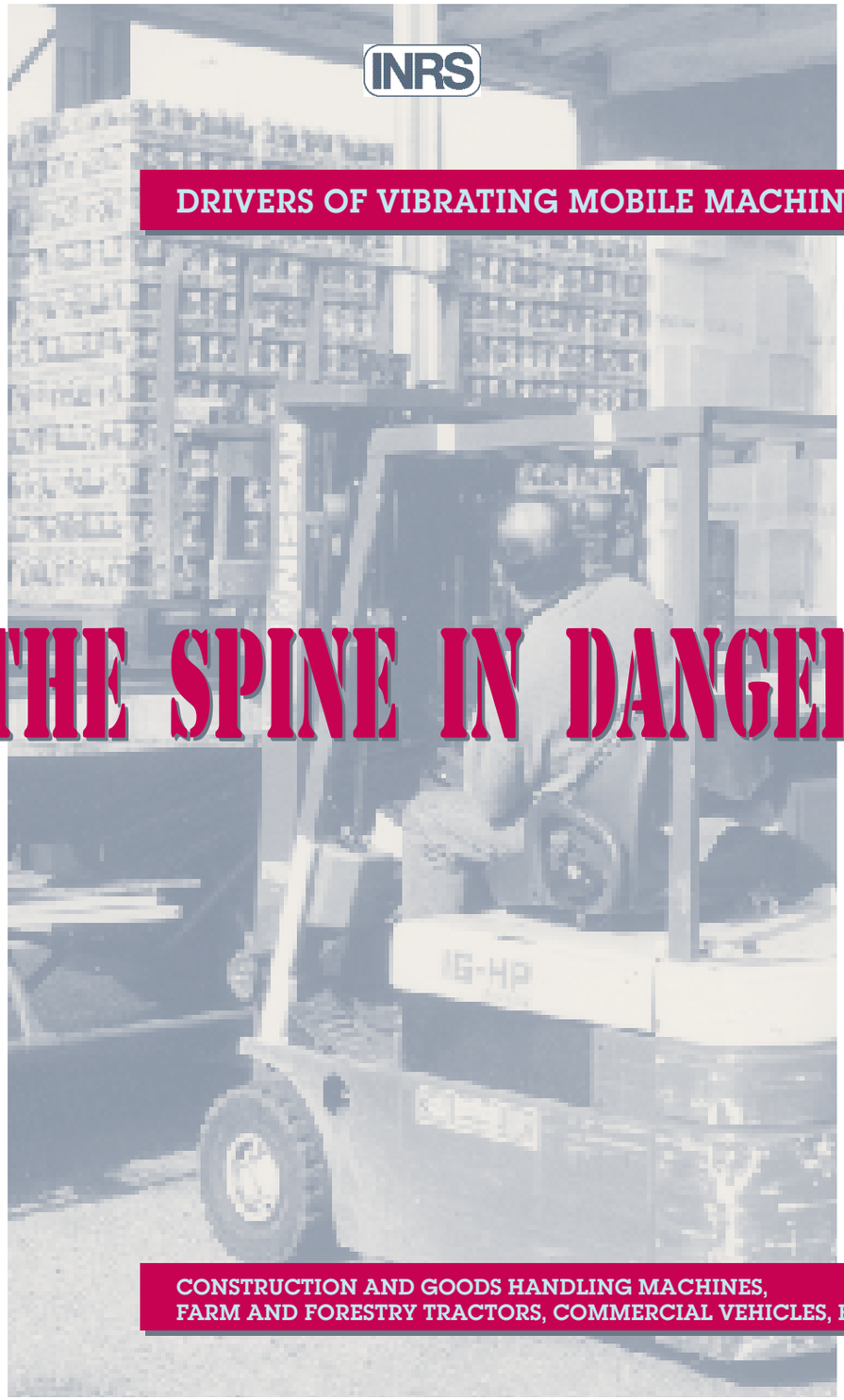
INRS

DRIVERS OF VIBRATING MOBILE MACHINERY

THE SPINE IN DANGER



CONSTRUCTION AND GOODS HANDLING MACHINES,
FARM AND FORESTRY TRACTORS, COMMERCIAL VEHICLES, ETC.

Drivers and seated operators of mobile machinery are exposed to vibration and shocks transmitted through the seat and the floor to the whole body.

LEGISLATION

The European Directive n° 89/391, concerning the safety and health of the workers requires employers to :

- avoid the risks by eliminating vibration where possible,
- implement means of protection which reduce or suppress the risk,
- assess health risks and control them,
- make employees aware of risks and train them to work safety,
- provide medical surveillance where there is still a risk.

Employees are required to comply with safety instructions.

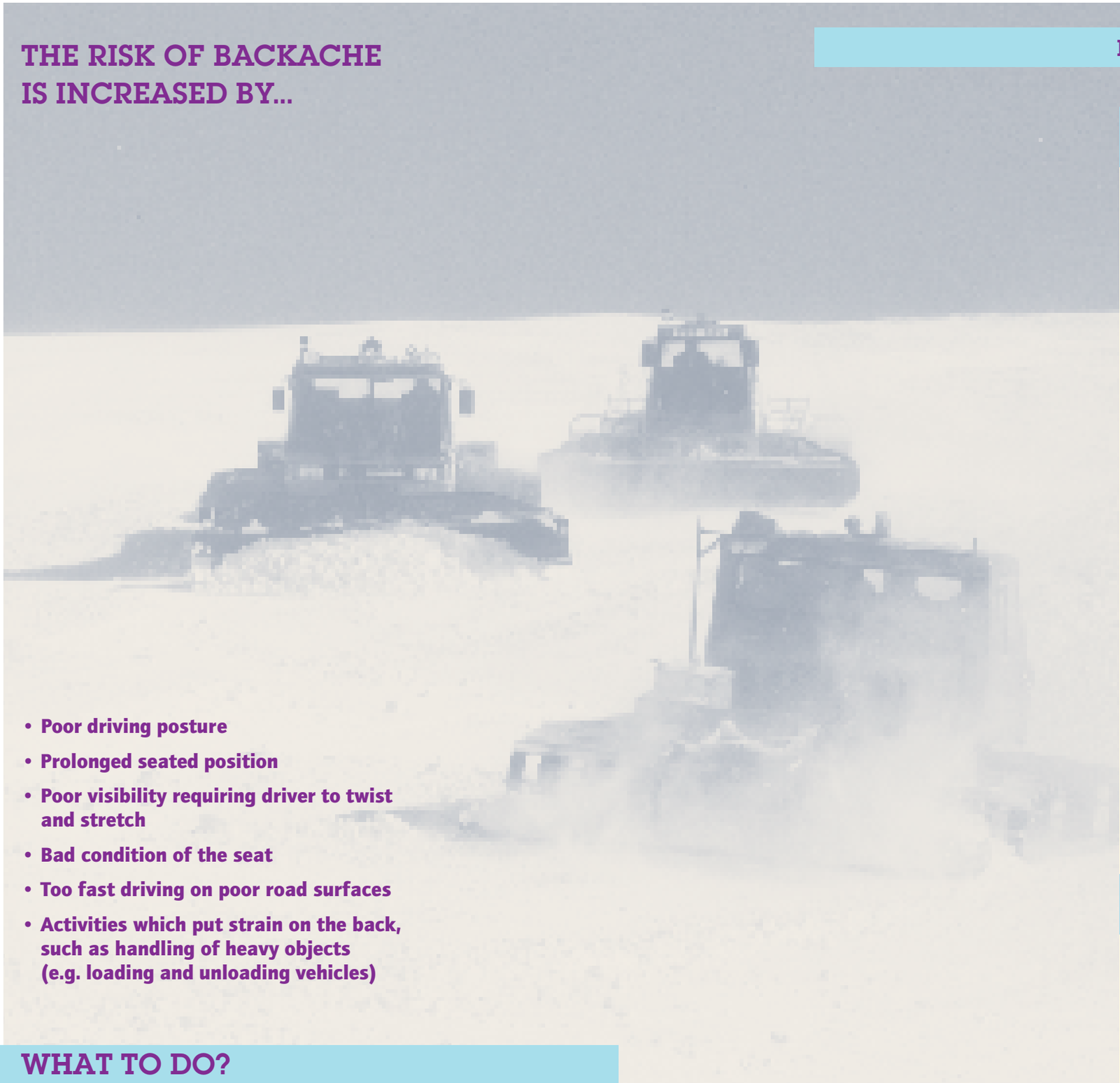
SEATED POSITION AND VIBRATION: THE BACK SUFFERS

Epidemiological studies show that drivers and operators seated in or on mobile machinery (construction and material handling vehicles and machinery, farm and forestry tractors, lorries, overhead cranes, etc.) have increased probability of suffering lower back pain and sciatica when compared with other employees. Frequent exposure to vibration and repeated shocks at sufficient levels over several months or years can cause injuries to the spinal vertebrae or disks. The longer the period and the higher the levels exposure, the more likely drivers are to suffer backache. Once a person starts to have backache, vibration may make the pain worse.

IN THE LONG TERM, HARMFUL EFFECTS

Vibration adversely affects comfort and can hamper work capability. It can present a long-term health risk to drivers. In addition to low back pain, vibration may cause, although less commonly neck and shoulder pain, and digestive disorders. Il may pose a hazard in pregnancy.

THE RISK OF BACKACHE IS INCREASED BY...



- **Poor driving posture**
- **Prolonged seated position**
- **Poor visibility requiring driver to twist and stretch**
- **Bad condition of the seat**
- **Too fast driving on poor road surfaces**
- **Activities which put strain on the back, such as handling of heavy objects (e.g. loading and unloading vehicles)**

WHAT TO DO?

Estimate the vibration magnitude

Vibration values declared by manufacturers are helpful, particularly, as explained in the next page, when new mobile machinery must be selected. However they may underestimate the severity of vibration exposure in some jobs.

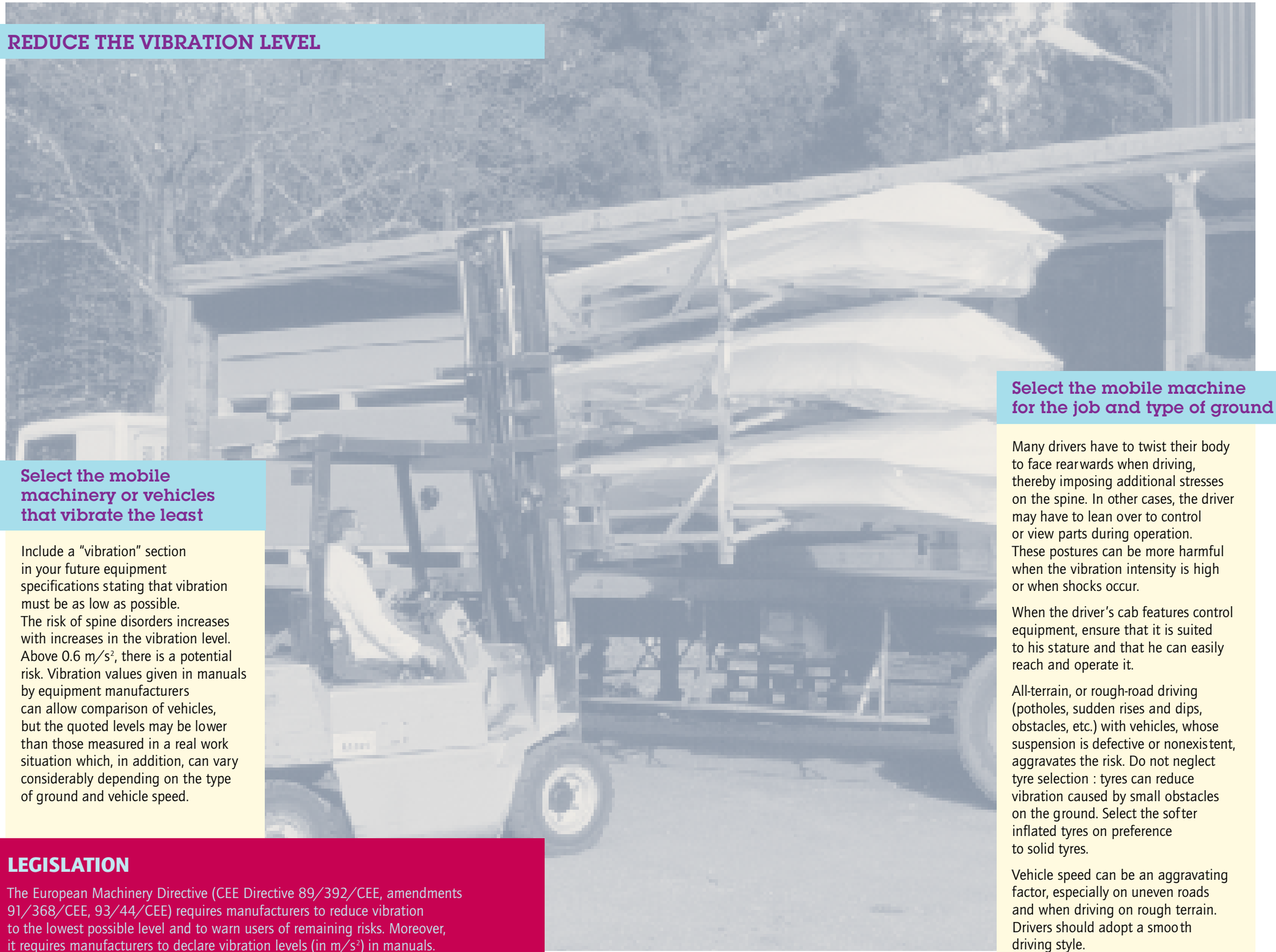
A more reliable evaluation of the exposure level can be gained by referring to measurements obtained for comparable machines and operations. There is a vibration measurement database on the Internet : http://umetech.niwl.se. This database permits the identification of the vibration on a large number of vibrating machines. If there are no measurements available for the vehicle or machine concerned, maximum values obtained on similar machines can be used as guidance.

Only measurements taken at the workplace allow accurate definition of the vibration level generated by a vehicle or a mobile machine where this is required. Modern instruments are easy to use and do not require the machine to be immobilised. The intervention of an occupational hygiene specialist may be advisable to assess exposure, identify any risk and recommend any preventive measures.

Estimate the exposure

International standard ISO 2631 (1997) defines a range above which safety measures should be adopted to protect the operator's health. Below the range, health effects have not been clearly observed. Caution should be taken with vibration magnitudes above 0.6 m/s^2.

REDUCE THE VIBRATION LEVEL



Select the mobile machinery or vehicles that vibrate the least

Include a "vibration" section in your future equipment specifications stating that vibration must be as low as possible.
The risk of spine disorders increases with increases in the vibration level. Above 0.6 m/s^2, there is a potential risk. Vibration values given in manuals by equipment manufacturers can allow comparison of vehicles, but the quoted levels may be lower than those measured in a real work situation which, in addition, can vary considerably depending on the type of ground and vehicle speed.

LEGISLATION

The European Machinery Directive (CEE Directive 89/392/CEE, amendments 91/368/CEE, 93/44/CEE) requires manufacturers to reduce vibration to the lowest possible level and to warn users of remaining risks. Moreover, it requires manufacturers to declare vibration levels (in m/s^2) in manuals.

Select the mobile machine for the job and type of ground

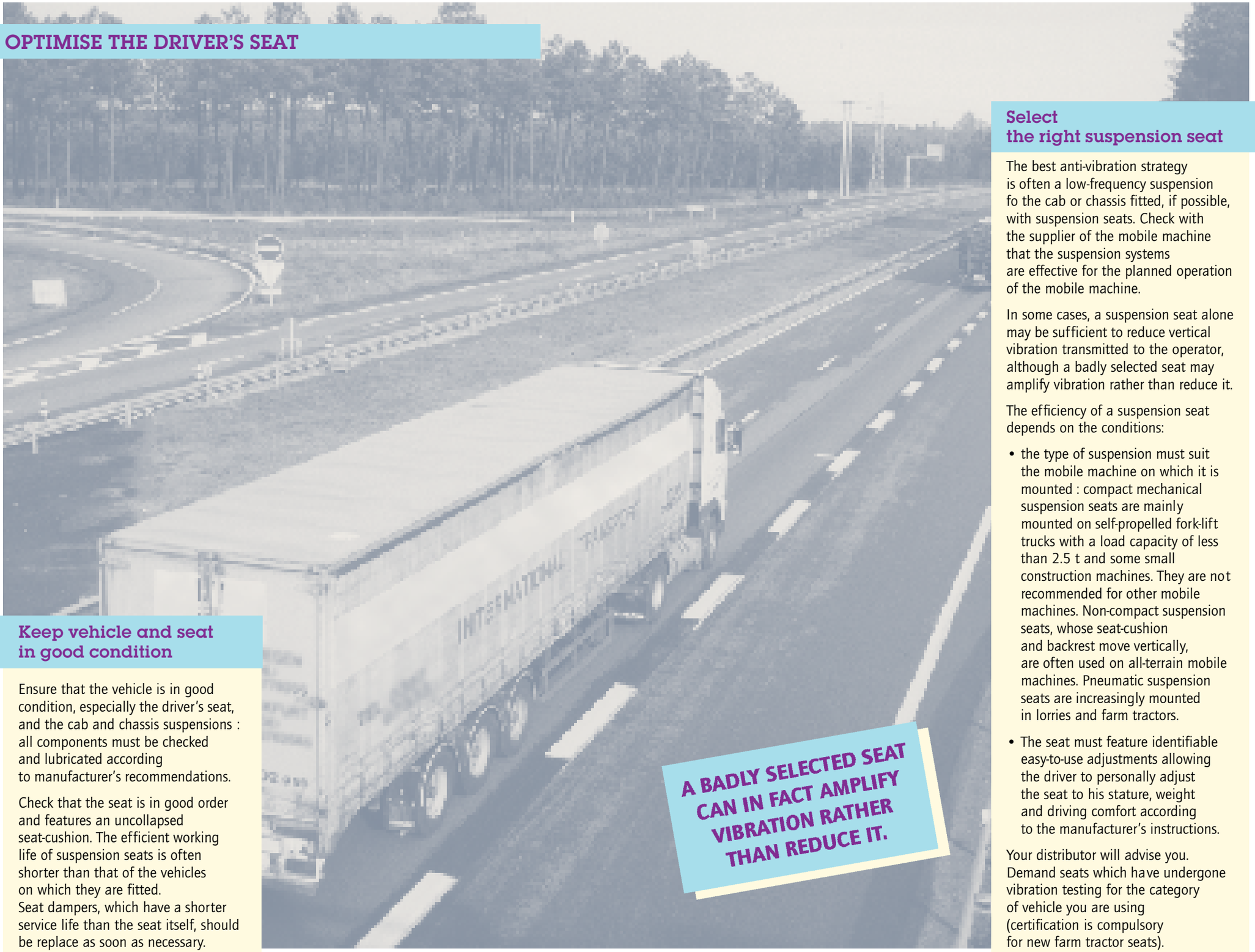
Many drivers have to twist their body to face rearwards when driving, thereby imposing additional stresses on the spine. In other cases, the driver may have to lean over to control or view parts during operation. These postures can be more harmful when the vibration intensity is high or when shocks occur.

When the driver's cab features control equipment, ensure that it is suited to his stature and that he can easily reach and operate it.

All-terrain, or rough-road driving (potholes, sudden rises and dips, obstacles, etc.) with vehicles, whose suspension is defective or nonexistent, aggravates the risk. Do not neglect tyre selection : tyres can reduce vibration caused by small obstacles on the ground. Select the softer inflated tyres on preference to solid tyres.

Vehicle speed can be an aggravating factor, especially on uneven roads and when driving on rough terrain. Drivers should adopt a smooth driving style.

OPTIMISE THE DRIVER'S SEAT



Keep vehicle and seat in good condition

Ensure that the vehicle is in good condition, especially the driver's seat, and the cab and chassis suspensions : all components must be checked and lubricated according to manufacturer's recommendations.

Check that the seat is in good order and features an uncollapsed seat-cushion. The efficient working life of suspension seats is often shorter than that of the vehicles on which they are fitted.
Seat dampers, which have a shorter service life than the seat itself, should be replace as soon as necessary.

Select the right suspension seat

The best anti-vibration strategy is often a low-frequency suspension fo the cab or chassis fitted, if possible, with suspension seats. Check with the supplier of the mobile machine that the suspension systems are effective for the planned operation of the mobile machine.

In some cases, a suspension seat alone may be sufficient to reduce vertical vibration transmitted to the operator, although a badly selected seat may amplify vibration rather than reduce it.

The efficiency of a suspension seat depends on the conditions:

- the type of suspension must suit the mobile machine on which it is mounted : compact mechanical suspension seats are mainly mounted on self-propelled fork-lift trucks with a load capacity of less than 2.5 t and some small construction machines. They are not recommended for other mobile machines. Non-compact suspension seats, whose seat-cushion and backrest move vertically, are often used on all-terrain mobile machines. Pneumatic suspension seats are increasingly mounted in lorries and farm tractors.
- The seat must feature identifiable easy-to-use adjustments allowing the driver to personally adjust the seat to his stature, weight and driving comfort according to the manufacturer's instructions.

Your distributor will advise you. Demand seats which have undergone vibration testing for the category of vehicle you are using (certification is compulsory for new farm tractor seats).

IMPROVE DRIVER COMFORT AND POSTURE

Encourage drivers to adjust the seat to their stature and weight

Seat adjustment is of major importance. When adjusting the seat to the driver 's own weight, the suspension should be at mid-travel. This allows proper operation of the suspension and vertical vibration attenuation.

It is important that drivers understand the importance of this adjustment, or they may use it improperly. For example, they should not use the weight adjustment to adjust the height of the seat-cushion, because this makes the suspension ineffective.

Pneumatic seat suspensions usually self-adjust automatically to a mid-travel position.

Adjustments of the forward-and-backward position of a seat, seat height and backrest inclination are also important : the driver must be able to reach the driving pedals and other controls without effort. When additional equipment is fitted in the cab, it must be easily accessible from a seated position, as well as being convenient and effortless to use.

Schedule working shifts

A prolonged seated position can aggravate backache.

Plan operator and driver shift rotations to reduce vibration exposure in vehicles, machines and working situations that produce high vibration levels.

Advise drivers to stretch before leaving the vehicle after a long period of driving, and not to jump down from the cab. They should also avoid lifting heavy loads directly after driving.

Keep a close watch on the condition of site terrain. Potholes or bumps generate more severe vibration than a relatively smooth ground surface.

MEDICAL SURVEILLANCE

Some risks can persist despite the above measures. Regular medical monitoring is required if exposure to dangerous vibration continues or if workers complain of backpain. An example of questionnaire on medical surveillance is on the Internet : http://human-vibration.com

The European Directive 89/391 (clause 14) requires medical surveillance and information on the risks for exposed employees.
The role of the occupational health physicians is to :

- inform employees of potential risks,
- give preventive advice to employers and employees and check that preventive measures are working,
- assess employees' state of health and diagnose possible disorders at an early stage.

A medical examination is advisable before placing an employee at a job involving exposure to vibration to make the employee aware of the risk, collect relevant signs and symptoms (for comparison during later examinations) and to detect the presence of diseases which could be aggravated by vibration exposure.

Drivers and operators seated in mobile machines are often exposed to vibration, shaking and shocks transmitted through the seat and floor to the whole body. Frequent regular exposure can cause back pains, injuries to spinal vertebrae or disks and other pathological effects.
There are ways of reducing this risk.

This leaflet aims to help employers, and others responsibles for the prevention of occupational risks, to become aware of the risks of exposure to vibration and to adopt measures to improve safety and health in their companies.

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