

**Guide to Recognition  
of  
Vibration-induced Disorders**

under the Act on Protection  
against the Consequences  
of Industrial Injuries

***March 2001***

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## **Introduction**

The Administrative Order on the List of Occupational Diseases published by the National Board of Industrial Injuries lists those diseases that, according to medical and technical experience, are caused by special influence to which certain groups of persons are exposed, through their work or working conditions, to a greater extent than persons not having such work. The most recent Administrative Order, as of March 2001, is No. 175 of 14<sup>th</sup> March 2000.

Appendix 1 of the List states under Group E, item 5, „bone and joint diseases as well as diseases in vessels and nerves caused by continuous vibrations". Examples of diseases included under this heading are vibration-induced white finger, neuropathy, and carpal tunnel syndrome.

These diseases are recognised as work-related only when the following general conditions are fulfilled, cf. section 1 of the List:

- (i) In respect of intensity and duration, the harmful exposure shall correspond to the exposure for which a causal relationship has been established between the exposure and the disease.
  - (ii) The pathological picture shall correspond to the pathological picture for which a causal relationship has been established between the exposure
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and the disease.

- (iii) There shall be no information available of any factors that make it probable beyond reasonable doubt that the disease was caused by non-occupational circumstances, cf. section 11(1) of the Act on Protection against the Consequences of Industrial Injuries.

This guide first and foremost concentrates on the disorder white finger, which is most frequently caused by work with vibrating tools.

The paragraph “Vibration-induced White Finger” describes the conditions to be met in order to recognise VWF as an occupational disease, cf. Group E, item 5.

The paragraph “Other Diseases” gives an account of the conditions for recognition of the other disorders included in Group E, item 5.

The paragraph “Information on the Case” gives an account of how the National Board of Industrial Injuries collects information for the case with a view to making an assessment of recognition in accordance with Group E, item 5.

The paragraph “Disorders not on the List of Occupational Diseases” discusses the possibility of recognising VWF caused by cold exposure, following submission of the case to the Occupational Diseases Committee.

The paragraph “Compensation for Permanent Injury and Loss of Earning Capacity” sets out the rules for compensation.

### **Vibration-induced White Finger, cf. Group E, item 5**

VWF is defined as cold-provoked attacks of pallor (whiteness) of fingers, with a sharp upward (proximal) delimitation. During the attack the affected fingers feel numb. The attack may affect one or several fingers, but rarely affects the thumb. As the attack is about to be over, the whiteness is replaced by bluish-red discoloration, associated with a throbbing and tingling sensation.

The Latin designation of VWF is morbus Raynaud. Raynaud's syndrome can be primary, which means that the cause of the disease is unknown.

Raynaud's syndrome can also be secondary to exposure or other disorders. One secondary form is vibration-induced white finger. Other vessel disorders of the arms, connective tissue diseases, and polycythaemia (a condition of a greater than normal number of erythrocytes) may cause Raynaud's syndrome. Raynaud's syndrome can also be the effect of therapy with ergotamine–alkaloids (a type of drug used for migraine headaches) or beta-blockers (medicine used for heart diseases and high blood pressure).

### **Exposure**

A condition for recognising VWF is that there has been vibration exposure through hands and arms from hand-held tools, hand-operated machines or stationary machinery, the exposure happening through a work piece. There are requirements with regard to the intensity and duration of the vibration. The intensity is measured by the acceleration of the vibration, the so-called

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frequency-weighted acceleration, which is stated as a unit of measurement in metre per second ( $\text{m/s}^2$ ) or decibel (dB). Usually vibration levels below approx.  $3 \text{ m/s}^2 = 130 \text{ dB}$  will not be deemed to have caused VWF.

Against the background of surveys made, the International Standards Organisation (ISO) has set up the correlation between exposure intensity and duration and stated the intensity/duration when 10 per cent of those exposed to vibrating tools will develop VWF. This standard (ISO 5349 from 1986) also forms the basis for the assessment of the vibration exposure made by the National Board of Industrial Injuries, see appendices 1 and 2. As appears from the table of appendix 1, 10 per cent will develop VWF if they are exposed, four hours a day, for six years, to vibrating tools with an intensity of vibration of  $5 \text{ m/s}^2$ . If the exposure lasted only 2 hours per day, not 12, but only 8.5 years are required. On the other hand, if the exposure has been for 8 hours a day, it does not take half the exposure, but 4.2 years.

The duration and the intensity must correspond to this standard. This means that the requirements with regard to duration will be lower if the vibration level is higher than stated in the standard, see example 3.

Therefore, in order to be able to assess the vibration exposure, it is important to know the type of vibration tool used, as well as the number of hours per day and the number of years that the tool has been used. If it is not possible to get information on the specific acceleration level of the tool, then, in order to facilitate the assessment, a table indicating an average level can be applied, see appendix 3.

It should be noted that older tools usually have a higher vibration level than more recent versions, which often have vibration dampening.

#### **Example 1:**

In the period 1961-1995, a man had been employed as a locksmith in a shipyard. Through all these years, in connection with sheet metal work, he had been using pneumatic chisels, surface grinders, angle grinders, drills, and pneumatic hammers. On an average, he had been using hand-held vibrating tools for an estimated four hours a day. He began to have attacks of cold white finger around the mid-eighties. The disorder was objectively established by way of a cold provocation test.

The disorder VWF was recognised as there had been relevant exposure to vibrating tools for more than half the workday for a period of more than five years.

#### **Example 2:**

An industrial sewing-machine operator had been exposed to vibration from the sewing machine in the period 1975-1981. She developed white finger. The disorder was not recognised as an occupational disease because the vibration level had been below  $3 \text{ m/s}^2$ .

#### **Comments:**

Group E, item 5 states that the vibration has to be continuous. The vibrations in connection with using a sewing machine are below the level required for

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VWF.

### **Example 3:**

A grinder had been exposed to pneumatic and electric grinding tools for two periods, first in 1982-83 and then again in 1991-94. He had been working with these tools for 5-7 hours per day. The disorder VWF was recognised, even though he had worked for only a total of three years with vibrating tools. The reason for recognising the disorder was that the vibrations were extremely intense.

When the National Board of Industrial Injuries needs to assess whether the requirements for exposure to vibrating tools are met, we usually collect a medical certificate from a specialist with a clinic of occupational medicine, such specialists having the expertise necessary for the assessment of the vibration level of tools.

### **Progress of disease and diagnosis**

A condition for recognition of VWF is documentation of the disorder. It is not sufficient for the injured person to describe how he or she occasionally suffers from attacks of VWF. The disorder has to be established by a doctor.

The following medical information is required:

- Onset of symptoms - i.e. how and when did the signs of VWF start.
  - Description of attacks - i.e. whether there is a sharp upward (proximal) delimitation of whiteness, and when and how often there are changes in skin colour and numbness; any triggers, and whether there is a difference in the attack frequency during summer and winter. Finally the attacks need to be described in terms of their typical extent, i.e. how many fingers and what parts of the fingers are affected.
  - Documentation, such as:
    - (a) A simple, standardised cold provocation test, i.e. the hands are held under cold running water for five minutes, perhaps supplemented by a cooling of the body. It should be noted that this test is not very reliable and may lead to false negative results. One explanation to this may be that, after an attack of VWF, there often is a refractory period, i.e. a time interval when there is no further reaction to the same exposure;
    - or
    - (b) An actual vasophysiological examination by a specialised laboratory, with registration of finger blood pressure before and after cooling down of fingers. Due to the risk of false negative results, some specialised laboratories refrain from performing this examination in the summer period;
    - or
    - (c) A doctor certifying having seen an attack of VWF;
    - or
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- (d) Photographic documentation, i.e. a photograph illustrating that the person in question suffers from VWF, when there is a good description of attacks besides. There has to be a picture of the white fingers and a picture of hands and face.

Regardless of the documentation method applied, it is necessary to describe which, and how many, fingers react with changes in colour and a numb sensation. Furthermore there has to be a detailed description of the delimitation and how the attack progresses.

### **Other information and examinations**

As mentioned above, a general condition for recognising an occupational disease is the absence of any information of factors that make it probable beyond reasonable doubt that the disease was caused by non-occupational circumstances.

It is therefore necessary to examine if there may be other causes of the disorder white finger.

The following information/examinations need to be available:

- Familial disposition (the disorder may be hereditary)
- Information of Raynaud's phenomenon in the toes
- Any previous arm fractures
- Symptoms or other information of any arteriosclerotic illness
- Information of any increased blood pressure
- Smoking and drug ingestion
- The following objective examinations:
  - Measuring of blood pressure on arms
  - Assessment of wrist pulse, also with arms lifted and head turned sideways at the same time
  - Auscultation of carotid arteries and heart
  - Description of the trophic of the hands (i.e. the nutritional state of the tissues: reduced blood supply during the attacks may have caused reduced nutrition of skin and subcutis, which may lead to ulceration) and coloration
  - Neurological status of arms and hands with regard to deep reflexes, tactile sensation, two-point discrimination of finger tips, clinical signs of carpal tunnel syndrome (Tinel's test, backward flexion of wrist).

If there is a distinct discrepancy between exposure to vibrating tools and the severity of the disorder, a more detailed examination is required.

It should be noted that extreme tobacco consumption may in itself lead to white finger. But even if the person in question is a smoker, no reservation will usually be made when recognising the disorder. If the tobacco consumption has been around 30-40 cigarettes per day, however, there may be reservations with regard to the consequences of this. In the event of even higher tobacco consumption,

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i.e. more than 40 cigarettes per day, the disease will not be accepted as work-related.

#### **Example 4:**

A skilled auto mechanic had been doing sheet metal work on aeroplanes from 1979 to 1995. For about a third of the working day, he had been working with vibrating tools. The reported disorder VWF was not recognised as work-related as it was not possible to establish the disease in medical examinations. A cold provocation test had shown normal pressure changes.

#### **Other Diseases, cf. Group E, item 5**

Also diseases other than white finger may be recognised as occupational diseases caused by exposure to vibrating tools.

As mentioned in the comments under Group E, item 5, of the List of Occupational Diseases, such diseases are carpal tunnel syndrome and neuropathy. In addition, certain types of arthrosis may be recognised under special circumstances, cf. (c) below.

##### **(a) Carpal tunnel syndrome**

This disorder is caused by an impact on or compression of the median nerve of the hand (nervus medianus) in the so-called carpal tunnel of the flexion side of the wrist. Through this "tunnel" pass, together with the median nerve, nine tendons. If there is not enough space, there may be pressure on the nerve, and the symptoms constitute the so-called carpal tunnel syndrome.

The symptoms are sensory loss, a tingling sensation in the fingers, butter fingers, reduced grip strength, and pain in hand and forearm, in particular during the night.

Carpal tunnel syndrome is listed under Group E, item 5, as a consequence of work with vibrating tools. The requirements with regard to exposure are the same as for recognition of VWF, on condition, however, that the applied tools have caused a particular load on palm and back of hand.

The disorder may be hard to diagnose. A presumption is, therefore, that the diagnosis is found in a neurophysiological examination.

It should be noted that carpal tunnel syndrome may be recognised as an occupational disease caused by exposure other than from vibrating tools, cf. Group E, item 12 of the List of Occupational Diseases. According to the List, it is possible to recognise the disease if it occurs after a long period of repetitive, monotonous, strenuous, wrist loading work.

Carpal tunnel syndrome may also be a complication of tenosynovitis and may therefore be covered by the recognition of tenosynovitis, cf. Group E, item 6(a).

##### **(b) Neuropathy of hands**

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Neuropathy means degeneration of peripheral nerves.

Peripheral neuropathy of the hands (sensory disturbance and/or chronic pain condition) is recognised in its own right if the symptoms are restricted to the hands and a neurophysiological examination establishes reduced neural conductance. If this is not the case, the symptoms are recognised only if white finger meeting the requirements for recognition is established at the same time.

(c) Bone and joint diseases

Wrist and elbow arthrosis (osteoarthrosis) can be recognised under Group E, item 5, only after extremely severe exposure to vibrating tools. This means that there must have been many years of exposure, largely all day, to intensely vibrating tools (pneumatic percussion tools). A further condition is the absence of any previous fracture of hand or arm.

## **Information on the Case**

For the purposes of assessing the question of recognition, the National Board of Industrial Injuries will examine if the disorder is one of those mentioned under Group E, item 5, and if there has been the required amount of work with vibrating tools. The Board collects medical information and asks the previous employer(s) for information on type of tool, the nature and extent of the work, etc.

When the disease and the exposure to vibrating tools fulfil the conditions mentioned under the headings “Vibration-induced White Finger” and “Other Diseases”, there is reason to believe that the disease is work-related.

## **Disorders not on the List of Occupational Diseases**

According to the most recent medical experience, there is no such correlation between VWF and cold exposure as to meet the requirements for inclusion in the List of Occupational Diseases. Therefore, the disorder is recognised only where it has been submitted to the Occupational Diseases Committee and must be deemed to have been caused, solely or mainly, by the special nature of the work.

In a few cases, the National Board of Industrial Injuries has recognised VWF upon the recommendation of the Occupational Diseases Committee. In these cases the injured persons handled frozen objects for many years, and there was a correlation between the cold impact and the symptoms of the disease.

## **Compensation for Permanent Injury and Loss of Earning Capacity**

The compensation for permanent injury is determined on the basis of section 33 of the Act on Protection against the Consequences of Industrial Injuries (“the Act”) and the guidelines of the Permanent Injury Rating List compiled by the National Board of Industrial Injuries.

The loss of earning capacity is determined on the basis of section 32 of the Act

and the Board's guide on compensation for loss of earning capacity.

## Appendix 1

### Correlation between vibration exposure and the development of VWF

The table illustrates the correlation between daily exposure, number of years, and vibration intensity.

The table indicates what it takes for 10 per cent of the population to get symptoms.

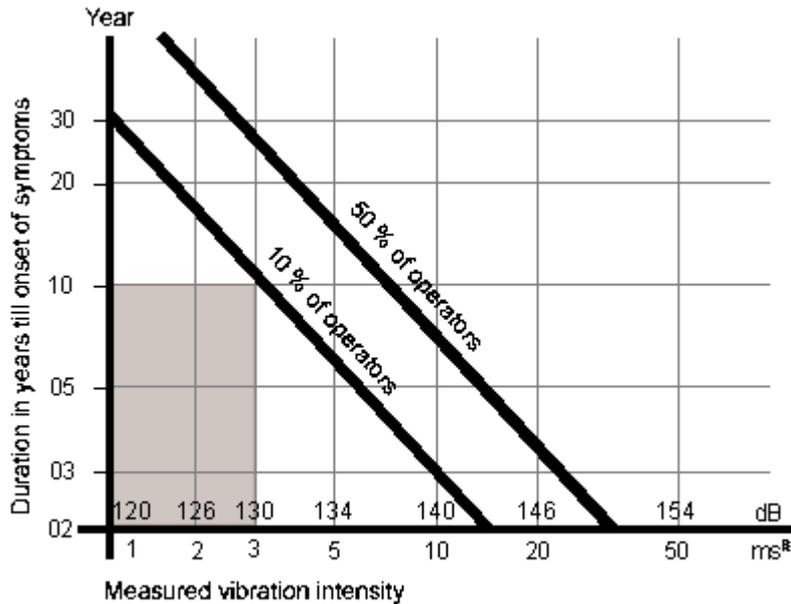
Frequency-weighted acceleration	Number of hours: 0.25	Number of hours: 0.5	Number of hours: 1	Number of hours: 2	Number of hours: 4	Number of hours: 8
2	More than 25 years	More than 25 years	More than 25 years	21.2 years	15 years	10.6 years
5	24 years	17 years	12 years	8.5 years	6 years	4.2 years
10	12 years	8.5 years	6 years	4.2 years	3 years	2.1 years
20	6 years	4.2 years	3 years	2.1 years	1.5 years	1.1 years
50	2.4 years	1.7 years	1.2 years	0.8 years	0.6 years	0.4 years

The calculations in the table were made on the basis of ISO standard No. 5349.

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## Appendix 2

Correlation between vibration exposure and the development of white finger at four hours of daily exposure



## Appendix 3

Examples of acceleration levels for some types of vibrating hand-held tools in the period 1970-1984. Frequency-weighted acceleration at the grip during paid work

Re acceleration group:

I: Less than 3 m/s<sup>2</sup> (under 130 dB)

II: 3-10 m/s<sup>2</sup> (130-140 dB)

III: More than 10 m/s<sup>2</sup> (over 140 dB)

Type of machine / work	Acceleration group			Comment
	I	II	III	
Angle grinders	X	X	X	The grinding disc substantially affects the level. New grinders.
Surface grinders		X		E.g. auto repair.
Fixed grinding machines		X	X	Exposure to vibration in the unit.
Electrical, non-percussion drilling machines	X			E.g. drilling in wood, plastics and metal.
Pneumatic, non-percussion drilling machines	X	X		Workshop industry. New drilling machines.
Percussion drills and hammer drills		X	X	E.g. electricians, wiring. E.g. drilling in wall.
Chisel hammers			X	Most large and old machines, workshop industry, auto repair shops, breaking of concrete and asphalt.

		X		New machines.
Riveting hammers	X	X	X	Old, aeroplane and shipyard work. New, aircraft work.
Holder-on in connection with riveting	X	X	X	Conventional iron work. New constructions, small rivets.
Bolt tools (compressed air)	X	X		Most, auto industry. Larger machines, give higher vibration levels. Slow hauling tools.
Power chain saws		X	X	Old (before 1968). New.
Clearing saws	X	X		Most. With vibration dampening.
Circular saws for plate cutting		X		Car repair
Poker vibrators	X	X		Most. Certain new models.
Handlebar grips and pedals	X			Higher levels for certain agricultural machines.