the study.

MACHINERY SAFETY DIRECTIVE

NOISE REQUIREMENTS OF THE MACHINERY SAFETY DIRECTIVE

Annex 1 of the Machinery Safety Directive contains the following requirements relating to noise:

Section 1.5.8

"Machinery must be so designed and constructed that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source."

Section 1.7.4 relates to instructions which must accompany all machinery and be included in sales literature which:

"...must give the following information concerning airborne noise emissions by the machinery, either the actual value or a value established on the basis of measurements made on identical machinery:

- equivalent continuous A-weighted sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact must be indicated,
- peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20μPa)
- sound power level emitted by the machinery where the equivalent continuous A-weighted sound pressure level at workstations exceeds 85 dB(A).

In the case of very large machinery, instead of the sound power level, the equivalent continuous sound pressure levels at specified positions around the machinery may be indicated.

Where the harmonised standards are not applied, sound levels must be measured using the most appropriate method for the machinery (Amendment 91/368/EEC).

The manufacturer must indicate the operating conditions of the machinery during measurement and what methods have been used for the measurement.

Where the workstation(s) are undefined or cannot be defined, sound pressure levels must be measured at a distance of 1 metre from the surface of the machinery and at a height of 1.6m from the floor or access platform. The position and value of maximum sound pressure must be indicated."

" Where necessary the instructions must give the requirements relating to installation and assembly for reducing noise and vibration (eg use of dampers, type and mass of foundation block etc.)"

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SHORT-TERM IMPLICATIONS

The main short-term implication of the Machinery Safety Directive is the requirement for manufacturers to provide information on noise levels. This is also a requirement of the Noise at Work Regulations. 24% of the companies surveyed have no experience of noise measurement and only 11% provide information on noise levels for all their products. The requirement to measure noise, particularly sound power, will present many firms with significant problems. Manufacturers in some other European countries are believed to be better-equipped to make measurements and are already collecting much of the necessary information.

LONG-TERM IMPLICATIONS

The long-term implications of the Machinery Safety Directive, resulting from the general duty to reduce noise, are less clear-cut.

It is accepted that the requirements for the provision of information on noise levels will enable machinery users to compare the noise performance of alternative machines from different suppliers. In general this will create some commercial pressure to reduce machine noise levels, particularly where these are close to 85 dB(A), although it is a general view that price, performance, speed of delivery etc. will continue to be the decisive factors. The major source of pressure to reduce noise seems to be from customers who have to comply with the Noise at Work Regulations.

The availability of noise information on all machines will make it possible to accumulate a machine noise 'database'. There are suggestions that this could be manipulated to produce a noise ranking order for machines of certain well-defined types which in turn could be used to define noise limits of these machine types, although this is not supported in the UK. The league table approach has found favour in Germany with the 'Blue Angel' Scheme.

The Directives covering noise of construction plant, mowers, and road vehicles impose noise limits some of which have been revised downwards with successive Directives. It is our understanding that the Machinery Safety Directive is not intended to lead to an extension of the range of machinery for which specific noise limits are imposed.

ENFORCEMENT

The way in which different member states will approach the enforcement of the noise reduction clause of the Directive is uncertain. The Directive itself has no mechanism to monitor enforcement.

The study disclosed a common fear that the safety standards may be more rigorously enforced in the UK than in some other countries, to the detriment of the competitiveness of UK manufacturers. Harmonisation of safety standards does not eliminate trade barriers if compliance with standards is not consistently enforced.

INTERPRETATION OF THE DIRECTIVE

The scope of the Directive is so wide that interpretation in the light of existing practices and knowledge is bound to differ between sectors of the machinery manufacturing industry. It is to be hoped that the legislation, standards and guidance notes produced in the implementation of the Directive will clarify the intended interpretation of the Directive, particularly regarding the application of the Machinery Safety Directive to machine components and incomplete machines, and the measurement methods to be applied.

Article 4(2) of the Directive states that if a component can function independently it must comply with the Directive. Components such as motors, pumps, gearboxes and complete sub-assemblies which are to be incorporated into a machine by others can sometimes be operated independently, but in many cases their noise level in this condition would not be representative of their contribution to the noise level of the complete machine. In such cases, the provision of noise information as required by the Directive is of limited value.

Many machines are supplied to users without tooling or guards. Presses are a notable example: tooling and guards are almost always supplied by other manufacturers or by the end user. It would be possible for the original manufacturer to provide noise data for the machine using standard tooling, as proposed in the press noise C-Standard (ISO DIS 8500); although the user's tooling arrangement will be totally different. The tooling alters press noise by up to 10 dB(A). The effect of guarding, which can modify noise levels by 3 to 10 dB(A), can only be determined following final commissioning by the user. The provision of noise information as required by the Directive is of limited value, if it is measured on an incomplete machine working in unrepresentative operating conditions.

Some firms manufacture machines which are designed by the end user or by a third party. Often such machines would be delivered incomplete to be set up and commissioned by others. It is unclear what the responsibilities of the manufacturer would be in such cases.

It would seem that the Directive was written on the basis that a machine is supplied directly from manufacturer to user as a self-contained, complete, working assembly. This is rarely the case. The precise responsibilities of manufacturers, designers, suppliers and agents in real situations must be formally interpreted to avoid confusion and to enable firms to comply.

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MEASUREMENT STANDARDS

What is the 'most appropriate' measurement method for the machinery as specified by the Directive?

In order to define the measurement methods a very large number of noise measurement standards are being written to cover the wide range of machines to which Directive 89/392/EEC applies. Measurement ('C') standards are being drawn up by working groups of CEN technical committees. The CEN committee with responsibility for noise (CEN/TC 211) have issued a draft guide to assist these working groups in defining measurement methods appropriate to the machine types they are considering.

Very few UK companies send their own employees to represent their interests on ISO, CEN, or other international committees dealing with noise measurement or control. 57% of the companies responding to the questionnaire did not know that these committees existed. It seems likely that the UK industry view on noise measurement and control will not be properly represented in Europe.

Discussion with UK representatives on some of these working parties, and examination of draft documentation available to and produced by them, suggests that there are several problems which must be addressed if workable measurement standards are to be formulated:

- Working groups do not always include members with practical experience of noise measurements.
- The guidance provided by CEN/TC 211 (CEN/TC 211 Ad Hoc 1/NSL) is thorough but seems to be unnecessarily complex for the intended purpose.
- It is likely that the agreed measurement standards will rely heavily on existing National Standards developed in other countries (eg. DIN standards). Many of these standards are unnecessarily complex, although European competitors may already be familiar with them.
- The B-standards on which C-standards will rely are still in the process of revision, and the drafts are more complex than existing versions.

Unless these problems can be addressed, many noise measurement standards are likely to be inappropriate or impracticable for routine application in industry. For example, for most machines, operating conditions have more effect on sound levels than acoustic conditions and the rigorous specification of acoustic conditions may impose an unnecessary burden on manufacturers.

The imposition of unnecessarily complex noise test methods would be a severe handicap for smaller firms making many machine types in small numbers: firms of this type are common in UK machinery manufacturing industry.

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PROBLEMS IN MEASURING NOISE

For most machinery manufacturers and suppliers the noise level information which must be measured represents an additional duty, and in some cases presents quite fundamental problems.

Approximately 61% of firms responding to the questionnaire claimed to have staff able to carry out noise measurements. However the interviews indicated that many firms over-estimated their capabilities. Measurement equipment was often out-of-date with no evidence of regular maintenance or calibration. Staff currently involved in noise measurement rarely had any formal training in measurement methods. Firms with BS 5750 approval tended to be better-organised, since noise measurement was often included in formalised inspection procedures.

Most manufacturers of machines which can be run in the suppliers' works could acquire the ability to carry out basic sound pressure level measurements, using a suitable engineering method, perhaps as part of a QA inspection procedure.

When sound pressure level at any workstation exceeds 85 dB(A) sound power level measurements are required, except for very large machines. The measurement of sound power level requires better-controlled measurement conditions, more extensive measurements and familiarity with noise calculation procedures. Very few companies outside the internal combustion engine and construction categories have the facilities, trained staff and equipment to measure sound power levels as required by ISO 3744, ISO DIS 9614, ISO 3747 etc, 79/113/EEC or any other relevant test code.

For meaningful results, machines must be tested at appropriate operating conditions. For machines which will be installed in a production line, a 'standard' operating condition could be devised, but it is difficult to imagine how some machines could be tested in isolation whilst handling a product at a rate representative of realistic working conditions, since they depend on 'upstream' and 'downstream' machines to deliver and remove the product. It may be possible to carry out measurements with the machine installed and operating on a customer's premises although if the machine in question is not the major noise source it will be necessary in these circumstances to use sophisticated or elaborate measurement methods (e.g. intensity measurements or screening of other sources).

Machines capable of processing or handling different materials tend to radiate very different noise levels for each application. For these and other machines in which product noise is the main source, the noise levels of the machine alone would be of little value. The cost of testing machines under all possible applications and operating conditions is likely to be prohibitive.

The noise measurement requirements are particularly onerous for manufacturers of one-off or special purpose machines or for those with a wide product range but small sales volumes. As an extreme example one manufacturer visited lists about 140 machines in their catalogue at an average ex-works cost of less than £1000. The additional cost of noise testing all types would be disproportionate, compared with the position of a larger competitor with a smaller range or higher volumes.

PROBLEMS IN REDUCING NOISE

UK machinery manufacturers supplying the European market are likely to be forced to develop treatments or designs to reduce noise as a result of commercial pressure and the requirements of the Machinery Safety Directive. 65% of the companies who responded to the questionnaire were concerned about the difficulty of reducing the noise from their products.

Companies which have developed expertise in noise control have found that it is possible to reduce noise at modest cost, provided that their engineers have insight into noise generating mechanisms, and have knowledge of the alternative noise control techniques which can be applied within the machine envelope: 'at source'. Only a few consultants have the detailed knowledge of machine functions needed to reduce noise at source effectively. Many noise control solutions have been developed by engineers with intimate knowledge of their machine design who learn noise control skills, rather than by acoustic specialists.

Within machinery manufacturing industry there are sectors which have developed the facilities and expertise to measure noise and to control noise cost-effectively. The impetus for such developments has been either specific noise regulations or customer pressure to reduce noise. Road transport vehicles, construction equipment and lawnmowers have been subject to regulations for some time influencing not only manufacturers of these products but also of internal combustion engines, hydraulic power systems, pumps, compressors etc. Hand-held power tools and equipment for the building services industry are subject to competitive pressure to reduce the noise from their products.

The technology for modelling, predicting and optimising working processes and structures is highly developed in some of these industrial sectors. Some of the processes and many of the structures used in other machine types are similar, and there is potential for the industrial technology developed by the most noise-experienced companies to be adapted for other applications. Currently there are no resources and no incentives to perform the necessary adaptations.

There seems to be no central source to which engineers may refer when seeking information on noise control. A comprehensive and consistent database of information on the performance of materials, devices and techniques to control noise, would be very valuable to engineers who are subject to pressure to reduce noise levels as a result of Directive 89/392/EEC.

CONCLUSIONS

The noise requirements of Directive 89/392/EEC are likely to cause problems for British machinery manufacturers, not only in terms of the technical aspects of measuring and controlling noise, but also arising from a lack of awareness of the implications of the Directive, (or even of its existence), the difficulty in interpreting what is actually required, and uncertainty as to how the Directive will be enforced.

The work of committees involved in writing the measurement standards to support the Directive appears to be in some confusion, due mainly to the large number of standards required and to the shortage of technical support on noise matters at the working level. The study showed that UK industry is inadequately represented on these standards committees.

The shortage of the necessary test procedures may, perhaps, have contributed to the decision, contained in the amending Directive to give manufacturers the option, from 1st January 1993 to 31st December 1994, of either complying with the Directive or of continuing to comply with existing national laws.

In the companies interviewed, there was a general concern to reduce noise. However, unless the company was in one of the few categories in which legislation existed to control noise, or in which competitive pressures existed to reduce noise, machine noise was a low priority in design. Only a small minority of machine manufacturers are currently capable of making the noise measurements required by 89/392/EEC, and of interpreting formal test procedures: a great deal of training will be required.

At the time of the study many companies were reducing the number of design and development engineers employed. These companies will be poorly placed to comply with complex legislation and to make the technical progress needed to design and develop quieter machines.

REFERENCE

Council Directive of 14 June 1989 on the approximation of the laws of the Member States relating to machinery (89/392/EEC). Official Journal of the European Communities no L 183 of 29.6.89, pages 9-32.

Council Directive of 20 June 1991. (91/368/EEC) amending Directive 89/392/EEC Official Journal of the European Communities no L 198 of 22.7.91, pages 16-32.

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