Product: EXCAVATOR
Model: E110B EXCAVATOR 4FJ
Configuration: CROSS-REFERENCE LIST OF PTNR TO SCM, CBSA, DECATUR & MOSSVIL 4FJ00001-UP (MACHINE)

Operation and Maintenance Manual
The European Union Physical Agents (Vibration) Directive 2002/44/EC
Media Number -SEBU8257-01 **Publication Date -01/11/2018** **Date Updated -22/09/2008**

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Foreword

SMCS - 1000; 7000

Literature Information

This manual should be stored in the operator's compartment in the literature holder or seat back literature storage area.

This manual contains safety information, operation instructions, transportation information, lubrication information and maintenance information.

Some photographs or illustrations in this publication show details or attachments that can be different from your machine. Guards and covers might have been removed for illustrative purposes.

Continuing improvement and advancement of product design might have caused changes to your machine which are not included in this publication. Read, study and keep this manual with the machine.

Whenever a question arises regarding your machine, or this publication, please consult your Cat dealer for the latest available information.

Safety

The safety section lists basic safety precautions. In addition, this section identifies the text and locations of warning signs and labels used on the machine.

Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance and repair on this machine.

Operation

The operation section is a reference for the new operator and a refresher for the experienced operator. This section includes a discussion of gauges, switches, machine controls, attachment controls, transportation and towing information.

Photographs and illustrations guide the operator through correct procedures of checking, starting, operating and stopping the machine.

Operating techniques outlined in this publication are basic. Skill and techniques develop as the operator gains knowledge of the machine and its capabilities.

Maintenance

The maintenance section is a guide to equipment care. The Maintenance Interval Schedule (MIS) lists the items to be maintained at a specific service interval. Items without specific intervals are listed under the "When Required" service interval. The Maintenance Interval Schedule lists the page number for the step-by-step instructions required to accomplish the scheduled maintenance. Use the Maintenance Interval Schedule as an index or "one safe source" for all maintenance procedures.

Maintenance Intervals

Use the service hour meter to determine servicing intervals. Calendar intervals shown (daily, weekly, monthly, etc.) can be used instead of service hour meter intervals if they provide more convenient servicing schedules and approximate the indicated service hour meter reading. Recommended service should always be performed at the interval that occurs first.

Under extremely severe, dusty or wet operating conditions, more frequent lubrication than is specified in the maintenance intervals chart might be necessary.

Perform service on items at multiples of the original requirement. For example, at every 500 service hours or 3 months, also service those items listed under every 250 service hours or monthly and every 10 service hours or daily.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

Certified Engine Maintenance

Proper maintenance and repair is essential to keep the engine and machine systems operating correctly. As the heavy duty off-road diesel engine owner, you are responsible for the performance of the required maintenance listed in the Owner Manual, Operation and Maintenance Manual, and Service Manual.

It is prohibited for any person engaged in the business of repairing, servicing, selling, leasing, or trading engines or machines to remove, alter, or render inoperative any emission related device or element of design installed on or in an engine or machine that is in compliance with the

regulations (40 CFR Part 89). Certain elements of the machine and engine such as the exhaust system, fuel system, electrical system, intake air system and cooling system may be emission related and should not be altered unless approved by Caterpillar.

Machine Capacity

Additional attachments or modifications may exceed machine design capacity which can adversely affect performance characteristics. Included would be stability and system certifications such as brakes, steering, and rollover protective structures (ROPS). Contact your Cat dealer for further information.

Cat Product Identification Number

Effective First Quarter 2001 the Cat Product Identification Number (PIN) has changed from 8 to 17 characters. In an effort to provide uniform equipment identification, Caterpillar and other construction equipment manufacturers are moving to comply with the latest version of the product identification numbering standard. Non-road machine PINs are defined by ISO 10261. The new PIN format will apply to all Cat machines and generator sets. The PIN plates and frame marking will display the 17 character PIN. The new format will look like the following:

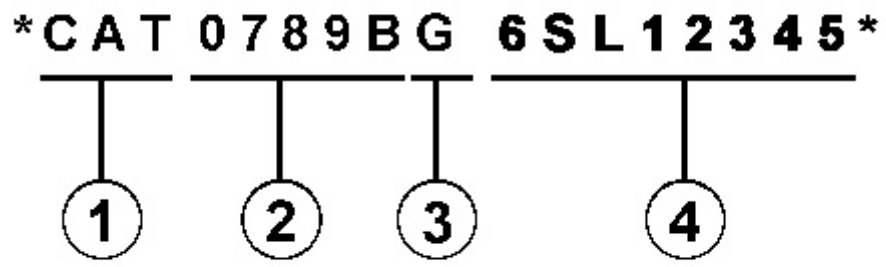

Illustration 1 g00751314

Where:

1. Caterpillar's World Manufacturing Code (characters 1-3)

2. Machine Descriptor (characters 4-8)

3. Check Character (character 9)

4. Machine Indicator Section (MIS) or Product Sequence Number (characters 10-17). These were previously referred to as the Serial Number.

Machines and generator sets produced before First Quarter 2001 will maintain their 8 character PIN format.

Components such as engines, transmissions, axles, etc. and work tools will continue to use an 8 character Serial Number (S/N).

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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 vibrationlevel 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
    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.
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Vibration Charts - and Example Calculations

SMCS - 7000

Equivalent vibration values of whole body vibration level for earthmoving equipment

Determining Exposure to Whole body vibration

If you are planning to determine a worker's vibration exposure values, the following pages will help you understand the process.

Use this assessment process in order to determine the Total Vibration Exposure Points (PE total) for a particular activity. The appropriate action will be shown by this process.

Find the vibration levels for a machine and activity in the Table 1. The X axis, the Y axis, and the Z axis are shown in the diagram below.

Illustration 1 g01223809

Table 1

"ISO Reference Table A - Equivalent vibration levels of whole body vibration emission for earthmoving equipment."								
Machine Family	**Machine Type**	**Typical Operating Activity**	**Vibration Levels**			**scenario factors**		
			X axis	**Y axis**	**Z axis**	**X axis**	**Y axis**	**Z axis**
Compactor	Single Drum Vibratory	compaction (boulder)	0,47	0,53	0,41	0,17	0,22	0,12
		compaction (silt)	0,29	0,28	0,28	0,08	0,17	0,11
	Vibratory Asphalt	asphalt with vibration	0,33	0,40	0,48	0,11	0,08	0,14
		asphalt without vibration	0,35	0,43	0,36	0,13	0,20	0,19
	Pneumatic-Tire Roller	Compacting	0,23	0,27	0,39	0,16	0,19	0,56
		Idling	0,03	0,04	0,04	0,01	0,01	0,01

	Landfill	work cycle	0,55	0,83	0,34	0,17	0,33	0,15
Excavator	Compact Track Excavator	excavating	0,33	0,21	0,19	0,19	0,12	0,10
		hydraulic breaker application	0,49	0,28	0,36	0,20	0,13	0,17
		transfer movement	0,45	0,39	0,62	0,17	0,18	0,28
	Track Type Excavator	excavating	0,44	0,27	0,30	0,24	0,16	0,17
		hydraulic breaker application	0,53	0,31	0,55	0,30	0,18	0,28
		mining application	0,65	0,42	0,61	0,21	0,15	0,32
		transfer movement	0,48	0,32	0,79	0,19	0,20	0,23
	Wheel Type Excavator	excavating	0,52	0,35	0,29	0,26	0,22	0,13
		transfer movement	0,41	0,53	0,61	0,12	0,20	0,19
Loader	Backhoe Loader	excavating	0,28	0,26	0,20	0,09	0,16	0,06
	Skid Steer Loader	load and carry motion	0,86	0,73	0,93	0,30	0,33	0,35
	Multi Terrain Loader	v-shape motion	1,21	1,00	0,82	0,30	0,84	0,32
	Compact Track Loader	v-shape motion	1,21	1,00	0,82	0,30	0,84	0,32
	Track Loader	load and carry motion	0,89	0,67	0,52	0,12	0,16	0,10
		transfer movement	0,58	0,49	0,60	0,18	0,12	0,15
		v-shape motion	1,24	0,93	0,63	0,41	0,35	0,18
	Compact Wheel Loader	load and carry motion	0,94	0,86	0,65	0,27	0,29	0,13
	Wheel Loader	load and carry motion	0,84	0,81	0,52	0,23	0,20	0,14

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