

Recommended practice: Labelling and use of hand-held tools

Working Together for Safety Recommendation 044E/2021



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1. Introduction

A great number of hand-held tools are used in connection with various operations, and the use of these tools exposes individuals to noise and vibration. Manufacturers of such equipment are obligated¹ to include information about noise and vibration in the tool's user manual, but no fixed system has been established regarding the labelling of the tools. Insufficient labelling can be problematic, as this may result in users being unaware of the levels of noise and vibration to which they will be exposed through use of the tools. This may lead to incorrect use and significant exposure, which may lead to health complaints and in the worst-case scenario permanent damage to an individual's health.

Work-related hearing loss is the most frequently registered occupational disease in Norway (865 of the total 1,777 reports of work-related illness in 2019), and the second most frequently registered in the petroleum industry. In this sector, there has been a reduction in the number of reported work-related noise injuries, but there were still over 160 cases in 2018. In terms of reports of work-related injury/illness associated with vibration exposure, 30 to 60 vibration injuries are registered with the Norwegian Labour Inspection Authority each year. This is likely underreported – neighbouring Sweden has 600 to 1,100 reports each year.

Due to the prevalence of these health problems, increased focus has been placed on noise and vibration both nationally and internationally. Norwegian Oil and Gas has previously undertaken a large-scale project (the Noise Project)², which prepared an overview of noise and vibration from hand-held equipment, in addition to calculation tools for. A guideline was also created for the handling of noise that may be injurious to health³. HSE (the UK Health and Safety Executive)⁴ has also prepared information sheets, exposure matrices and a vibration calculator.

This Working Together for Safety recommendation builds on the work of Norwegian Oil and Gas and HSE in the UK.

2. Purpose

The purpose of this recommendation is to:

- Establish guidelines for the labelling of hand-held tools and provide information about the maximum recommended trigger times with regard to noise and hand-arm vibration (HAV)
- Contribute to more emphasis on noise- and vibration data when purchasing hand-held tools
- Contribute to increased focus and knowledge about possible health complaints relating to the use of vibrating hand-held tools
- Contribute improved risk assessments and increased control of exposure/triggertime.

3. Target group

The target group for this recommendation is anyone who supplies, manages, organises or performs work using hand-held tools.

4. Terms and abbreviations

Noise is defined as undesirable sound. Sound refers to normal fluctuations in the air in the audible region from 20 Hz to 20,000 Hz. Sound is measured in decibels (dB) on a logarithmic scale³. An increase in volume of 3 dBA constitutes a doubling of the sound pressure level, which results in the halving of the maximum recommended use time / trigger time.

Vibration refers to the movements that arise in structures and tools, and is measured in m/s^2 . Hand-arm vibration is mechanical vibration that is transferred from the tool to the worker's hand and arm. HAVS (hand-arm vibration syndrome) is an umbrella term for injuries caused by vibration:

- White finger / Reynaud's phenomenon
- Nerve damage
- Carpal tunnel syndrome
- Injuries to the musculoskeletal system

Limit value: The daily noise or vibration exposure that shall not be exceeded, since doing so poses a significant risk of health problems.

Action value: The daily vibration exposure that necessitates the implementation of technical and organisational measures to reduce the exposure.

Trigger time: The actual use time for a tool, i.e. the time for which the equipment is actively used and the button held in (trigger time = exposure time).

Legislation⁵ defines the action and limit values for both noise and vibration, and also describes the types of measures that may be implemented⁶. See also section 6.7 for measures.

5. Background

The Noise Project led by Norwegian Oil and Gas placed increased focus on noise and vibration in the workplace. The project created a noise and vibration database, along with calculators² that can be used to calculate the daily exposure and maximum recommended trigger time over the course of a working day. This work forms the foundation for our recommendations regarding the labelling and use of hand-held tools.

NB: It is important that the noise and vibration database is as complete as possible, to ensure that it represents an accurate and effective source of data for users. All companies are therefore requested to actively contribute by submitting measurements to the administrators of this database.

Noise and vibration measurements must be performed by personnel who have the necessary technical expertise to perform such measurements in accordance with the established requirements^{11,12,13}. Personnel who perform simple noise measurements should as a minimum have completed a course in noise measurement.

There are several factors that make it difficult to assess the true risk associated with noise and vibration from hand-held tools.

Factors that affect noise exposure:

- The surroundings (open/enclosed spaces, etc.)
- Work on different surface types
- Influence of other noise / area noise
- Age/maintenance of equipment
- Differences in equipment/accessories, e.g. different nozzles and grinding/cutting discs, etc.
- Frequency spectrum and quality of hearing protection

Factors that affect vibration exposure:

- Age of and maintenance routines for tools
- Quality and type of interchangeable parts
- Properties of the material being worked on
- The operator's technique, experience and skill
- Working position, weight on the equipment, access and surface
- Climate and temperature
- Duration of the work and use time / trigger time

A tool is labelled with a given noise and vibration level, based on the most probable accessories and typical values for the above-mentioned factors. Note that these factors include the tool being properly maintained and in good working order. When using different accessories, or old and poorly maintained equipment, new measurements should be taken.

6. Recommended practice

6.1 Governing documentation

Companies must have a system in place for mapping factors that may affect the employees' physical or mental health and safety. Plans and measures that are

triggered by the mapping and risk assessment shall be documented⁷. The following elements shall be described (the list is not exhaustive):

- Routines for use, including training
- Routines for the risk assessment of hand-held tools, including how noise and vibration exposure for the individual tool are mapped
- Labelling based on mapping of the individual tool
- Overview of hand-held tools
- Routines that ensure that noise and vibration requirements are set for tools prior to purchasing (in addition to an assessment of the tool's safety functions)
- Routines for maintenance

Each company must be familiar with the prerequisites for the labelling regime and evaluate how to implement in their own company. In addition, information and training material shall be prepared for employees, which makes users aware of the tools' correct use. See section 6.8.

6.2 Labelling

The employer has the overall responsibility for providing users with satisfactory information about the noise and vibration exposures associated with the individual hand-held tool. This is most easily achieved by labelling the tool. This Working Together for Safety recommendation presents a labelling system based on current action and limit values, as well as the results from the Noise Project² and Guideline 114³.

Noise: Guideline 114 features a colour coding system for noise maps / the labelling of area noise. It is recommended that the same colour codes are used for the labelling of hand-held tools. Note that when using hand-held tools, the trigger time does not correspond to the time spent in an area with the same noise level. This is because the damping effect of hearing protection is generally better for high frequency noise (typical for tools) than for low-frequency noise (e.g. area noise)². See Appendix 1 for the suggested colour coding system for noise labelling.

Vibration: Measurements have shown that vibrations from hand-held tools is spread over the entire range of the labelling regime and with a top (ie. most tools) that is above the limit value. It has therefore been decided that the labelling relating to vibration should be divided into more areas than green, yellow and red alone, based on the action and limit values^{2c, 5}. This provides the user with better information about the available trigger time, and also makes it easier to compare different tools. See Appendix 2 for the suggested colour coding system for vibration labelling.

NB: A labelling system cannot cover all eventualities but is based on the current measurements for each tool. The most common types of accessories should therefore be used with the tool, and the tool should be used in connection with the most usual work operations for the tool in question. When setting the maximum recommended trigger time, how the work site facilitates work in favourable working positions and any risk reducing measures, etc. should be taken into consideration. (see section 6.3 – 6.6)

6.3 Basis for labelling

Through the Machinery Directive, manufacturers are obligated to specify a machine's noise and vibration properties. The manufacturer's vibration data is not suitable for labelling, since it rarely reflects the vibration value during actual use. A comparison of measured data versus the manufacturer's data shows that actual measurements vary from around the same level as that specified by the manufacturer to levels that are several times higher. It is therefore recommended that measurements taken by competent personnel on suitable equipment and for a given work situation are used.

Alternatively, available databases can be used to find measurements taken on the same/equivalent tool. The Noise Project has created a database² of noise and vibration from hand-held tools, which is accessible to everyone. The database is not complete, and does not feature all manufacturers and models, but it is possible to undertake overall assessments with regard to the type of tool, which include several manufacturers and models. This will likely result in values with slightly greater uncertainty, and therefore a conservative use time. Whether the data is adequate to be able to calculate noise and vibration for the equipment to be labelled, or whether separate measurements need to be taken, must be assessed.

6.4 Ergonomics

Ergonomics refers to the interplay between people and the physical and mental environment that surrounds us. When we talk about the ergonomic working environment, it is often ergonomic risk factors and how musculoskeletal health problems can be prevented that are the central areas of focus. Musculoskeletal health complaints is an umbrella term for pain and discomfort that can lead to reduced function of the muscles, tendons or joints. Such health complaints can be temporary or chronic, and they may arise suddenly or develop over time. Injuries may arise when the body's tolerance limits are exceeded, and are a normal reaction to excessive strain.

Manual work may result in health complaints when the work is too heavy, monotonous or prolonged, or performed in unfavourable working positions. The individual's tolerance limit is personal, and there are many factors that affect exposure. These factors may include time pressure and stress, the organisation of the work, temperature and humidity, the work surface and the surroundings.

This complexity illustrates how difficult it is to label vibrating hand-held tools with ergonomic properties, but awareness of these factors also has a central impact on the development of health complaints due to vibration and noise exposure.

6.5 Selection of tools

The selection of equipment should be based on the following assessments:

- The work to be performed and the tool's suitability (technical suitability, safety and ergonomics). This includes an assessment of how 'time efficient' the equipment is, i.e. the time it takes to complete the job with a given tool must be weighed up against how much noise and vibration the equipment produces.
- Noise and HAV data (database or appropriate measurements)
- Risk assessments (see section 6.6)

Selection of tools starts with the purchase. The companies should have procedures and routines that ensures requirements are in place for noise and vibrations from the tools. These requirements should be included in relevant contractual documents,

6.6 Risk assessment

The employer shall ensure that the tools that subject employees to noise and vibration are mapped, and assess the risk of employees developing health complaints from the use of such tools. Measures shall be implemented to reduce the risk.

In order to find out an employee's exposure when using a given tool, the employer together with the safety representative must maintain an overview of:

- 1) The work equipment at the organisation which subjects employees to noise and vibration
- 2) The noise and vibration level of the equipment
- 3) How long employees may use the tool

The employer shall protect employees against noise and vibration exposure. If the relevant competence is not available internally, the occupational health service's expertise should be used in this work. In addition, the employer shall ensure that employees subjected to noise and vibration in the working environment are offered health monitoring. It may also be necessary to relocate employees due to health-related reasons, especially in the event of hearing loss, nerve damage or Raynaud's phenomenon.

In addition to assessing noise and hand-arm vibration, the economic conditions at the workplace shall also be considered when using hand-held equipment, especially with regard to working position, weight on the equipment and risk-reducing measures. The employer is responsible for ensuring that the company has procedures for the assessment of the ergonomic risk, and how this affects the maximum recommended trigger time.

Other factors that must be considered include heat, cold, wind and chemical exposure. Perform a complete risk assessment of the job as the basis for considering how long an employee may work, the need for breaks, job rotations, etc.

6.6.1 Noise

A risk assessment of noise exposure involves the assessment of two conditions:

- The risk that the employee will experience hearing loss over time
- The risk that an employee will experience hearing loss as a result of exposure to peak values of the sound pressure level (bangs/impulse noise)

A working day may include exposure from stationary sources (area noise) and from tools (noise produced by the individual's work). The risk assessment shall include a calculation of the average noise dose over the course of a typical work day. The standard for measuring noise in the working environment, ISO 9612, describes the calculation of uncertainty.

Norwegian Oil and Gas Guideline 114, "Recommended guidelines for handling noise which may induce hearing loss", provides guidance regarding risk assessments for noise exposure³.

6.6.2 Vibration

In order to protect employees against factors that may affect the employees' health and safety, the employer shall map and document the extent to which employees are exposed to vibration. Mapping and risk assessments, in addition to plans and measures that are triggered by risk assessments, shall be documented and stored so that the information can be utilised at a later date.

In order to assess the risk of developing HAVS, the employer must maintain an overview of

1. Action and limit values
2. The equipment's vibration level
3. Exposure time
4. The work operation in its entirety, including ergonomic risk factors that may reduce or increase the risk of developing health complaints
5. Suggested risk-reducing measures

The equipment's vibration level is determined based on the following (in order of priority):

- A. HAV measurements taken during actual work tasks in the field
- B. Databases that contain field measurements (see also section 6.3)

In the event of a lack of measurements or good data in the database, previous practice has been to use the vibration level specified by the manufacturer multiplied by a correction factor of $2^{2,10}$. This is **not** recommended, due to poor correlation between the manufacturer's data and measurements performed in the field.

In order to determine the daily vibration exposure, the time to which an individual is subjected to HAV over the course of the day must be calculated. This is often referred to as the trigger time, and is the actual time spent using the equipment, i.e. the time for which the equipment is used actively (holding in the button).

Methods that can be used to determine the trigger time are:

- Stopwatch and manual logging
- Time loggers attached to the tool
- HAV watches

When the vibration level and trigger time / exposure time are known, it is possible to calculate the total daily exposure value using an exposure calculator^{2b}, for example. The exposure value with incorporated uncertainty shall be assessed against the action value or limit value.

We have used the limit value as the basis for labelling the maximum use time. This shall not be exceeded, and some safety factors have therefore been incorporated into the labelling regime. The most important is that the 90th percentile of performed measurements shall be used for labelling. In addition, the values in the labelling regime are rounded down. Finally, there is relatively large jump in the rated values for high vibration levels, which means that few tools will reach the limit values.

6.6.3 Planning the day

The total noise and vibration exposure to which an employee is subjected over the course of a working day shall not exceed the limit values given in the Regulations concerning action and limit values³. This means that when the maximum recommended trigger time has been used, the individual shall be protected from noise and HAV for the rest of the day/shift. In the event that the action value is exceeded, measures shall be implemented.

The work shall be planned and arranged so that exposure to noise is limited, and so that sufficient noise-free rest periods are ensured. If the maximum noise does is reached, the individual shall be protected from noise levels exceeding 75 dBA for the rest of the shift. Correspondingly, plans shall be established to maintain control of HAV exposure.

As part of the “Noise in the petroleum sector” project, a database of hand-held tools with typical noise and HAV levels has been created. Accompanying the database is a calculation program (calculator) for noise and vibration exposure. The calculation program may be used to perform rough estimates (simple calculator) or more detailed assessments (advanced calculator). The calculator works out how long executing personnel may work on an activity before the relevant limit values are reached. The advanced calculator may be used to calculate the total noise and vibration exposure for a day that includes different activities, i.e. if several types of tools shall be handled over the course of a shift and/or work is performed in noisy areas (> 80 dBA).

When calculating the maximum recommended trigger time, how the workplace facilitates work in favourable and varied working positions should be taken into consideration. Note that working at height may give different values than noise measurements taken at deck level. There may also have been changes in an area after the last noisemap was produced. Ask for new measurements taken by a competent specialist in the area where you plan to work.

6.7 Measures

The overall aim is to plan and organise the work in such a way that exposure to noise and vibration remains as low as possible, while ensuring that the work can be carried out in an appropriate way. The necessary measures shall be implemented in the following order of priority:

1. Eliminate danger
2. Replace current processes, operations, materials or equipment with less hazardous ones
3. Use technical barriers and reorganise the work
4. Use administrative barriers, including training
5. Use personal protective equipment

Here are some examples of measures:

- Technical measures:
 - Establish good maintenance routines
 - Replace old/worn equipment
 - During purchasing, select tools that give the lowest possible noise and/or vibration level. Inform the relevant persons internally within the company if you become aware of other models or other tools that give a lower exposure.
 - Consider the use of ergonomic aids, e.g. suspension systems, stands, etc. that reduce strain by reducing the required weight and grip force.
 - Consider opportunities to reduce simultaneous exposure, for example by reducing area noise. Contact the area responsible and investigate opportunities for shutting down other sources of noise in an area where noisy work must be performed. This is especially important in the event of high levels or in the event of prolonged work in such an area.
- Organisational/administrative measures:
 - Establish plans and provide information and training.
 - In many cases, the user is able to influence both the noise and vibration levels when using hand-held tools and equipment: how much pressure is applied, the selected angle, adjustment of nozzles, etc. Training in good practice and the sharing of experience are therefore important.

- Plan the job so that noise and vibration exposure doses are limited by:
 - Selecting tools with the lowest possible noise and vibration levels
 - Facilitating job rotations, distributing the exposure time, and take regular breaks
 - Minimise other risk factors such as stress / time pressure, cold/humidity and poor ergonomic conditions
 - Protect at-risk groups (at risk of hearing damage, HAVS, etc.)

- Protective measures:
 - Ensure the correct use of personal protective equipment. Training is important.
 - It is possible to select a stricter safety regime than that specified, e.g. the use of double hearing protection when only single hearing protection is required. This does not necessarily mean that an individual can be exposed to noise over a longer period, but they will be subjected to a lower dose.
 - The perceived effect of vibration dampening gloves² varies among individuals. Use such gloves if you feel that they help, but the time spent using the tool shall remain unchanged. Note that the dampening values of gloves are currently being surveyed, and will be included in the noise/vibration calculator when this work is completed.
 - Double hearing protection may be replaced by another type of hearing protection with the equivalent damping effect, or 'intelligent' hearing protection with an integrated noise dosimeter and alarm function.

Remember that area measurements are normally taken at head height. Work at height may involve different sound levels. In addition, changes may have been made to an area since the last noise map was created. Request assistance with taking new sound measurements from a person with the relevant expertise if you are unsure about the noise level in your work area.

Other factors that should be considered include heat, cold, wind, working position, poor visibility and dust / chemical vapour. Perform a complete risk assessment of the job as the basis for considering how long an employee may work, the need for breaks, job rotations, etc. (see sections 6.4 and 6.6).

Remember to secure hand-held tools in accordance with Working Together for Safety Recommendation 024/2018 Part 1 (section 5.3) in the event of work at height.

6.8 Training

The employer shall ensure that employees who may be exposed to noise or mechanical vibrations receive the necessary training⁶. The following elements should be included in the training plan for the use of hand-held tools that may cause health problems due to noise or vibration:

- HAVS, including acute and chronic health effects, and why it's important to avoid this
- How users are affected by vibrations from hand-held tools
- What affects the risk of developing HAVS (e.g. exposure time, age, smoking, cold (consider the need for heat insulating gloves?) humidity, illness, working technique, etc.)
- How to prevent health problems (reduce the required grip and thrust, ergonomic facilitation, training in the use of equipment and work techniques)
- Training in work techniques
- The impact of the surface on which the tool is used
- Monitoring of the exposure/trigger time and the use of the noise calculator
- Information about different problem areas related to noise
 - Risk of hearing damage/loss
 - Correct use of hearing protection and time limits
- Consider using alternative equipment and job rotations to reduce exposure
- Maintenance of tools

7 References and links

- 1) Regulations regarding machinery [FOR-2009-05-20-544](#)
- 2) Noise Project (Norwegian Oil and Gas):
 - a) [Main page](#)
 - b) [Database and calculator](#)
 - c) [Noise and vibrations from hand-held tools \(presentations, etc.\)](#)
 - d) [Vibration levels specified by manufacturers](#)
 - e) [Uncertainty associated with manufacturers' measurements and uncertainty factor](#)
 - f) [Hand in Glove project](#)
- 3) Norwegian Oil and Gas 114 '[Recommended guidelines for handling noise which may induce hearing loss](#)'
- 4) [UK Health and Safety Executive - vibration](#)
- 5) Regulations concerning action and limit values [FOR-2011-12-06-1358](#)
- 6) Regulations concerning the performance of work, use of work equipment and related technical requirements, section 14 [FOR-2011-12-06-1357](#)
- 7) Regulations concerning organisation, management and employee participation, section 7-1 [FOR-2011-12-06-1355](#)
- 8) Regulations concerning organisation, management and employee participation, section 13.2
- 9) Activities Regulations, section 8
- 10) Regulations concerning the working environment, health and safety of workers on board ships, section 14 [FOR-2005-01-01-8](#)
- 11) [NE-EN ISO 9612:2009 Determination of noise exposure in work environments](#)
- 12) [NS-EN ISO 5349-1:2001 Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration Part 1: General requirements](#)
- 13) [NS-EN ISO 5349- 2:2001 Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration. Part 2: Practical guidance for measurement at the workplace](#)

Appendix 1 Labelling of noise from hand-held tools

Noise interval [dBA]	Description
	<p>The use of hand-held tools with a purple noise label (>110 dBA) <u>must</u> be evaluated with a competent specialist in order to assess the possible use time.</p> <p>Competent specialist refers to occupational hygienists or others with equivalent competence.</p>
	<p>The use of hand-held tools with a purple noise label (>110 dBA) <u>should</u> be evaluated with a competent specialist in order to assess the possible use time.</p> <p>Equipment with noise levels between 106 and 110 dBA may be used for up to 30 min when using double hearing protection.</p>
	<p>The use of hand-held tools with a light purple noise label may be used for up to 2 hours per day when using double hearing protection (earplugs and headset).</p>
	<p>The use of hand-held tools with a red noise label may be used for up to 6 hours per day when using double hearing protection (earplugs and headset).</p>
	<p>The use of hand-held tools with an orange noise label may be used for up to 6 hours per day when using single hearing protection (earplugs and headset).</p>
	<p>The use of hand-held tools with a dark yellow noise label may be used for up to 12 hours per day when using single hearing protection (headset).</p>
	<p>There is no time limit to the use of hand-held tools with a light-yellow noise label when using single hearing protection (headset).</p>
	<p>There is no time limit to the use of hand-held tools with a green noise label.</p>

Appendix 2 Labelling of vibration from hand-held tools

(See also Appendix 3 for an overview of the use time vs. action and limit values)

Vibration interval [m/s ²]	Description
	<p>The use of hand-held tools with a purple vibration label (over 20 m/s²) should be avoided. Any use shall be considered together with a competent specialist (occupational hygienist or others with equivalent expertise) in order to assess the possible use time.</p>
	<p>The use of hand-held tools with a purple vibration label (between 10 and 20 m/s²) should be evaluated with assistance from competent personnel* in order to assess the maximum use time.</p> <p>The max. use time without a specific assessment is 30 mins per shift/day. Measures to reduce exposure should be considered.</p>
	<p>The use of hand-held tools with a light purple vibration label (between 5.5 and 10 m/s²) should be evaluated with assistance from competent personnel* in order to assess the maximum use time.</p> <p>The max. use time without a specific assessment is 2 hours per shift/day. Measures to reduce exposure should be considered.</p>
	<p>The use of hand-held tools with a red vibration label (between 4 and 5.5 m/s²) should be evaluated with assistance from competent personnel* in order to assess the maximum use time.</p> <p>The max. use time without a specific assessment is 6 hours per day. Measures to reduce exposure should be considered.</p>
	<p>Hand-held tools with a yellow vibration label (between 2 and 4 m/s²) may be used for up to a maximum of 12 hours per day.</p> <p>Workplaces with 8-hour days may use equipment with a yellow label between 2.5 and 5 m/s² for max. 8 hours per day. Measures to reduce exposure should be considered.</p>
	<p>There is no time limit on the use of hand-held tools with a green vibration label.</p> <p>Workplaces with 8-hour days may use equipment with a green label of up to 2.5 m/s² with no time limit.</p>

Appendix 3 Use time vs. action value and limit value

The graph below shows the connection between the max. use time vs. the action and limit values for vibration.

