

Whole-body vibration in ports

HSE information sheet

This information sheet outlines the risk of developing back pain from whole-body vibration (WBV) when using port machinery and explains what you can do to reduce exposure to it. It should be read in conjunction with INDG242(rev1) *Control back-pain risks from whole-body vibration*.¹

What is whole-body vibration (WBV)?

Whole-body vibration is both the vibration and shock you feel when you sit or stand on a vehicle or machine travelling over uneven ground or along uneven rails. Shocks can occur, for example, when driving over subsidence, potholes or slab or rail joints. Low levels of whole-body vibration may be felt from the engines of mobile machinery or when you work near powerful machinery aboard ships, but this does not contribute to the risks discussed here. Exposure to WBV at low levels is unlikely to cause back injury, but it can aggravate existing back injuries which may prompt complaints of back pain.

There are many causes of back pain other than WBV such as awkward postures and manual materials handling. It is important to reduce the risks from the most likely causes first. See leaflet INDG242 for more information, and leaflets INDG143² and INDG383³ for guidance on assessing and managing the risks from manual handling (see 'Further reading').

The law

The Control of Vibration at Work Regulations 2005 (the Vibration Regulations)⁴ require 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.

HSE also recommends health monitoring to identify workers suffering from back pain from any source, not just from WBV.

What are the action and limit values?

The Vibration Regulations require risks from vibration to be minimised. They set an exposure action value (EAV) which is the amount of daily exposure to WBV above which you are required to take specific actions to reduce risk, as well as an exposure limit value (ELV) that should not be exceeded. They also require control of shock.

WBV exposures in operators of port machinery are generally around the EAV and so require management (see Groups 1 and 2 in Table 1). In some cases there is a risk that needs careful management (see Group 3 in Table 1). Shocks experienced on terminal and ro-ro internal movement vehicles are higher than on other port plant. The risk of back pain in ports appears higher than expected compared with vibration exposure in other industries, possibly because drivers are exposed to WBV at the same time as other causes of back pain.

You should not usually need to measure WBV exposures to know where and how the Regulations apply. However, action to manage workplace exposure to WBV is required for most mobile machinery used in ports.

What action should I take?

The action you need to take varies with the degree of risk. Table 1 identifies common machinery and indicates into which WBV risk management group they will normally fall when following good practice suited to, for example, vessel and load types and dockyard surface quality. You may also need to address the risk of back pain from awkward postures.

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 decide what you need to do.

Table 1 Port machinery grouped according to likely exposure

Group 1: WBV alone is unlikely to cause back pain*	Group 2: Risk of back pain from WBV alone is low	Group 3: WBV is a likely cause of back pain	Group 4: You must restrict duration of exposure to WBV
<ul style="list-style-type: none"> ■ Rubber-tyred gantry cranes ■ Rail-mounted gantry cranes ■ Quayside cranes** ■ Steel-handling fork-lift trucks 	<ul style="list-style-type: none"> ■ Straddle carriers** ■ Reach stackers** ■ Empty container handlers ■ Top lifts ■ Industrial trucks ■ Front loaders/shovels 	<ul style="list-style-type: none"> ■ Internal movement vehicles (IMVs) – terminal and ro-ro ■ Pallet trucks*** 	<p>It is unusual for tasks in port activities to fall into this category</p>

<p>Group 1: WBV alone is unlikely to cause back pain*</p> <ul style="list-style-type: none"> ■ Exposure is likely to be below the EAV ($0.5 \text{ m/s}^2 A(8)$) with no significant shocks. ■ Low-cost vibration-reduction measures and management of WBV can reduce damage to machinery and reduce the likelihood of back pain. ■ Exposure to WBV in combination with poor posture (or other independent causes of back pain) may greatly increase the risk of back pain compared with that from any of the individual causes alone. <p>Group 2: Risk of back pain from WBV alone is low</p> <ul style="list-style-type: none"> ■ Exposures are likely to exceed the EAV ($0.5 \text{ m/s}^2 A(8)$) on 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 either by other factors or by the combined effect of WBV and other factors. 	<ul style="list-style-type: none"> ■ You must have a formal programme of WBV management (proportionate to the risk) in place for Group 2 and above. ■ You must have low-cost vibration-reduction measures in place, but costly or difficult measures are unlikely to be reasonably practicable. <p>Group 3: WBV is a likely 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 ($1.15 \text{ m/s}^2 A(8)$) you must restrict how long people are exposed to WBV.
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* Although vibration exposures are very low, it is advisable to control vibration exposures in ports because WBV and poor posture (or other causes of back pain) together are likely to increase the risk of back pain.

** Examples of these machine types are known to cause much higher vibration exposures than indicated here. Avoid unnecessary WBV when choosing, maintaining, and specifying operating procedures for these types of machinery.

*** High vibration and shocks have been measured on the footplate of this type of machine but the likelihood of WBV causing back pain is probably lower than measured exposures indicate because the operator is standing. A good health monitoring scheme will help confirm the level of risk from WBV for operators of these machines.

Controlling the risk from WBV

Take precautionary measures

- Make someone responsible for managing WBV.
- Ensure good communication between those responsible for managing WBV and those responsible for managing other causes of back pain.
- Find out where shocks occur and what can be done to minimise them, such as adequate maintenance of rail joints.
- Find out what can reduce vibration, such as limiting speed or good maintenance of machinery suspensions and roadways.
- Consider vibration information when purchasing or hiring machinery.
- Consult your employees and their representatives on the causes of shocks and vibration and practical solutions.

- Provide information and training for operators on how to minimise exposure to WBV and shock and how to recognise and report symptoms.

Select suitable machinery

Port management should ensure that machinery:

- is suitable for the intended task;
- is properly maintained in accordance with the manufacturer's recommendations;
- will not cause unnecessary vibration exposure; and
- will not require awkward postures to be adopted.

Manufacturers/suppliers have duties to:

- supply machinery with low vibration emissions;
- inform buyers of the WBV emission level; and

- provide additional information about WBV, as necessary, for the machinery to be used without risk from WBV.

There is usually little difference in the vibration of directly competing machines but where there is a difference, consider WBV emission levels when judging overall suitability. Comparing levels is only meaningful if the measurements have been made using the same method. Ask suppliers for likely vibration emissions for the work the vehicle is most likely to do and what methods of operation are likely to minimise vibration exposures.

Select, adjust and maintain seats

Seats should provide good support to the machine operator and reduce exposure to vibration and shock. They should be easily adjusted to support the operator in a good posture.

Suspension seats best reduce vibration when they are correctly adjusted for the weight of the operator. They will also prevent uncomfortable and very damaging shocks, so long as the suspension does not impact the bottom end-stops (caused by, eg driving too fast over poor slab joints or the driver being too heavy for the seat). However, on many Group 1 and 2 machines, suspension seats have little effect and can increase the vibration slightly because the vibration is too low for the seat suspension mechanism to work well, but they will still reduce the size and number of shocks.

Setting the weight adjustment higher than the driver's weight can reduce end-stop impacts, as can raising the height adjustment found on some seats. If end-stop impacts continue to be a problem, contact your seat and vehicle manufacturers who together may be able to suggest alternative suitable seat suspension systems.

The seat assembly should be assessed regularly as part of the maintenance regime for port vehicles. Seat suspension components may need replacing during the life of the seat. The seat will probably need replacing several times during the life of the machine.

Some ways to help ensure the seat is helping control WBV risks are:

- Machine manufacturers/suppliers must ensure that the seat adjustment controls are readily accessible and easy to use. The same applies when fitting replacement seats.
- Employers must train operators to set seats correctly. Incorrect seat adjustment is frequently the source of poor posture and unnecessary vibration or shock.
- Employers must check, lubricate and maintain seat, cab and chassis suspensions as recommended by the manufacturer.

Maintain roadway surfaces and rails

Most port activities involve driving over a mix of surfaces (slab, block weave, tarmac, Hardicrete, Durbar etc). The condition of the surface and the operator's chosen speed and route have more influence on the vibration and shock than the surface material. WBV exposures are similar for routes over different combinations of surface materials – possibly because operators naturally adapt speeds and paths according to the way machines respond to different surfaces and their condition. It is important to maintain roadways in good condition and to identify and repair problem areas quickly.

For some operations, such as driving over link-spans and aboard ships, there is little choice of route, so control of exposure has to be achieved by slowing down to a speed that is appropriate to the machine and surface.

Rails must be set within roadways to minimise the vibration and shock exposure of the roadway users. In some machines, eg quayside cranes, maintenance of rails and rail joints is essential to avoid unnecessary shock and vibration.

In ports problems often occur when:

- subsidence causes pot-holing or steps between slabs;
- holes or ruts develop in areas where heavy vehicles turn; or
- rail joints deteriorate.

Avoid exposure to WBV combined with awkward postures

Operators of port machinery have to bend, twist and stretch to get good, clear views of driveway routes and vehicle loads. Also, drivers of many machines must climb to and from the cab and often have a large drop down from the last step.

These awkward postures combined with WBV can, in some circumstances, independently cause back pain and other musculoskeletal disorders. Exposure to shock or vibration while in a bent, stretched or twisted posture may increase the risk of back pain.

Where awkward postures are difficult to avoid, try to eliminate shocks and reduce vibration to well below the EAV to help prevent back problems. Consider steps to improve poor posture, such as providing mirrors and CCTV so that there is good visibility without the need to twist and stretch.

Balancing management of vibration and shock

Individual large shocks can cause back pain, especially if they occur while in a bent, twisted or stretched posture. Your first priorities should be to achieve good postures, prevent large shocks and

minimise the number of shocks an operator may experience.

Port machinery can expose operators above the ELV if it is driven too fast over poor surfaces but, when following good practice, the ELV should not be reached. Nobody should operate machines in Group 3 for more than 10 hours per day.

Ensure shocks have been eliminated before using job rotation to minimise WBV exposure, otherwise the number of operators exposed to risk may increase.

Provide information and training for operators and drivers

A competent and skilled machine operator who drives in a smooth and controlled manner will often generate lower exposure to vibration than a less skilled operator or someone working under pressure.

Instruct operators to avoid driving over areas likely to cause shock such as poor slab joints or subsided land. If travelling over surfaces causing shocks cannot be avoided before they are repaired or improved, instruct operators to reduce speed so that shocks are minimised and suspension seat end-stop impacts are avoided.

Encourage operators to avoid sitting in the same position for too long, eg by leaving the machine seat during breaks.

Train operators and give them information about:

- the risks of lower back pain which arise in their job from WBV, and from poor posture and how these might combine to increase the risk of back pain;
- the factors that are within their control (such as choice of speed and route) and where experience has shown these to be important;
- how to set the seat for good posture and to set the suspension correctly for their weight to minimise vibration;
- how to modify the suspension seat weight or height setting if necessary to avoid impacting the suspension's bottom end-stops;
- how to identify and report faults; and
- the purpose and benefits of health monitoring.

Health monitoring

Operators of port machinery should be included in health monitoring schemes used to check for excess of back pain from any possible cause. Health monitoring will ensure you are made aware of problems workers may be having with lower back pain, allowing you to intervene and modify your risk

controls to prevent the problems getting worse. More information is in HSE's guidance booklet L141.⁴

Further reading

- 1 *Control back-pain risks from whole-body vibration: Advice for employers on the Control of Vibration at Work Regulations 2005* Leaflet INDG242(rev1) HSE Books 2005 (single copy free or priced packs of 10 ISBN 978 0 7176 6119 0) www.hse.gov.uk/pubns/indg242.pdf
- 2 *Getting to grips with manual handling: A short guide* Leaflet INDG143(rev2) HSE Books 2004 (single copy free or priced packs of 10 ISBN 978 0 7176 2828 5) www.hse.gov.uk/pubns/indg143.pdf
- 3 *Manual handling assessment charts* Leaflet INDG383 HSE Books 2003 (single copy free or priced packs of 10 ISBN 978 0 7176 2741 7) www.hse.gov.uk/pubns/indg383.pdf
- 4 *Whole-body vibration. The Control of Vibration at Work Regulations 2005. Guidance on Regulations L141* HSE Books 2005 ISBN 978 0 7176 6126 8
- 5 *Non-binding guide to good practice for implementing Directive 2002/44/EC (Vibrations at work)* European Commission ISBN 978 92 79 07533 9. Order or download free at www.bookshop.europa.eu

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This document contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

This document is available web-only at: www.hse.gov.uk/vibration/wbv/ports.pdf.

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