

Guidelines

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1. AIM OF THE VIBRATION DATABASE

Legislative Decree No. 187 of August 19, 2005 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from mechanical vibration, implementing Directive 2002/44/EC of June 25, 2002, defines specific methods to determine and assess risks arising from the exposure of workers to hand-arm vibration (HAV) and whole-body vibration (WBV) and specifies protection measures that are to be documented in the risk assessment report required by Legislative Decree 626/94.

Article 4 of Legislative Decree 187/05 places an obligation on employers to assess the risks to workers resulting from their exposure to vibration while performing their duties. Risks can be assessed either without performing measurements, thus referring to the information available from manufacturers and/or certified databases (ISPESL, CNR, Regions) or by means of measurements carried out in accordance with methodology defined in specific ISO-EN standards. The availability of databases containing such information could facilitate the assessment of the risk and the immediate implementation of protection measures required by Legislative Decree 187/05, with no need for expensive and often complex measurements that due to a number of environmental and technical factors, are often wrong.

It is to be pointed out that the analysis of how risks may be reduced is part of the process aimed at determining and assessing risks which is required by Legislative Decree 187/05.

Such requirement is particularly relevant with regard to risks from vibration, in fact in case of exposure to hand-harm vibration as well as exposure to whole-body vibration **there are no anti-vibration PPEs that adequately protect workers or reduce the level of workers' exposure below the limit values established in the Decree**, as it is the case of hearing protectors used to reduce the noise-related risk. As regards vibration, in the majority of cases, **reducing the risks at their source is the only possible measure** to decrease exposure levels so that they do not exceed the limits established in the Directive.

2. LEGISLATIVE DECREE No. 187 of AUGUST 19, 2005

2.1 Scope

The scope as defined by Legislative Decree 187/05 is specified by the following definitions included in Article 2:

Hand-arm vibration: *"the mechanical vibration that, when transmitted to the human hand-arm system, entails risks to the health and safety of workers, in particular vascular, bone or joint, neurological or muscular disorders"* (art. 2 paragraph 1, section a).

According to this definition, the list shown in Table 1 provides indications on a number of tools that, when regularly used, entail in the majority of cases remarkable risks to workers arising from exposure to hand-arm vibration.

Whole body vibration: *"the mechanical vibration that, when transmitted to the whole body, entails risks to the health and safety of workers, in particular lower-back morbidity and trauma of the spine"* (art. 2 paragraph 1, section b)

The latter definition shows that the exposure to whole-body vibration when the extent of such exposure does not affect the spine, is not included within the scope of the legislation though it may result in the discomfort of the exposed subject or motion sickness. The latter effects are discussed in the ISO standard 2631-1: 1997 (appendices C, D) and they can be generally included in the evaluation of the ergonomic requirements for the workplace as required by Legislative Decree 626/94.

The list shown in Table 2 provides indications on a number of machinery or processes that regularly expose workers to vibration falling within the scope of this legislation.

Table 1 – Examples of risk sources for the exposure to hand-arm vibration

Type of tool	Main types of processing and manufacturing
Chisel Hammers, Scalers, Riveting hammers	Construction - stone, engineering industry
Hammer drills	Construction – stone processing
Demolition hammers and Pick hammers	Construction - stone quarrying
Percussion drills	Engineering industry
Impact wrenches	Engineering industry , Body shops
Sandblasters	Foundries - engineering industry
Shears and Nibblers for metal	Engineering industry
Orbital and rotary-orbital sanders	Engineering industry – Stone - Wood
Circular saws and Jig saws	Engineering industry – Stone – Wood
Angle and axial grinders	Engineering industry – Stone – Wood
Light duty straight grinders	Engineering industry - Stone - Wood
Chain saws	Agricultural and forestry works
Brush cutters	Agricultural and forestry works
Lawnmowers	Maintenance of green areas
Motor-Cultivators	Agricultural and forestry works
Nailing Machines	Palletts, wood
Concrete Compactors	Vibrated concrete production
Electric and pneumatic injectors	Vibrated concrete production
Rotating shaping machines with flexible shaft	Engineering industry, Artistic manufacturing
Motorcycle handlebars	Transports, etc.
Cubing machines	Stone processing (porphyry)
Riveting machines	Shoe factories
Dentist's Drills	Dentistry

Table 2 - Examples of risk sources for the exposure to whole-body vibration

Machinery	Main fields of application
Scrapers, power shovels, excavators	Construction, stone, agriculture
Drillers	Stone, construction sites
Tractors, Combine Harvesters	Agriculture
Lift Trucks	Construction sites, industrial handling
Tractors equipped with fifth wheel coupling	Construction sites, industrial handling
Trucks, buses	Transports, forwarding services etc.
Motorboats, dinghies, boats	Transports, maritime industry
Rail transports	Transports, industrial handling
Helicopters	Civil protection, Police force, etc.
Motorcycles, mopeds	Police force, postal services, etc.
Truck cranes, cranes	Construction sites, industrial handling
Vibrating plate compactors	Vibrated concrete, several industrial applications
Ambulances	Health

2.2 Obligations established in the Decree

2.2.1 Risk reduction

In compliance with the general principles for risk reduction stated in Legislative Decree 626/94, Legislative Decree 187/05, article 5 ("Prevention and protection measures") lays down that "employers shall eliminate risks at their source or reduce them to a minimum and, in any case to levels that do not exceed the exposure limit value". This principle is always applied regardless whether the action values or the limit values established in the legislation are exceeded or not. In case such values are exceeded, there are further specific measures aimed at reducing or avoiding exposure to vibration, as specified in items 2-3 of the aforementioned Article 5.

2.2.2 Determination and assessment of risks

Pursuant to Article 4 ("Assessment of risks") of Legislative Decree 187/05, employers are obliged to assess the risk to workers arising from exposure to mechanical vibration while performing their duties. The risk assessment can be either carried out with no need for measurements, thus using relevant information available in certified databases (ISPESL, Regions, CNR), including information provided by the manufacturer, or by means of measurements carried out following the methodology illustrated below. The assessment process, either including measurements or not, shall be planned and carried out by competent staff at regular intervals. The assessment report shall detail the protection measures adopted in compliance with Article 5 of the Decree. The assessment shall take into account the following aspects.

a) the level of transmitted vibration and duration of exposure with reference to action values and limit values established in the Decree, Article 3 and listed below, in Table 3;

Table 3 – Daily action values and limit values for the exposure to hand-arm and whole-body vibration

Hand-arm vibration	
Daily exposure action value $A(8) = 2.5 \text{ m/s}^2$	Daily exposure limit value $A(8) = 5 \text{ m/s}^2$
Whole-body vibration	
Daily exposure action value $A(8) = 0.5 \text{ m/s}^2$	Daily exposure limit value $A(8) = 1.15 \text{ m/s}^2$

b) any effects concerning the health and safety of workers at particularly sensitive risk;

c) any indirect effects on worker safety resulting from interactions between mechanical vibration and the workplace or other work equipment;

d) information provided by the manufacturers of work equipment in accordance with the relevant Community Directive on machinery;

e) the existence of replacement equipment designed to reduce the levels of exposure to mechanical vibration;

f) specific working conditions that may increase risks, such as working at low temperatures in case of hand-arm vibration exposure.

When assessing the risks, the analysis should be focused on the fact that the possibility to reduce risks, besides being a specific obligation ensuing from risk assessment, is thus included in the process for the determination and assessment of risks required by the legislation whenever action values are exceeded.

3. RISK ASSESSMENT METHODOLOGY: GENERAL PRINCIPLES

3.1 Hand-arm vibration

The assessment of the level of exposure to hand-arm vibration is based on the calculation of the daily exposure value normalised to an eight-hour reference period, $A(8)$ (m/s^2), expressed as the square root of the sum of the squares ($A_{(w)\text{sum}}$) of the r.m.s. values of the frequency-weighted accelerations, determined on the orthogonal axes x , y , z , as defined in the ISO standard 5349-1: 2001. The mathematical formula to calculate $A(8)$ is shown below.

$$A(8) = A_{(w)sum} (T_e/8)^{1/2}$$

- T_e : Total daily duration of vibration exposure (hours)
 $A_{(w)sum}$: $(a_{wx}^2 + a_{wy}^2 + a_{wz}^2)^{1/2}$
 a_{wx} ; a_{wy} ; a_{wz} : r.m.s values of frequency-weighted acceleration (in m/s^2) on the orthogonal axes x, y, z (ISO 5349-1: 2001)

Calculation of A(8) for exposure to vibration produced by different types of tools and/or operating conditions

If worker is exposed to different types of vibrations, e.g. when several vibrating tools are used in one working day, or if the same equipment is used in different operating conditions, the daily exposure to vibration A(8), in m/s^2 , will be calculated as follow:

$$A(8) = \left[\sum_{i=1}^n A8_i^2 \right]^{1/2} (m/s^2)$$

where:

$A8_i$: A(8) partial result relating to the n^{th} operation

$$A8_i = A_{(wsumi)} \sqrt{\frac{T_{ei}}{8}}$$

T_{ei} : Exposure duration relating to the n^{th} operation (hours)

$A_{(wsumi)}$: $A_{(wsum)}$ associated to the n^{th} operation

3.2 Whole-body vibration

The assessment of the level of exposure to whole-body vibration is based on the calculation of the daily exposure over an eight-hour period, A(8) (m/s^2), calculated as the highest r.m.s. value of the frequency-weighted accelerations, determined on three orthogonal axes:

$$1.4 \times a_{wx}, 1.4 \times a_{wy}, a_{wz}$$

using the formula shown below:

$$A(8) = A_{(wmax)} \times (T_e/8)^{1/2}$$

T_e : Total daily duration of vibration exposure (hours)

$A_{(wmax)}$: Highest value between $1.4 \times a_{wx}$; $1.4 \times a_{wy}$; a_{wz} (individual into a seated position)

a_{wx} ; a_{wy} ; a_{wz} : r.m.s values of the frequency-weighted acceleration (in m/s^2) on the orthogonal axes x, y, z (ISO 2631-1: 1997)

Calculation of A(8) for exposure to vibration produced by different types of machinery and/or operating conditions

If worker is exposed to different types of vibrations, e.g. when several types of machinery are used in one working day, or if the same machinery is used in different operating conditions, the daily exposure to vibration A(8), in m/s^2 , will be calculated as follow:

$$A(8) = \left[\sum_{i=1}^n A8_i^2 \right]^{1/2} (m/s^2)$$

$A8_i$: A(8) partial result relating to the n^{th} operation

$$A8_i = A_{(wmaxi)} \sqrt{\frac{T_{ei}}{8}}$$

T_{ei} : Exposure duration relating to the n^{th} operation (hours)

$A_{(wmaxi)}$: $A_{(wmax)}$ associated to the n^{th} operation

4. ASSESSMENT WITHOUT MEASUREMENTS: THE VIBRATION DATABASE

4.1 Overview

The purpose of the Vibration Database discussed here is to:

a) ensure easy access and retrievability of exposure values related to vibrations produced by machinery commonly used in the industrial sector in order to facilitate **the immediate implementation of measures aimed at reducing risks at their source already when assessing the risks and without having to use measurements that are often expensive and complex**;

b) allow employers and their consultants to identify the machinery that reduce to a minimum the risks arising from vibrations when purchasing new machinery or replacing obsolete machinery.

The development of the National Vibration Database is based on the expertise acquired by ISPESL (Italian National Institute for Occupational Safety and Prevention) and USL 7 (Local Health Unit) in Siena that contributed – as Italian partners – to the development of the first European database within the framework of the European project VINET (Vibration Injury Network: 1997-2001).

The European database is available in English and can be accessed from the Link area in the menu of the ISPESL Vibration Database.

The National Vibration Database (BDV) was developed in order to meet the following criteria:

- easy access and consultation;
- quality control on data added to the database;
- field data collection following specific measurement protocol and meeting quality requirements;
- easy periodical update of the database.

The Vibration Database shall be updated every time that regulatory and technical changes occur (new data being added, update of technical standards,...), and relevant communication will be given on the Institute's website.

The database can be accessed to find information respectively on hand-arm vibration (HAV) or whole-body vibration (WBV). For each machinery, a technical sheet is given providing a number of basic information such as: manufacturer, model, type of power supply, power, weight, etc., a picture of the machinery itself and two types of vibration exposure data, the ones declared by the manufacturer in compliance with the Machinery Directive (when available) as well as field collected data (whenever available) following specific measurement protocol in order to ensure that uncertainty of results is checked. In this case, field measurement conditions as well as measurement references are also specified.

Currently, the only centres authorized to input and verify data are the Laboratory of Physical Agents of the ISPESL's Department of Occupational Hygiene and the Laboratory of Physical Agents of the USL 7 (Local Health Unit) in Siena.

4.2 Vibration Database: usage guidelines

As already mentioned, the database provides two types of data:

- emission values declared by manufacturers in compliance with the Machinery Directive;
- vibration values obtained through field measurements following specific international measurement standards.

4.2.1 Values declared by Manufacturers

The "Machinery Directive" 98/37/EC, implemented in Italy by Presidential Decree No. 459 of July 24, 1996 states under section 1.5.9. named "Vibration" that: "Machinery must be so designed and constructed that risks resulting from vibrations produced by the machinery are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source".

With reference to hand-held and hand-guided machinery, the Machinery Directive establishes that information in the instruction handbook shall include *"the weighted root mean square acceleration value to which the arms are subjected, if it exceeds 2.5 m/s²".* Where the acceleration does not exceed 2.5 m/s², this must be mentioned.

As regards mobile machinery, the Directive establishes in section 3.6.3. that *“apart from the minimum requirements set out in 1.7.4, the instruction handbook must contain: the weighted root mean square acceleration value to which the arms are subjected, if it exceeds 2.5 m/s², should it not exceed 2.5m/s², this must be mentioned; the weighted root mean square acceleration value to which the body (feet or posterior) is subjected, if it exceeds 0.5 m/ s², should it not exceed 0.5m/s², this must be mentioned.*

Usually, the emission values declared by the manufacturers are obtained under standard operating conditions, adopting specific measurement methods determined for each machinery by the ISO-CEN standards. These standards provide for measurements to be taken under operating conditions that do not necessarily match the actual operating conditions of each machinery. Thus, it is to be questioned the extent to which such measurements should be used in the assessment and prevention of risks from vibration.

Based on the studies carried out so far on the reliability of emission data provided by manufacturers to prevent the risk from vibration, the general indications shown in Tables 4, 5 and 6 may be provided. These tables contain multiplicative coefficients that resulted from a number of experimental conditions which are to be used in order to get estimated values for A(8) that can be found in field according to certification data.

It is strongly recommended to use data declared by manufacturers which are duly multiplied by the factors shown in Tables 4-5-6 only if operating conditions match those listed in the tables and in case of machinery that is in good maintenance conditions.

When data provided by manufacturers shall not be used

Currently, there are several grinders and other rotary machines for which data declared by manufacturers – in compliance with the Machinery Directive – show a level of vibrations lower than 2.5 m/s², though in field they can produce values higher than 2.5 m/s².

Thus, in a number of operating conditions the risk would be underestimated if only data provided by manufacturers are taken into account without actually measuring vibration emitted by the tool during actual operating conditions.

In addition, data provided by manufacturers as well as the simplified methodology for risk estimation described in this paragraph cannot be used when:

- the machinery is not used following indications provided by the manufacturer;
- the machinery is not in good maintenance conditions;
- the machinery is used in operating conditions that differ from those listed in tables 4-5-6;
- the machinery is not exactly the same as the one shown in the database (different manufacturer – model).

In all these cases, using the simplified methodology based on data provided by the manufacturer may lead to underestimating risk.

Table 4 – Internal-combustion engine machines. Multiplicative coefficients (correction factors) to calculate the field estimated exposure based on certification data

Machine	Reference standard	Operating conditions during test	Actual operating conditions	Correction factor	Notes
Chain saws	EN ISO 22867	Minimum no-load revolutions, maximum no-load revolutions, cutting	Forestry maintenance, section cutting, limbing, felling	1	Field values basically identical to certified values

Nylon line brush cutters	EN ISO 22867	Minimum no-load revolutions, maximum no-load revolutions	Grass cutting	1	Field values basically identical to certified values
Blade brush cutters	EN ISO 22867	Minimum no-load revolutions, maximum no-load revolutions	Grass cutting, hedge cutting, shrub cutting	1	Field values basically identical to certified values (value for maximum no-load revolutions is similar to maximum load vibration)
Hedge trimmers	EN 774:1996/A3	Minimum no-load revolutions, maximum no-load revolutions	Hedge and shrub cutting	1	Field values basically identical to certified values (value for maximum no-load revolutions is similar to maximum load vibration)
Air Blowers	Being prepared	Minimum and maximum revolutions	Heavy air-jet-cleaning	1	Field values basically identical to certified values
Vacuum cleaners	See air blowers	Minimum and maximum revolutions	Heavy air-jet-cleaning	1	Field values basically identical to certified values
Atomizers	Being prepared	Minimum and maximum revolutions	Fluid spraying	1	Field values basically identical to certified values
Other internal-combustion engine machines	Being prepared	Minimum and maximum revolutions	Several applications	1	Field values basically identical to certified values

Table 5 – Electric-powered machines. Multiplicative coefficients (correction factors) to calculate the field estimated exposure based on certification data

Machine	Reference standard	Operating conditions during test	Actual operating conditions	Correction factor	Notes
Hammer drills	EN50144-2-6	Cement drilling	All	2	Lower value only with drill without percussion
Demolition hammers	EN50144-2-6	Steel ball-type absorber	Cement drilling and/or masonry	1.5	Correction factor is applicable only if machine is used in compliance with manufacturer instructions
All drills, percussion drills excluded	EN50144-2-1	No-load measurements at maximum speed	All drilling and screwing operations (percussion operations)	1	All, impact excluded

			excluded)		
Percussion drills	EN50144-2-1	Cement drilling with agglomerates	All drilling and screwing operations (percussion operations excluded)	1.5	Percussion operations only
Sanders (all types)	EN50144-2-4	Aluminium sheet sanding	All grinding operations (polishing operations excluded)	1.5	Lower value, when polishing
Grinders (all types)	EN50144-2-3	No-load unbalanced disc	All grinding operations (polishing operations excluded)	1.5	Lower value, when polishing
Jig saws	EN50144-2-10	Multi-layer cutting	Cutting different types of materials	1.5	Correction factor is applicable only if machine is used in compliance with manufacturer instructions
Circular saws	EN50144-2-11	Multi-layer cutting	Cutting different types of materials	2.0	Correction factor is applicable only if machine is used in compliance with manufacturer instructions
Screwdrivers	EN50144-2-2	No-load maximum speed	Screwing different materials	1.5	Correction factor is applicable only if machine is used in compliance with manufacturer instructions
Chain saw	EN 50144-2-13	Wood cutting	Construction site and carpentry works	1	Field values basically identical to certified values

Table 6 – Pneumatic machines. Multiplicative coefficients (correction factors) to calculate the field estimated exposure based on certification data

Machine	Reference standard	Operating conditions during test	Actual operating conditions	Correction factor	Notes
Percussion hammers and chisels	EN28662-2:1992	Steel ball-type absorber	All	1.5 – 2.0	1.5 when used as riveting hammer and scaler; 2.0 for all other uses
Hammer drills for stones and rotary hammers	EN28662-3:1994	Cement drilling	Stone and cement drilling	2.0	
Grinders (all types)	EN28662-4:1995	No-load unbalanced disc	All grinding operations (polishing operations excluded)	1.5	Not applicable to cutting tools and steel wire brushes
Grinders (all types)	EN28662-4:1995	No-load unbalanced	Cutting	2.0	Applicable to steel wire brushes

		disc			
Road breakers and rock drills for construction works etc.	EN28662-5 :1994	Steel ball-type absorber	Cement and asphalt demolition	2.0	1.5 for asphalt demolition (if shock absorber devices are used, exposure depends on thrust force. Correction factor is applicable only if machine is used in compliance with manufacturer instructions)
Percussion drills	EN28662-6 :1995	Percussion drilling under standard conditions	Percussion drilling	1.5	
Gun and straight screwdrivers, screwdrivers	EN28662-7 :1997	Trial on test material	All	1.5	None
Orbital and rotary-orbital sanders	EN28662-8 :1997	Standard steel surface honing with abrasive paper	All	1.5	Applicable only if machine is kept in good maintenance conditions
Compactor (rammers)	EN28662-9 :1996	Percussion operations on standard surface	All	1.5	None
Shears and nibblers	EN28662-10 :1998	Metal sheet cutting	All	1.5	None
Nailing machines	CEN ISO/TS 8662-11:2004			n.a.	
Saws	EN28662-12 :1997			n.a.	
Angle grinders and straight die grinders (axial)	EN28662-13 :1997	No-load unbalanced disc	All	1.5	None
Needle scaler – stone processing tools	EN28662-14 :1996	Steel ball-type absorber	Cleaning, welding - Stone processing	2.0	None

Example: using declared values for risk estimation
A grinder operator uses a grinder xxxx manufacturer yyy model for 2.5 hours per day

Values declared by the manufacturer (according to the instruction handbook or database):

$$a_w = 5.2 \text{ m/s}^2$$

Value $a_{w\text{sum}}$ to be used when estimating A(8):

$$a_w = 5.2 \times 1.5 = 7.8 \text{ m/s}^2$$

$$A(8) = 7.8 \sqrt{\frac{2.5}{8}} = 4.4 \text{ m/s}^2$$

4.2.2 Values obtained through field measurements

With regard to different types of machinery, the Vibration Database (BDV) contains the vibration exposure values obtained through field measurements carried out in different operating conditions.

A detail sheet is associated to each field measurement while for each machinery, a summary is provided containing all field measurement results with reference to maximum, medium and minimum values.

If for a specific machinery the database includes several acceleration measurements (e.g. chainsaw X manufacturer Y model measured in different test fields or operating conditions), the **A(8)** value shown in the list of vehicles and tools is calculated for the highest (a_w) values obtained for that specific machinery, taking into account, when calculating the highest value, the values measured in the actual operating conditions (if available). When using values obtained through field measurements, it should always be taken into consideration the operating condition that reflects the actual use of the machinery.

If, for the same type of machinery, several field measurements are available, then the calculation of A(8) shown in the section "field measurements (summary)" is based on the following value:
 a_w (mean) + standard deviation

Therefore, it may be ensured that in 95% of cases the value of A(8) measured in actual operating conditions is lower than the estimated value.

In risk assessment – if there is more than one measurement position (e.g. front and rear handle) – the highest value should be used.

When data obtained through field measurements should not be used

Data obtained through field measurements are affected by the actual operating conditions. Thus, it is recommended not to use data included in the Vibration Database when:

- the machinery is not used in the same operating conditions as those described in the detail sheet containing the measurement conditions of the database;
- the machinery is not in good maintenance conditions;
- the machinery is not exactly the same as the one shown in the database (different manufacturer – model);
- in case of whole-body exposure, different characteristics determining the road surface, driving speed, type of fitted seats deeply affect the exposure levels thus produced even though the same type of machinery is involved.

Whenever using the Vibration Database may lead to underestimating risks, exposure to vibration shall be directly measured during actual operating conditions of machinery in use.

5. ASSESSMENT FOLLOW-UP

Article 5 "*Prevention and protection measures*", paragraph 1 of Legislative Decree 187/05 establishes that exposure limit values, which are respectively equal to **A(8) = 5 m/s²** with reference to hand-arm and **A(8) = 1.15 m/s²** with reference to whole-body, shall not be exceeded.

Paragraph 3 in the same Article establishes that if limit values are exceeded, employers shall "*take immediate action to reduce the exposure below the exposure limit value*".

This is a very important issue, especially when considering that in case of hand-arm vibration and whole-body vibration, there are no anti-vibration PPEs that can safely protect workers and reduce the exposure levels below the limit values set out in the Decree such as, for example, the hearing protectors used against noise-related risk. In many cases, reducing the risk at source is the only measure that can be adopted to reduce exposure below the limit values set out in the Decree. If in the course of assessment procedures limit values are exceeded, it is recommended to refer to the Vibration Database in order to identify any available technological solution offering lower risks, as provided for by the legislation.

Though sometimes data declared by manufacturers in compliance with the Machinery Directive do not allow a correct and reliable estimate of actual values obtained through field measurements, still for each type of machinery such data facilitate the identification of models providing lower levels of vibration. It is expected that the ongoing update of international standards will lead to the availability of certification data that better reflect the level of vibrations emitted in the actual operating conditions of machinery.

The Legislative Decree No. 187 establishes that when action values are exceeded (hand-arm: **$A(8) = 2.5 \text{ m/s}^2$** ; whole-body: **0.5 m/s^2**) the employer shall establish and implement a technical and organizational programme intended to reduce to a minimum the exposure to vibration, taking into account in particular:

- a) other working methods that require less exposure to mechanical vibration;
- b) the choice of appropriate work equipment of appropriate ergonomic design and, taking account of the work to be done, producing the least possible vibration;
- c) the provision of auxiliary equipment that reduces the risk of injuries caused by vibration, such as seats that effectively reduce whole-body vibration and handles which reduce the vibration transmitted to the hand-arm system;
- d) appropriate maintenance programmes for work equipment, the workplace and workplace systems;
- e) the design and layout of workplaces and work stations;
- f) adequate information and training to instruct workers to use work equipment correctly and safely in order to reduce their exposure to mechanical vibration to a minimum;
- g) limitation of the duration and intensity of the exposure;
- h) appropriate work schedules with adequate rest periods;
- i) the provision of clothing to protect exposed workers from cold and damp.

The auxiliary equipment mentioned in item c) include certified "anti-vibration" gloves pursuant to the EN ISO 10819 (1996) standard. Though they do not generally feature high protection levels, as shown below in Table 7, anti-vibration gloves are still useful in order to avoid the amplification of vibration transmitted to hands which is usually found in common work gloves, and to further reduce the level of vibration produced by the tools used. Moreover, another important reason for using gloves is to keep hands warm and dry as this may contribute to reducing some of the negative effects induced by vibration.

Table 7 – Minimum protection levels provided by anti-vibration gloves estimated for certain types of machine.

Machine type	Expected attenuation of vibrations (%)
Percussion machines	< 10%
Chisel hammers and Scalers, Riveting hammers	< 10%
Hammer drills	< 10%
Demolition hammers and Pick Hammers	< 10%
Percussion drills	< 10%
Impact wrenches	< 10%

Sandblasters	< 10%
Shears and nibblers for metal	< 10%
Small scaler hammers	< 10%
Rotary machines	
Orbital and rotary-orbital sanders	40% - 60%
Circular saws and Jig saws	10% - 20%
Angle and axial grinders	40% - 60%
Chain saws	10% - 20%
Brush cutters	10% - 20%

Article 6 of Legislative Decree 187/05 also establishes that workers who are exposed to the risks from mechanical vibration and their representatives should receive information and training concerning in particular:

- the measures taken in order to eliminate or reduce to a minimum the risks from mechanical vibration;
- the limit values and action values;
- the results of the assessment;
- the potential injury arising from the work equipment in use;
- the methods to detect and report signs of injury;
- the circumstances in which workers are entitled to health surveillance;
- the safe working practices to minimise exposure to mechanical vibration;
- the health surveillance programme.