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## Operation and Maintenance Manual

### The European Union Physical Agents (Vibration) Directive 2002/44/EC

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## General Information - Background Information for the Directive on Vibration

SMCS - 7000

### Machine Vibration

Caterpillar machines work in harsh environments. This can decrease operator comfort. You must have a good knowledge of the transmission of vibration in order to control vibration. This will help you reduce the vibration exposure. This knowledge will improve efficiency and productivity. This supplement has been produced by Caterpillar in order to help educate you and your personnel about the concerns related to the directive. This publication will help you and your workers operate the machine safely.

### Action needed

The member states of the European Union must comply with the "European Physical Agents Directive (vibration) 2002/44/EC".

Unlike previous directives on sound levels and emissions, you have an important function because the effective control of vibration exposure is not just a function of the manufacturer's machine.

Vibration exposure results primarily from these three factors:

- the machine
- operator technique
- ground conditions

All three factors are influenced by the operator and the machine.

### Responsibilities

The directive places the following responsibilities on employers:

- assess the levels of vibration exposure.

- decide if personnel will be exposed to the limits in the directive.
- take steps in order to reduce workers' exposure to vibration.
- provide personnel with information and training on proper operation of the machines in order to reduce the risk of exposure to vibration.
- keep a record of your risk assessment and control actions.
- review your risk assessment and update your risk assessment regularly.

## Vibration Types

Exposure to vibration at work happens in two main ways:

- Whole Body Vibration (WBV)
- Hand/Arm Vibration (HAV)

HAV levels in earthmoving equipment with an operator are below the legal thresholds. This supplement explains the actions that will reduce WBV.

## Understanding Vibration and Operator Discomfort

Operators of earthmoving equipment experience vibration during operation. This may result in the discomfort of the operator.

Caterpillar equipment works in some of the harshest environments. You can learn about vibration. You can help reduce vibration exposure. This will improve the efficiency and productivity of the operator.

The severity of the vibration and the length of time are combined in order to produce the whole body vibration level.

The most common causes of high level WBV exposure

- using an improper machine for the task
- operators use poor techniques, such as driving too fast or operating the machine too aggressively.
- the operators are bumped and the operators are shaken.
- haul roads or work areas that have potholes, cracks, or rubble

Other problems

- poorly designed controls
- poor visibility that causes the operator to twist or stretch
- incorrect adjustment of the seat that causes the operator to twist, bend, lean and stretch

continually

- sitting for long periods without a change in position
- poor operator posture
- repeated manual handling and lifting of loads by the operator
- repeatedly climbing into a high cab
- jumping from a high cab
- poor access to the cab
- the operator's level of general physical condition and choice of sports activity

You should consider all these factors when you assess the risk of whole body vibration for your personnel.

## **Industries that expose operators to Whole Body Vibration**

- construction and rock quarry
- tractors, agricultural products, and forestry products
- industrial trucks, lift trucks, and straddle carriers
- over-the-road truck application, railroad, and buses

## **Assessing Whole Body Vibration Levels**

Machine operators will be exposed to vibration. The risk assessment is the first step. Collect the needed basic information. Observe the tasks and talk to your managers and personnel. A local safety organization or a trade association should be able to provide additional guidance about a risk assessment.

Exposure may be high if the following conditions exist:

- the machine is improper for the task.
- operators are using poor techniques, such as driving too fast or operating the machine too aggressively.
- the operators are being bumped.
- the operators are being continuously shaken.
- haul roads or work areas have potholes, cracks or rubble.

You need to record your findings. The operators at a high risk will be determined by your findings.

Use information from international institutes, organizations, and manufacturers to conduct an

assessment of the vibration exposure. This document contains three examples of calculations and assessments of exposure to whole body vibration.

Most machine movements in normal use will produce daily exposure below the limit value. Some earthmoving equipment will generate high levels of vibration. These machines may exceed the exposure limit value.

If vibration information is not available, you may need a vibration consultant to measure the WBV levels. Compare the results with the values in the directive.

Once you have the results, you can determine a course of action. A local safety organization or a trade association should be able to provide additional guidance if vibration information is not available.

## **Controlling the Risks from Whole Body Vibration**

Take the appropriate action for the identified risk. If the whole body vibration level is high, you may need to give higher priority to controlling the risk.

If the whole body vibration level is low, and no other risk factors are present, you probably need very little action.

If actions are needed, the action needs to be assigned. Record these details in your risk assessment.

Many actions are available in order to reduce the WBV levels.

Actions for controlling risks could include the following:

Train operators and instruct operators.

1. adjust the suspension seats in order to avoid the seat suspension "bottoming out" on rough ground.
2. adjust the seat position and controls correctly in order to provide good line of sight, adequate support and ease of reach for foot and hand controls.
3. adjust the vehicle speed in order to suit the ground conditions.
4. perform the following operations smoothly:
  - a. steer
  - b. brake
  - c. accelerate.
  - d. shift the gears.
  - e. operate attached equipment.
5. follow haul roads in order to avoid travelling over rough surfaces, uneven surfaces, or poor surfaces.

Choose the proper equipment for the job:

- the appropriate size, power and capacity for the work and the ground conditions
- a suspension seat that meets "ISO 7096"
- a suspension seat that gives good support to the back, buttocks, thighs, and feet
- easy adjustment of the seat
- controls that are easy to use
- easy access to the cab

Maintain the machinery and the work area:

- make sure that paved surfaces or roadways are well maintained.
- correctly maintain suspension systems, including the cab, tire pressures, and seat suspension.
- make sure that the controls, the hydraulic system and linkages are well maintained.
- if you are obtaining a replacement seat, replace the seat with the proper seat for the machine.

Plan your schedules:

- schedule the work in order to avoid long periods of exposure in a single day.
- schedule breaks.

## Long Term Actions

After you complete the action in order to reduce whole body vibration levels, you can take long term action in order to reduce vibration at the source.

Earthmoving equipment must be designed in order to minimize the vibration exposure.

Manufacturers should provide you with vibration information for your equipment.

Ask manufacturers or suppliers for the test information.

Ask manufacturers or suppliers for advice about use and maintenance of the machines in order to minimize whole body vibration levels.

## Operator Training

Provide training to tell operators about WBV, and actions that can reduce the level of exposure.

In particular, cover the importance of the following:

- sitting and posture

- adjust the seat for a good position.
  - adjust a suspension seat for the weight of the operator.
  - correct tire pressures
  - keeping speed low on uneven terrain
  - avoiding debris and potholes
  - vary patterns in order to reduce exposure.
  - report the operator discomfort as early as possible.
1. Use the right type and size of machine, equipment, and attachments.
  2. Maintain machines according to the manufacturer's recommendations.
    - a. Tire pressures
    - b. Brake and steering systems
    - c. Controls, hydraulic system and linkages
  3. Keep the terrain in good condition.
    - a. Remove any large rocks or obstacles.
    - b. Fill any ditches and holes.
    - c. Provide machines and schedule time in order to maintain the conditions of the terrain.
  4. Use a seat that meets "ISO 7096". Keep the seat maintained and adjusted.
    - a. Adjust the seat and suspension for the weight and the size of the operator.
    - b. Inspect and maintain the seat suspension and adjustment mechanisms.
  5. Perform the following operations smoothly.
    - a. Steer
    - b. Brake
    - c. Accelerate.
    - d. Shift the gears.
  6. Move the attachments smoothly.
  7. Adjust the machine speed and the route in order to minimize the vibration level.
    - a. Drive around obstacles and rough terrain.

- b. Slow down when it is necessary to go over rough terrain.
8. Minimize vibrations for a long work cycle or a long travel distance.
- a. Use machines that are equipped with suspension systems.
  - b. Use the ride control system on wheel loaders.
  - c. If no ride control system is available, reduce speed in order to prevent bounce.
  - d. Haul the machines between workplaces.
9. Less operator comfort may be caused by other risk factors. The following guidelines can be effective in order to provide better operator comfort:
- a. Adjust the seat and adjust the controls in order to achieve good posture.
  - b. Adjust the mirrors in order to minimize twisted posture.
  - c. Provide breaks in order to reduce long periods of sitting.
  - d. Avoid jumping from the cab.
  - e. Minimize repeated handling of loads and lifting of loads.
  - f. Minimize any shocks and impacts during sports and leisure activities.

## **Guidelines for Reducing Vibration Levels on Earthmoving Equipment**

Properly adjust machines. Properly maintain machines. Operate machines smoothly. Maintain the conditions of the terrain. The following guidelines can help reduce the whole body vibration level:

1. Use the right type and size of machine, equipment, and attachments.
2. Maintain machines according to the manufacturer's recommendations.
  - a. Tire pressures
  - b. Brake and steering systems
  - c. Controls, hydraulic system and linkages
3. Keep the terrain in good condition.
  - a. Remove any large rocks or obstacles.
  - b. Fill any ditches and holes.
  - c. Provide machines and schedule time in order to maintain the conditions of the terrain.
4. Use a seat that meets "EN ISO 7096". Keep the seat maintained and adjusted.

- a. Adjust the seat and suspension for the weight and the size of the operator.
  - b. Inspect and maintain the seat suspension and adjustment mechanisms.
5. Perform the following operations smoothly.
- a. Steer
  - b. Brake
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