Health and Safety at the Workplace
Noise and Vibration Limits

- EU occupational safety directives transposed into German national law
- Increased safety and improved health protection at work
Health and Safety at the Workplace

Occupational safety directives require protection from noise and vibrations

In its production of top-grade surface machining and cutting tools, PFERD is guided by the fundamental principles of labour safety, health at work, and care for the environment. As a premium manufacturer we are committed to the goal of improving our tools and production processes in line with ergonomic and ecological standards, for the benefit of the user.

Moreover, we consider it our duty to propagate information about new findings and methods of protecting the health and safety of the people working with PFERD tools.

In the Federal Republic of Germany, occupational safety – including health and safety at the workplace – is regulated by numerous laws, ordinances and codes.

Occupational safety covers all measures which help to protect the life and health of people at work, to preserve their labour capacity, and to make workflows as humane as possible. The prevention of occupational accidents, occupational diseases and labour-related health risks forms part of this effort.

Establishing detailed occupational safety requirements through legislation is the responsibility of the state. However, in their legislative efforts, the German federal and Land governments are bound by European Union (EU) law. The European Union harmonizes occupational safety regulations in its member states and has laid an extensive groundwork of regulations and activities for the protection of health at work. EU directives on occupational safety are binding on all member states and must be adopted as part of their respective national legal systems.

European Union (EU) occupational safety directives

In the EU, minimum requirements have been defined for the protection of employees from noise (2002/44/EC) and vibration (2003/10/EC). In Germany, these were implemented in national law through the ‘Directive for the protection of employees from hazards caused by noise and vibration’ (Noise and vibration work protection directive) dated March 6, 2007.
Noise is undesirable sound (e.g., machine noise, acoustic tones, explosion or impact noise, high-decibel music, irritating speech sound) that may give rise to hearing impairments or other damage to health.

Noise-induced hearing loss tops the statistics for occupational disorders. Intense noise at the workplace may affect the hearing of workers. In Germany, about 5 million employees are exposed to noise which presents a risk of hearing impairment.

How our ear works

Our ability to hear sound is based on a fascinating mechanism. Every sound consists of vibrations. These are transmitted through the air as waves and picked up and processed by our ear. We refer to this process as hearing.

The ear directs sound waves into the auditory canal through which they reach the eardrum, causing the latter to vibrate. These vibrations are transmitted to the fluid-filled cochlea, our actual hearing organ, via the auditory bones (hammer, anvil and stirrup).

Oscillations are thus produced in the fluid of the cochlea, like a stone flung into water will create waves. These oscillations pass to the inner ear which is lined with fine sensory cells (hair cells). The purpose of their minuscule hairs is to convert the mechanical oscillation into electrical impulses at the end of the transmission chain. An auditory nerve conducts these impulses to the brain, where they are processed into the actual acoustic image.
Health effects of high noise exposure

Elevated noise levels, such as high-decibel music or loud traffic sounds, may depress the hairs on the hair cells. These hairs will then conduct sound less effectively, at least until they have reverted to their upright position. The noise of an explosion, or many years of continuous noise exposure at the workplace, may cause them to collapse or break off altogether. The result will be irreparable loss of hearing, since these hairs will not grow again.

Hearing is one of our brain’s main sources of sensory input. Uncomfortable noise distracts us. As a result, we experience loss of concentration, fatigue, a reduced capacity to work due to increased physical strain, attention deficits, and an impaired ability to communicate verbally.

Hardness of hearing is incurable. Hearing aids can provide only a limited improvement. This makes noise protection all the more important.

Regulations and exposure action values

In measuring sound levels, a filter is used to simulate the response of human hearing. This filter is referred to as the “A-filter”. Sound intensity is commonly measured in decibels = dB(A).

In February 2003, the European Parliament and the European Council published EC Directive 2003/10/EC which defines the limits of noise exposure for workers. Like its predecessor, the new directive places primary emphasis on the duty to achieve technical noise abatement.

In the German implementation of this directive in the noise and vibration work protection directive, a distinction is made between two values for the daily exposure level: The lower trigger value of 80 dB(A) and the upper trigger value of 85 dB(A). When these values are reached or exceeded, certain measures become necessary; these measures can be found in the table “Overview of preventive measures” on page 5.
Prevention measures

An employer must provide hearing protectors when noise levels exceed the lower exposure action value. However, the use of such equipment becomes mandatory only when the upper exposure action value is reached or exceeded. Workers are required to wear hearing protectors in high-noise areas, which need to be expressly marked as such.

Machines represent a main source of noise at the workplace. It follows that the call for noise abatement “at source”, i.e., on the machinery in question, is a key factor in the noise control concept.

Sound pressure level (dB)

Sound pressure levels are measured in Pascal, the physical unit of measurement for pressure. The human ear can perceive acoustic stimuli over an almost inconceivably broad sound pressure range. In order to obtain smaller and more workable figures, the intensity of sound input is expressed in decibels (dB), a logarithmic unit.

The sensitivity of the human ear follows an approximately logarithmic law, too. As a result, a 10 dB increase in sound pressure level will be experienced as twice as loud. An increase by 3 dB is enough to double the risk of hearing impairment.

Overview of prevention measures

<table>
<thead>
<tr>
<th>Upper / lower action value ($L_{EX, th}$)</th>
<th>&gt; 80 dB (A)</th>
<th>&gt; 85 dB (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty to provide information and instruc-</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>tion $L_{EX, th}$ ≥ 80 dB(A))</td>
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<tr>
<td>Hearing protectors to be made available</td>
<td>X</td>
<td></td>
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<tr>
<td>Right to a preventive audiometric exami-</td>
<td></td>
<td></td>
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<tr>
<td>nation if an assessment or measurement</td>
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<tr>
<td>suggests a health hazard</td>
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<tr>
<td>Right to have hearing examined by a do-</td>
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<tr>
<td>ctor</td>
<td>X</td>
<td></td>
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<tr>
<td>Duty to wear hearing protectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$L_{EX, th}$ ≥ 85dB(A))</td>
<td>X</td>
<td></td>
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<tr>
<td>Noise abatement programme</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Marking of high-noise areas</td>
<td>X</td>
<td></td>
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<tr>
<td>Delimitation or access restriction, if</td>
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<tr>
<td>technically feasible and justified by</td>
<td>X</td>
<td></td>
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<tr>
<td>the exposure risk</td>
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<td></td>
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<tr>
<td>Keeping of health records if an assess-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ment or measurement suggests a health</td>
<td>(X)</td>
<td>(X)</td>
</tr>
<tr>
<td>hazard</td>
<td></td>
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</tr>
</tbody>
</table>

Source: Noise and vibration work protection directive dated 2007-03-06

Examples of sound pressure levels

As a premium manufacturer, PFERD is continuously working on the development of noise-reduced tools. In our production operations we prefer machinery and work methods with minimum noise output.
Vibrations are mechanical oscillations which pose a hazard to human health when acting continuously on the hand-arm system (hand-arm vibrations) or on the entire body (whole-body vibrations). Vibrations may cause blood circulation problems, bone or joint disorders, neurological or muscular conditions, back pain, or damage to the spinal column.

**Effects of vibrations on the human body**

Scientists are researching vibration effects in an effort to determine thresholds which, when properly observed, will safeguard health. Occupational performance impairment and discomfort due to vibrations, whether in isolation or combined with noise, are another subject of human experimental studies for which highly advanced laboratories are available.

The health risk posed by vibration loads depend on the point of introduction into the human body (e.g., feet, buttocks, hands), the vibration intensity, and the effect of repeated daily exposure over a period of several years.

**The following distinction is made in this context:**

- **Whole-body vibrations**
  - Introduction of vibrations via the feet (when standing) or buttocks (when seated), e.g., by vehicles, excavating equipment, forklift trucks, tractors, etc.

- **Hand-arm vibrations**
  - Introduction of vibrations via the hands, e.g., by handheld or hand-guided vibrating tools, equipment, machines or workpieces or, possibly, by the controls of mobile or stationary machines.

**Health effects of high vibration levels**

The effect of vibrations is a function of their frequency and intensity. Vibrations in the low-frequency spectrum lead to disorders of the muscular and skeletal system (damage to joints).

The high-frequency portion damages the peripheral blood vessels and nervous system (disturbed blood circulation in the fingers and hands, or even numbness and loss of grip). Even low vibration levels may cause discomfort and reduced productivity.
Regulations and exposure action values

In July 2002, the European Parliament released EC Directive 2002/44/EC which addresses the minimum health and safety requirements regarding worker exposure to risks arising from physical agents (vibration). The directive stipulates both an exposure action value and an exposure limit value.

Under this directive, employers are required, inter alia, to determine the level of exposure to vibrations at the workplace. A workplace is deemed to pose a hazard if it involves persistent vibration exposure in the form of hand-arm vibrations or whole-body vibrations.

The duration and intensity of the vibration exposure must initially be determined. A so-called daily exposure value, standardized to an 8-hour reference period, must then be established.

The new directives need to be observed wherever work is carried out with the aid of vibrating tools or equipment. Employers are expected to know and monitor the vibration exposure of their personnel, and to take remedial action where necessary.

Exposure action values and limits

<table>
<thead>
<tr>
<th>Expositionsgrenz- und Auslösewerte für Vibrationen</th>
<th>Hand-arm vibrations (HAV)</th>
<th>Whole-body vibrations (WBV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily vibration exposure value A(8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure action value A(8) = 2.5 m/s²</td>
<td>A(8) = 0.5 m/s²</td>
<td></td>
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<tr>
<td>Exposure limit value A(8) = 5.0 m/s²</td>
<td>A(8) = 0.8 m/s²</td>
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<tr>
<td></td>
<td>in Z-direction (vertically)</td>
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<tr>
<td></td>
<td>A(8) = 1.15 m/s²</td>
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<tr>
<td></td>
<td>in X/Y-direction (horizontally)</td>
<td></td>
</tr>
</tbody>
</table>

Quelle: Lärm- und Vibrations-Arbeitsschutzverordnung vom 06.03.2007

Preventive action

If the exposure action value of 2.5 m/s² is exceeded for hand-arm vibrations, the employer is required to describe, in an action plan, by which means and in which period of time such worker exposure is to be reduced.

When the exposure limit value of 5.0 m/s² is reached for hand-arm vibrations, the worker in question must no longer be assigned to any activities involving vibration exposure. The same applies to whole-body vibrations.
Health and Safety at the Workplace

Vibration protection requirements

When the trigger value is reached:
- Prepare and carry out vibration reduction program with technical and organizational measures (§10 LärmVibrationsArbSchV).
- Instruct employees about possible health hazards and health check-ups (§11 LärmVibrationsArbSchV).
- Offer employees medical check-ups (§14 LärmVibrationsArbSchV).

When the exposure limit value is reached:
- Determine reasons without delay and initiate further measures to reduce the exposure to a level below the exposure limit values (§10 LärmVibrationsArbSchV).
- Arrange for regular medical check-ups for employees (e.g. according to G46) (§14 LärmVibrationsArbSchV). The accident prevention and insurance associations responsible will provide you with more detailed information.

The statements in this brochure are based on the "Directive for the protection of employees from noise and vibration" in the version dated 2008-12-18.

As a premium manufacturer of tools intended for handheld use, PFERD is aware of its responsibility. The extensive experience accumulated over many years by our Technical Customer Advisors, backed by our direct exchange with users on site, reinforce us in our determination to make every effort, in both development and manufacturing, to minimize vibration exposures associated with the use of PFERD tools.

Please do not hesitate to contact PFERD for any further information or advice you may require.

PFERDERGONOMICS offers solutions for
- Lower vibrations
- Reduced noise
- Reduced dust load
- Optimized haptics at work.

ERGOSCAN
Do you have any questions about ergonomic influences at your workplace? PFERD’s experienced field staff will be happy to advise you.

On request, PFERD’s Technical Customer Service can carry out measurements of noise and vibration load on your premises according to national and international standards.

For further information and suitable PFERD tools see the brochure "PFERDERGONOMICS – The focus is on people".

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