1. The occupational exposure to noise

The struggle against occupational exposure to noise and vibrations: the Belgian experience

- industrial noise: a slow progress
- industrial vibrations: still a long way to go...

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Occupational Health Issues
The E.U. Directives on noise and vibrations

1. Unit for noise exposure

Unit of noise level: decibel

\[ L_p = 10 \log \left( \frac{p}{p_0} \right) \]

where \( p_0 = 20 \mu Pa \)

Unit of acoustic capacity: decibel

\[ L_W = 10 \log \left( \frac{W}{W_0} \right) \]

where \( W_0 = 10^{-12} W \)

2. Unit for noise exposure

Unit of noise level: decibel

\[ L_d = 20 \log \left( \frac{D}{D_0} \right) \]

where \( D_0 = 0.000124 \)
The E.U. Directives on noise and vibrations -

- city centres, heavy industry, proximity of a motorway or airport
- shopping or light industry areas
- urban residential areas, less than 500 m away from busy traffic routes
- residential areas, more than 500 m away from busy traffic routes

2. The Belgian regulatory framework

2.1. Standards (codes of good practice)

- national standards, like NBN S1-401 on comfort
- comfort criteria
- limit values for noise exposure in different environments [19,49]

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(Note: the table continues with similar data for different environments.)

2.1.1. Standards (codes of good practice)

The comfort criteria (from NBN S1-401) limit values for noise exposure in different environments.
2. The Belgian regulatory framework (3)

- Emission standards

Within the framework of the Machinery Directive, the E.U. defines the acoustic capacity $L^w$ of:

- tower cranes
- lawn mowers
- ...
2. The Belgian Regulatory Framework (5)


- (Theoretical) lowering of the limit value with respect to the general exposure to continuous noise?
- Measuring impact noise with a C-filter?
- Leq(8h) may be replaced by Leq(week)?
- Tolerable mean values (leg) at the workplace?
- Tolerable peak values (leg) for a special permit.
- Companies exceeding this limit should apply for a special permit.

° Tolerable peak values
- 85 dB(4)
- 90 dB(4)
° Peak Level
- 140 dB
° Impact Noise (max.)
3. Industrial noise reduction in practice (2)

- Noise map

- Production hall: Noise map: the distribution of noise through the environment (e.g., reverberation time, measurement of the acoustic quality of the related measurements, frequency-specific measurements (e.g., frequency, dose measurements (personal sampling with dose meter), To begin with a simple dB measurement).

Combination of:

- To begin with a simple dB measurement.
II. The occupational exposure to vibrations

Noise map of a diary production hall
1. Transposition of the directive

The E.U. Directive 2002/44/EC has been translated into the Belgian regulatory system by the Royal Decree of July 7th, 2005

Nearly literal transposition

Decree of July 7th, 2005 into the Belgian regulatory system by the Royal Decree 2002/44/EC has been translated

2. Main problems for implementation in Belgium

1. Limited measuring capabilities
   - Clumsy equipment
   - Interference with impacts (shocks)?
   - 8 h ?

2. Measuring problems
   - Measuring expertise is rare
   - Expensive equipment

3. Main problems for implementation in Belgium

- Limited measuring capabilities
- Clumsy equipment
- Interference with impacts (shocks)?
III. Occupational health issues with respect to noise and vibrations

1. Occupational illnesses in general

Top 10 in Belgium (2002)

1. Illnesses related to vibration exposure (incl. back injuries)
2. Deafness
3. Neuroparalysis due to pressure
4. Skin cancer (due to asbestos exposure)
5. Lung cancer due to asbestos exposure
6. Asbestosis
7. Mesothelioma
8. Allergy to natural latex
9. Dermatitis
10. Farinosis
Objective of the Belgian regulations - prevention and early diagnostic of any damage associated with the exposure to noise and vibrations.

Medical examinations (Royal Decree 28/05/2003 health supervision):
- who needs to be medically surveilled:
  "Cat 3 : activities with a definite risk: exposure to physical agents"
  medical examinations (Royal Decree 28/05/2003 health supervision)

Health surveillance, including audiometry, is mandatory for noise exposure.

1. Actual situation

2. Exposure to noise/vibration : the big picture

3. Noise exposure and occupational medical surveillance
   - during the pre-employment exam
   - after 12 months
   - during the pre-employment exam
   - periodically: once per year
   - after 1 to 3 years
   - after 12 months
   - levels above 85 dB(A) Leq:
   - afterwards: every 1 to 3 years

For workers exposed to above 90 dB(A) Leq:
- during the pre-employment exam
- periodically: once per year

The employer should determine whether there is exposure or not.
The employer should measure the exposure levels.

Exposure to noise, vibrations „Cat 3 : activities with a definite risk: exposure to physical agents“.
1.2. The future situation after the implementation of the directive 2003/10/EC

If exposure > new lower action level (80 dB(A))
- periodicity: once per year
- health surveillance will be mandatory

If exposure > new upper action level (85 dB(A))
- periodicity: frequency ?
- health surveillance will most probably be mandatory


3. Noise exposure and occupational medical surveillance (3)

- The E.U. Directives on noise and vibrations -
Deafness due to occupational exposure to noise is considered in Belgium as an occupational illness. It figures on the limitative list of professional conditions with the following standard for recognition:

Minimum hearing loss = 50 dB on the best ear.

Hearing loss on 1000 Hz + loss on 2000 Hz + loss on 3000 Hz

After having applied the following formula:

In 2003: 25% of the recognized occupational illnesses where due to occupational noise and vibration exposure, good for 7.4 mil. Euro.

If hearing loss is identified, the employer must:

- Propose job rotation to the employee, leading to an alternative job post without further exposure.
- Revise the prevention programme.
- Revise the evaluation of the exposure.
4. Noise exposure and occupational illnesses (3)

Correct use of the PPEs.
The employer has to make a considerable effort to ensure the

- PPE s are worn consistently
- PPE s are worn properly
- PPE s are worn uncomfortable
- Occupational deafness advances stealthily: workers are hard to

Practical drawbacks with respect to prevention programmes

5. Vibration exposure and occupational medical surveillance

1.1. Actual situation (1998)

No action levels
- data provided by the manufacturer (fabrikant)
- evaluate on the basis of the work practices
- If yes, the employer must determine whether there is exposure
  - Hand arm < 100 Hz: RX upper limbs
  - Hand arm > 100 Hz: RX spine
  - WBV < 20 Hz: RX spine
  - WBV > 20 Hz: annual exam
- When exposure > 7 days/year: annual exam

Health Surveillance:
- and when necessary, measure the exposure levels

The employer has to make a considerable effort to ensure the

Practical drawbacks with respect to prevention programmes
The E.U. Directives on noise and vibrations

5. Vibration exposure and occupational medical surveillance (2)

6. Vibrations: health effects

Important characteristics in assessing the risks:

- Working at low temperatures
- The duration of exposure
- The amplitude (acceleration m/s²)
- The frequency: low to high
- The type of vibrations: hand-arm, whole body

Limits:
- Hand-arm V < 100 Hz: finger temperature
- Hand-arm V > 100 Hz: RX upper limbs
- WBV > 20 Hz: RX spine

Health surveillance if:
- Exposure < action level

WBV: 0.5 action level (1.5 exposure limit value)
Hand arm: 2.5 action level (5 exposure limit value)

1.2. The future situation after the implementation of the directive 2002/44/CE
6. Vibrations: health effects (2)

\[ \text{Hand-arm vibrations} \]

- Neurological
- Osteo-articular
- Vasculair

Associated health effects:
- Entering the body through the hands and arms
- Vibrating machines and tools

6. Vibrations: health effects (3)

Hand-arm vibrations

Symptoms: pain and limitations of the joints.

- Kienboch disease (pseudo-arthrosis of scaphoidum)
- Köhler disease (necrosis of lunatum)
- Arthritis, vacuoles, etc.

Bone and joint disorders at shoulders, elbows, wrists:
- Osteo-articular
  - Ex. Pneumatic hammer

1. Vibrations in low frequency bands ( < 60 Hz):

The pathology depends on the vibration frequency:

- Vasculair
- Neurological
- Osteo-articular

Hand/arm vibrations
6. Vibrations: Health Effects (4)

### Vascular: Raynoud Phenomenon (White Fingers)

- **Stage 0**: Exposure to vibrations without symptoms
- **Stage 1**: Light occasional fits, limited to the extremities of one or more fingers
- **Stage 2**: Moderate偶尔 fits in the second and third phalanxes of one or more fingers
- **Stage 3**: Severe repeated fits in all phalanxes of several fingers
- **Stage 4**: Very severe like 3, with tropical changes of the skin at the finger tips

### Neurological Effects: Pathologies Nerves in the Hands and Fingers

- **Stage 0**: Exposure to vibrations, without symptoms
- **Stage 1**: Intermittent paresthesia, with or without pain
- **Stage 2**: Intermittent or continuous paresthesia, lessening of the sensory capacities
- **Stage 3**: Intermittent or continuous paresthesia, lessening of the touch perception and/or finger dexterity

**Ex. Vertical grinding machine**

**Ex. Smoothing machines**
6. Vibrations: health effects (7)

Whole Body Vibrations

produced by vehicles (ex. driving a fork lift truck) and machines

(ex. standing on platforms)

entering the body through the feet and seat

- associated health effects:
  - low back pain
  - spine problems

Osteo-articular and angioneurotic diseases

= recognised as professional illness

Objectified radicular pathology caused by whole body vibrations

= recognised as professional illness

caused by vibrating tools

To be found in the building and transport industry