

Whole-body vibration in agriculture

CEMA Practical User's Guide

This leaflet contains notes on good practice and can be seen as guidelines. It is based on the HSE (www.hse.gov.uk) information sheet 'WBV in agriculture'.

Introduction

Whole body vibration (WBV) is caused by machinery vibration passing through the buttocks of seated people or the feet of standing people. WBV is considered to be a key factor in the occurrence of back pain. However it is not that simple as there are many factors that can influence short term or long term problems in the back and often a combination of factors can even be more detrimental. Some of these factors are:

- ✓ Awkward posture
- ✓ Handling of heavy goods
- ✓ Life style such as being overweight, smoking...
- ✓ Vibrations
- ✓ Shocks from jumping or hitting obstacles
- ✓ ...

Therefore not only the machine but also the driving behaviour/ manual handling/ other tasks, prehistory of the operator and the environment will play a role.

This information sheet provides you with more information to reduce your susceptibility for developing back pain including the optimal reduction of vibrations and shocks.

Who is responsible for the health of the tractor driver?

The Employer could be held responsible for damage to the health of the employee due to WBV according the EC directive 2002/44/EC as transposed into the national legislations.

The directive requires you to control the risks from WBV and shock, by a combination of:

- ✓ identifying sources of exposure and possible exposure controls;
- ✓ minimising exposure by maintaining or modifying machinery and following good practice measures to control exposure; and
- ✓ training operators to ensure controls are effective.

CEMA also recommends health monitoring to identify and minimise the risk of back pain from all sources, not just from WBV.

Transitional period for older vehicles

For machinery given to the workers before 6 July 2007, Member States may postpone the implementation of the directive until maximum 6 July 2010. For agricultural and forestry machines they may even extend the transitional period until 6 July 2014. But it depends from Member state to Member state.

What are the vibration values?

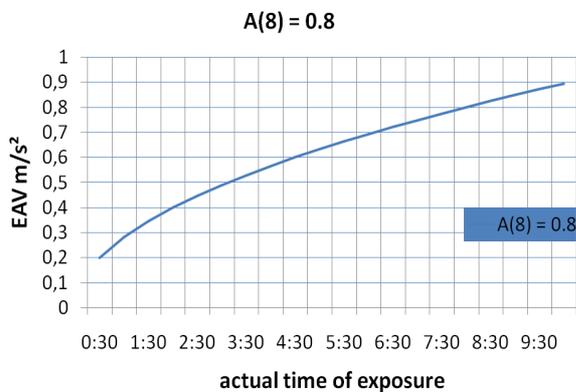


Figure 1: actual time of exposure and corresponding EAV for an $A(8)$ of 0.8 m/s^2 . For an EAV of 0.5 m/s^2 only 3 hours of vibration exposure is allowed.

The $A(8)$ value is the vibration exposure value for a period of 8 hours [m/s^2]. The actual values you measure are independent on the measurement time if measurement conditions are always the same. Depending on the actual time of exposure you may have different values (Figure 1).

The Vibration Regulations set an exposure action value (EAV) which is the amount of daily exposure to WBV above which you are required to take action to reduce risk (0.5 m/s^2). They also set an exposure limit value (ELV) that should not be exceeded (1.15 m/s^2).

Exposures for those using agricultural machinery are likely to be above the EAV and in some cases need careful management to remain below the ELV (see Table 1).

When to measure WBV values?

You should not usually need to measure WBV exposures to know where and how the Regulations apply. However, action to reduce workplace exposure to WBV is required for most operators

using most types of agricultural machinery on at least some days. If more detailed information is required it is advisable that employers do their own measurements rather than relying on declared values. In case of need for help to do measurements the vehicle/seat manufacturer may be contacted.

A useful tool to calculate the daily exposure value when using multiple applications can be found on the CEMA website www.cema-wbv.eu.

SEAT 'Seat Effective Attenuation Transmissibility' values provided by seat or vehicle manufacturers indicate the attenuation level for vertical direction only. Vibrations from horizontal directions need to be taken into account as well.

The kind of action you need to take

varies with the degree of risk. Table 1 puts agricultural tasks into four groups according to the likely exposure to WBV.

- ✓ If you have identified that the work will not reach the EAV (e.g. Group 1 tasks), or only occasionally exceed it, you need to take precautionary measures to ensure that exposure is as low as reasonably practicable.
- ✓ If exposure is often above the EAV (e.g. Group 2 and 3 tasks) then you need to make changes to your working practices to reduce exposure to vibration and shock. You should also consider modifying or replacing unsuitable machinery.
- ✓ If you have taken action and exposures are still likely to exceed the ELV (e.g. Group 4 tasks) then you need to limit how long you spend doing the task.

Group 1 WBV unlikely to be a risk for back pain	Group 2 WBV is likely to be a small risk for back pain	Group 3 WBV is likely to be a risk for back pain	Group 4 WBV is a risk for back pain *†
It is unusual for tasks in agriculture to fall into this category. Even if machinery is shared among a large workforce and exposure durations are short enough for exposures to be below the exposure action value, it is highly likely that there will be some exposure to significant shocks.	<ul style="list-style-type: none"> ✓ Combining ✓ Hedging and ditching ✓ Self-propelled foragers ✓ Duties requiring power take-off not otherwise listed 	<ul style="list-style-type: none"> ✓ Baling ✓ Drilling ✓ Foraging ✓ Spraying ✓ Ploughing ✓ Harrowing ✓ Primary cultivation (up to 5½ hours) ✓ Mowing (up to 8 hours) ✓ Tedding (up to 5 hours) ✓ Transport using unsuspended tractors (up to 4½ hours) ✓ Transport using tractors with suspended cab or chassis (up to 7 hours) 	<ul style="list-style-type: none"> ✓ Primary cultivation (over 5½ hours) ✓ Mowing (over 8 hours) ✓ Tedding (over 5 hours) ✓ Transport using unsuspended tractors (over 4½ hours) ✓ Transport using tractors with suspended cab or chassis (over 7 hours)

<p>Group 1: WBV unlikely to be a risk</p> <ul style="list-style-type: none"> ✓ Exposure is likely to be below the EAV (0.5 m/s² A(8)) with no significant shocks. ✓ Low-cost vibration-reduction measures and management of WBV will reduce maintenance and the likelihood of back pain. <p>Group 2: You must manage exposure to WBV</p> <ul style="list-style-type: none"> ✓ Exposures are likely to exceed the EAV (0.5 m/s² A(8)) on at least some days, but shocks are expected to be small. ✓ The risk of back pain from WBV is likely to be low and back pain is more likely to be caused by other factors ✓ You must have low-cost vibration-reduction and management measures in place, but costly 	<p>or difficult measures are unlikely to be reasonably practicable.</p> <p>Group 3: WBV may be a cause of back pain</p> <ul style="list-style-type: none"> ✓ Exposures are likely to be much higher than the EAV and/or contain large shocks. ✓ You must have effective engineering and management controls. ✓ Health monitoring is recommended to confirm that the risk from WBV is under control. <p>Group 4: You must restrict exposure to WBV</p> <ul style="list-style-type: none"> ✓ To comply with the ELV (1.15 m/s² A(8)) you must restrict how long people are exposed to WBV. <p><i>* A transitional period permits older agricultural machinery to continue in use until 2014 with operators exposed in excess of the ELV, so long as exposure is reduced so far as is reasonably practicable.</i></p> <p><i>† Investigation of your specific activities may, in some cases, show that the tasks can continue for longer than stated.</i></p>
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Exposures for some tasks vary by the type of holding (arable, livestock, mixed). If you operate machinery or perform tasks not listed in Table 1 you may find information from manufacturers, your trade association, or elsewhere to identify what level of control action is required. Exposures should be reduced so far as is reasonably practicable. You may wish to get advice from a person who has the qualifications, knowledge and expertise to help you determine what you need to do.

Check list of precautionary measures to reduce the risk of WBV

- ✓ Seat adjustments / maintenance checks;
- ✓ Limit general friction / wear / clearance on the machine;
- ✓ Proper tire pressure, balance and condition;
- ✓ Limit wheel and wheel ballast eccentricity;
- ✓ Proper weight balance;
- ✓ Maintenance of suspension systems other than from the seat;
- ✓ Activation / good adjustment of all suspension features;
- ✓ Implement / trailer hitch compatibility
- ✓ Check wearing parts regularly, especially connections of suspension systems / implements / trailers

Other precautionary measures to reduce the risk of WBV

- ✓ Obtain vibration information when purchasing or hiring machinery;
- ✓ Check which farm tracks / roads may pose dangers for too high exposure:
 - Promote appropriate driving speed;
 - Promote proper maintenance of roadways;
- ✓ Provide information and training for operators on
 - How to minimise exposure to WBV and shock,
 - How to prevent occurrence of back pain by taking into account load handling, awkward

posture, shocks from jumping and general lifestyle;

- How to recognise and report symptoms.

Maintenance, adjustment and replacement of suspension seats

- ✓ Check whether the seat adjustment controls are readily accessible and easy to use.
- ✓ Train operators to set seats correctly. Incorrect seat adjustment (e.g. right weight adjustment and damper setting) is often the source of poor posture and unnecessary vibration.
- ✓ Check, lubricate and maintain seat suspensions (and cab and chassis suspensions) as described in the manual.

Replacement of seat parts:

Seat suspension components and especially the damper, will probably need replacing during the life of the seat. Seat suspension components normally have a shorter lifetime than the seat itself. The seat's lifetime is typically half the lifetime of the tractor. Inspect the seat assembly regularly for defects. The damper is likely to be defective if the seat easily hits the bottom end stops while driving over relatively smooth terrain with the weight control correctly set or, when the machine is parked, if the seat cushion is easily pushed into the end stops, for example with your knee.

The **seat** will on average need one replacement during the life of the machine. Replacement seats need to take account other factors such as roll-over protective structures (ROPS) and seat belts as well as vibration.

Modifications of the seat suspension should be made only in discussion with the manufacturers of both the seat and the machine. For example, fitting a heavier damper will often reduce exposure to shock and extend damper life but will increase the average vibration.

Seats are available with fore-aft as well as vertical suspension. Fore-aft vibration can be important in applications such as tractor-trailer transport, or many self-propelled foragers and sprayers. The seats can be effective in reducing vibration, although many operators choose to lock the fore-aft suspension because, when active, the suspension reduces their confidence in their ability to maintain control of the machine.

How to select suitable machinery?

Farm managers should ensure that machinery:

- ✓ is suitable for the intended task. E.g. using under-sized or under-powered machines is likely to increase exposure to WBV and shock.
- ✓ is properly maintained in accordance with the manufacturer's recommendations; and
- ✓ will not cause unnecessary vibration exposure.

When purchasing or hiring vehicles, farm managers should seek information about how to use the machinery without risk from WBV. Manufacturers should provide information about the risks from WBV and how the user can control the risks.

Agricultural tractors must meet the vibration specification for the seat prescribed according to a standard test. However this test is not suitable for evaluating the real WBV exposure of operators.

Vibration can change markedly from task to task, operator to operator, and day to day, so there is always a relatively wide range of vibration for a machine or task. Further information on uncertainties can be found in the 'EU non-binding guide to good practice for implementing Directive 2002/44/EC'.

Comparing spot vibration levels is only meaningful if the measurements have been made using the same method and, at present, there are no appropriate industry standard test methods.

Where to pay attention when travelling and working in the fields

Most exposure to vibration and shock during field working occurs at headlands or when driving over un-worked land or ruts. The higher levels of vibration at headlands will often contribute only slightly more to the daily vibration exposure because of the short time spent there, compared with that spent working the main field (with lower vibration).

However, the risk from shock is unlikely to average out between headland work and work in the main field because each shock could have the potential to cause microscopic damage which might add up over time into pain or injury. The risk from shock could be increased when in an awkward posture, for example when twisted or leaning to one side, as the machine makes uneven progress across ruts. Try not to spend a large proportion of a day working around headlands. Plan cultivation to minimise sources of shock.

Also try to change seating position from time to time. This is important as by altering the activated muscle groups, muscle stiffness can be avoided. Muscle stiffness is seen as a factor that increases the susceptibility for back injuries.

In cold conditions seat heating systems when available would also be beneficial.

Where to pay attention to when travelling on roads

Most agricultural machinery produces the highest vibration when travelling on roads, usually because it is being driven at a relatively high speed. In most cases this contributes only a small part to the overall daily exposure because the duration of exposure during travel to, from, or between fields is usually only a small part of the working day. However be careful during trailer transport and hauling, where vibration levels are high and the duration can be many hours. This is perhaps the

most common cause of exposures exceeding the ELV. For hauling activities, the type of trailer, its balance and its connection to the tractor is important.

When travelling back after many hours working on the field the back muscles are more susceptible to damage. Shocks from seat end stop contact or jumping off the machine or handling of heavy goods right after arriving home, should be avoided.

WBV levels are considered the highest in the for-and-aft direction when driving on the road. Therefore fore-and-aft suspension of the seat should be activated, when available. The operator should attempt to become comfortable with such for-and-aft seat suspension because even if it is unfamiliar to him, during transport operations, it can significantly reduce the WBV level.

Consider introducing limits on the time spent driving on roads, as well as speed limits when the road surface is not maintained appropriately. Farm roads and field entrances in employer care should be maintained properly.

Information and training for workers

A competent and skilled farm worker who drives in a smooth and controlled manner will often generate lower exposure to vibration than a less skilled worker or someone working under pressure. Train farm workers and give them information regarding:

- ✓ the risks of lower back pain which arise in their job;
- ✓ the factors that are within their control (such as choice of speed and route); and
- ✓ the situations where these are important.
- ✓ how to prevent non-ergonomic postures by appropriate placement of implement control and monitoring panels and use of visual aids (e.g. mirrors, CCTV...).
- ✓ that a good comfort feeling not necessarily implies a low WBV exposure.

For training information the manufacturer's website can be consulted. For more expert level information the 'EU non-binding guide to good practice for implementing Directive 2002/44/EC' can be consulted.

Monitor and control

All mobile agricultural machinery has the potential to cause exposure in excess of the ELV if exposure management controls are not implemented and followed. Actual exposures are usually between the EAV and ELV so controls are necessary and must be maintained.

Management measures, such as restricting how long machines are used for or reducing travelling speed, may be required to reduce vibration exposure to below the ELV, in addition to the control measures mentioned above. Restrictions on route or speed may help reduce exposure to a minimum and so may be considered essential for adequate management of WBV exposure.

Using job rotation as a control action may actually increase the number of workers at risk because large shocks, especially if the back is twisted, can cause microscopic but permanent injury. Before job rotation is introduced it is important that the risk of being exposed to large shocks is reduced or removed.