

# THE DEVELOPMENT OF REVISED VIBRATION EMISSION STANDARDS FOR POWER TOOLS.

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*The situation regarding vibration standards today is complicated. The revised machinery directive 2006/42/EC will become active 2009-12-29. The national regulations based on the Physical Agent's (Vibration) Directive 2002/44/EC, (known as the vibration directive), was published July 2006. Both directives have contributed to give focus on vibration problems in industry. At the same time the confusion is big. This paper will explain how the different directives and standards regarding hand arm vibration are related.*

*Tool vibration, In-use vibration and Vibration exposure are three vibrations with different meanings. They are all given as vibration acceleration in  $m/s^2$ . It is important to understand the differences and how e.g. the declared Tool vibration can be used to estimate the In-use vibration for rough exposure assessments.*

*Vibration emission, Vibration exposure, Vibration standards, Vibration directives,*

## **1 Present standards and directives related to hand arm vibration**

Three groups of people are involved. The **Manufacturer** of the power tools is responsible for developing and marketing tools and equipment that do not create unnecessary vibrations. The **Employer** is responsible for the safety of his employees. As part of that he should, whenever possible, choose tools that give low vibration exposure. The **Operator** is responsible for using the tools according to the given instructions and to react when he or she has reason to believe that vibrations are unusually high.

The operator is also the person exposed to vibrations and therefore the one that shall be protected from unnecessary vibration exposure. The exposure comes from working with vibrating tools and from other objects such as vibrating handles or controls on larger equipment. Exposure could also be from vibrating workpieces that are hand-held during a process. Such objects often expose the operator to high vibrations.

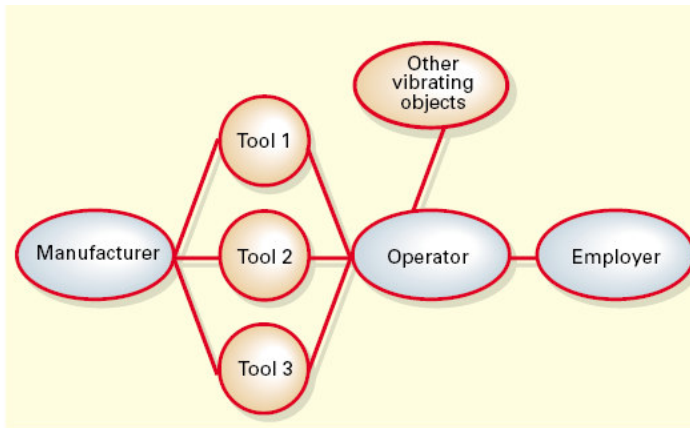


Fig 1 Operators are exposed to vibrations from different sources and also from power tools.

Manufacturers are responsible to market tools designed for low vibration.

Employers are responsible to protect their operators from excessive exposure to vibration.

### 1.1 The responsibility of the manufacturer

The manufacturer's responsibility is regulated according to Machinery Directive (98/37/EC). In July 2009 the revised directive (2006/42/EC) will be active. From that date a number of changed demands on the manufacturer also in the vibration area will be active. The machinery directive deals with essential health and safety requirements of machinery. The CEN standard EN 792 explains in more detail what the manufacturers have to do to comply with the directive.

The Machinery Directive requires the manufacturer to declare the vibration emission from his tools. The values shall be declared in accordance with the appropriate test code. Air driven tools are declared according to the ISO 8662 series of standards and electric power tools to the EN 60745 series. The vibration emission standards are under revision to follow the demands and requirements in the new directive.

### 1.2 The responsibility of the employer

The employer must follow the national law regarding health and safety for his operators. Before July 2005 the law differed from country to country.

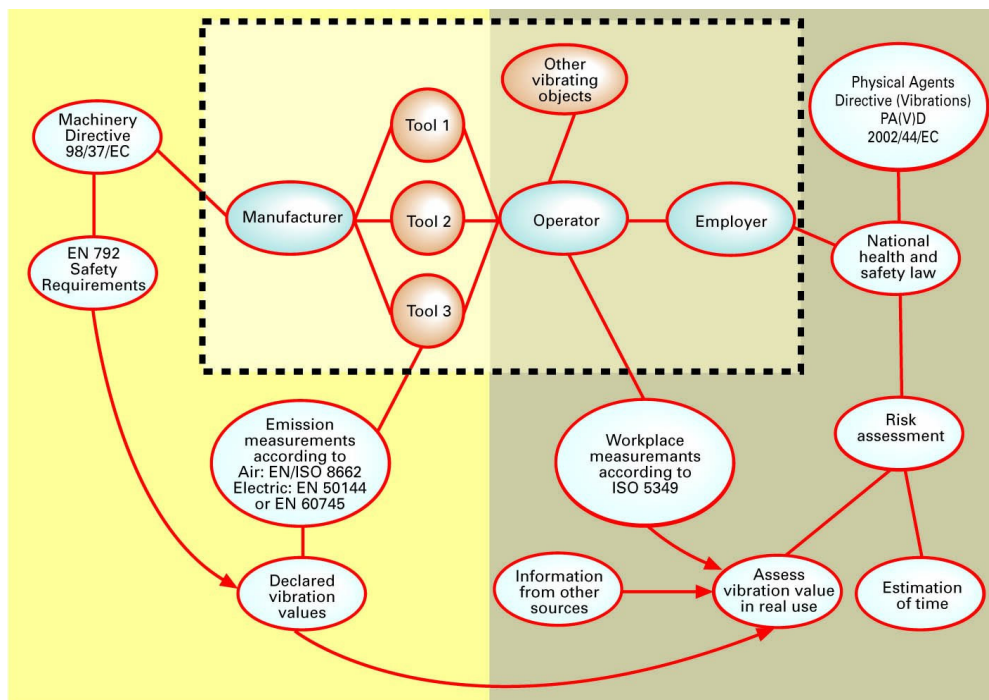


Fig 2 The complete picture of relations between the different standards shows a complicated pattern. To avoid unnecessary misunderstandings and to avoid confusion it is essential to understand how the directives and standards are linked together.

Today, as a result of the demands in the Physical Agents (Vibration) Directive (2002/44EC), all national regulations are more equalized.

Risk assessments must e.g. be done for all employers exposed to vibrations. When the vibration exposure exceeds the action value  $2,5 \text{ m/s}^2$  an action program must be implemented and vibration exposure in excess of the limit value  $5 \text{ m/s}^2$  are prohibited.

### 1.3 The three different vibration values and their meaning.

**Tool vibration**, **In-use vibration** and **Vibration exposure** are three vibrations with different meanings. They are all presented as vibration acceleration in  $\text{m/s}^2$ , but they are totally different. It is important to understand the differences and how e.g. the declared tool vibration can be used for rough exposure assessments.

**Tool vibration** is the vibration emission from the tool measured in well defined laboratory conditions. The tool vibration is used as the declared vibration emission published together with the tool. For most non electric tools tool vibration is measured according to the ISO 8662 series and electric tools are measured according to EN 60745. These standards are under revision follow the demands in the new B-standard 20643 and the requirements in the revised Machinery Directive ( 2006/42/EC ).

**In-use vibration** is the vibration that an operator is exposed to then the tool is triggered and working performing a work task. The in use vibration is together with the exposure time the input needed to calculate the daily vibration exposure. If measured the value should be obtained using recommendations given in ISO 5349.

**Vibration exposure A(8)** is the average vibration an operator is exposed to averaged over the whole 8h working day. This is the vibration exposure value that is used in the regulations following the Physical Agents (Vibration) Directive.

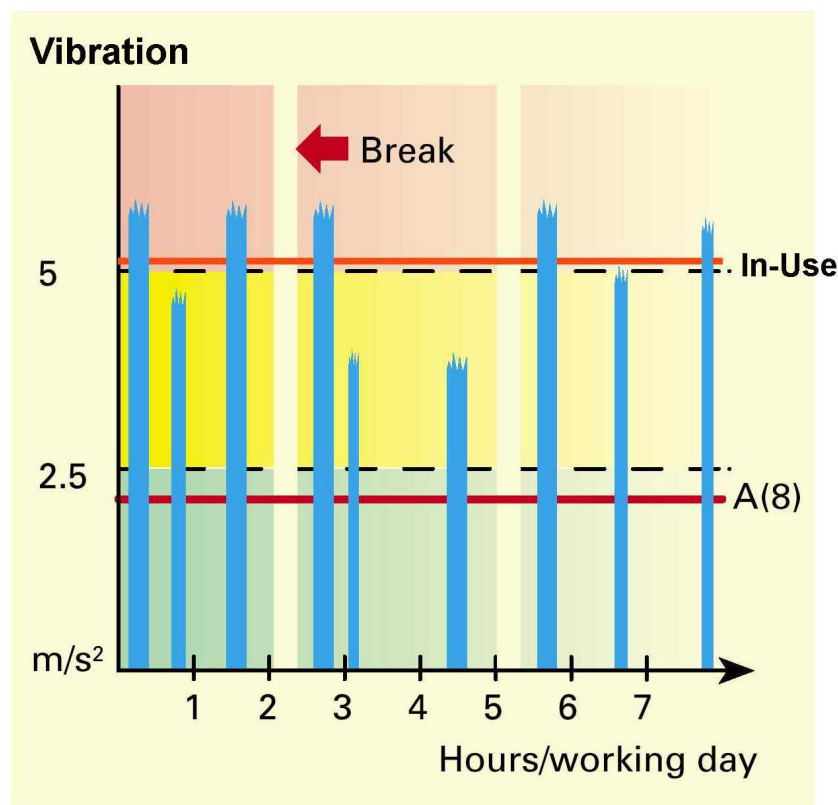


Fig3 The bars in the diagram represent various in-use vibration values during the 8 hour working day. The average in use vibration from the bars is a value slightly above  $5\text{m/s}^2$ . The A(8) for the same vibration is about  $2.4\text{m/s}^2$

## **2 The aim with vibration emission standards**

### *2.1 Compare tools*

The tool vibration is used as the declared vibration value associated with a tool. Traditionally the declared values have been used to compare different tools of the same type. Choosing the tool with the lowest declared value should normally mean that the best tools from the operator's standpoint is chosen. However there are some exceptions. Output power of a tool is often linked to vibration emission. On the other hand a more powerful tool can often do the job faster. This would than result in a shorter exposure time and lower exposure to vibration.

Values intended to compare tools must be repeatable and reproducible and the spread in the results must be kept low. The method should also rank tools in an order that is representable for the vibration levels they create in a real use situation. This is the basic idea behind the present standards. The values are not necessarily of the same magnitude as values in real use but the ranking is in most cases correct.

### *2.2 Input data to risk assessments*

The declared emission values published together with the tools have often been criticized for underestimating the values in real use. This is true in many cases primarily because the present standards in the ISO 8662 series measure in only one direction instead of the 3 directions used in vibration exposure measurements according to ISO 5349. To overcome this problem CEN has published a technical report CEN TR 15350. This report deals in detail with the problem to use emission values to do risk assessments. In the report are also tables that give correction factors for most types of tools. The factors are intended to correct the emission value when used as input to risk assessments.

## **3 The development of the revised emission standards**

### *3.1 New demand requires revised standards*

Three important documents have been published. ISO 20643 is the B standard that sets the demands on the revised standards. The revised Machinery directive (2006/42/EC) sets the demand on the emission standards to be accepted as the basis for the vibration declarations. The Physical Agents (Vibration) Directive (2002/44/EC) has increased the interest in the published emission values as a basis for risk assessment

### *3.2 EN-ISO 20643*

This B-standard was published in 2005. It requires the revised C-standards in the present ISO 8662 and EN 60745 series to give values that are representative of the upper quartile of the range of values obtained under typical working conditions of the machine measured in accordance with EN ISO 5349-1. To be able to give such values measurements must in most cases be made in 3 directions.

The revised C-standard shall also produce vibration emission values and uncertainties suitable for comparing the emissions of machinery of the same type irrespective of the date or location of the testing. This standard does not affect existing emission standards but once revised they should be written in accordance with this standard.

### 3.3 *The revised Machinery Directive (2006/42/EC)*

The first Machinery directive was published in 1989. It was revised in 1998 to the version that is active today. A revised version was published in June 2006 (2006/42/EC). This version will be active 2009-12-29. Among other things this revised directive also requires declared vibration values to be vibration total value (3 directions) followed by the associated uncertainty in measurements. To meet this requirement all parts of the present ISO 8662 standards need to be revised.

### 3.4 *The Physical Agents (Vibration) Directive (2002/44/EC)*

In June 2002 The Physical Agents (Vibration) Directive (2002/44/EC) was published. The requirements in this directive should have been incorporated into national law and regulations by all EU member states not later than June 2005. This was also done with a few exceptions. Germany for example did not publish their regulations until March 2007.

This directive deals with the obligations the employer has to protect his workers from excessive exposure to vibration. It has two parts one for whole body vibration and one for hand-arm vibration. The following text deals only with the hand-arm part.

According to the directive the employer must do risk assessments for all operators exposed to vibration. This has increased the demand on the declared values to be representative for the vibration values that can be expected in real use. The declared values based on the revised vibration emission standards can be used in this way. The values from the existing emission standards can be used if they are adjusted using the correction factors available for different tool types in the technical report CEN-TR 15350.

## **4 Present situation for the revision of ISO 8662 and EN 60745**

The whole ISO 8662 series is under revision. A timetable has been set up and the plan is to have all parts published not later than July 2009. To avoid confusion between values already published according to the present ISO 8662 standards the revised standards will have a new number series ISO 28927. The new standards will follow the B standard ISO 20643. Values can therefore be used for the risk assessments required by the Physical Agents (Vibration) Directive. In this case the correction factors used to on values obtained according to ISO 8662 shall no longer be used.

The EN 60745 series has progressed further. Most parts are either published or out for formal vote. Many of the standards in this series are revisions from the earlier EN 50144 series, but some are just revisions from an earlier version of 60745. In those cases the way to distinguish between values are the publication date for the referenced standard.

How to use the emission values for risk assessment are dealt with in the paper Vibration exposure assessment using declared vibration values.