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English Version

Whole-body vibration - Guidelines for vibration hazards reduction - Part 1: Engineering methods by design of machinery

Vibrations globales du corps - Guide pour la réduction des
risques de vibrations - Partie 1: Mesures techniques lors de
la conception des machines

Ganzkörper-Schwingungen - Leitfaden zur Verringerung der
Gefährdung durch Schwingungen - Teil 1: Technische
Maßnahmen durch die Gestaltung von Maschinen

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Foreword

This Technical Report (CEN/TR 15172-1:2005) has been prepared by Technical Committee CEN/TC 231 "Mechanical vibration and shock", the secretariat of which is held by DIN.

CEN/TR 15172 consists of the following parts:

CEN/TR 15172-1, *Whole-body vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery*

CEN/TR 15172-2, *Whole-body vibration — Guidelines for vibration hazards reduction — Part 2: Management measures at the workplace*

Introduction

This Technical Report deals with engineering methods for design of machinery transmitting vibration to the human body. Guidance on management measures at the workplace is given in CEN/TR 15172-2.

Significant whole-body vibration is mainly related to operators of mobile machinery. Mobile machinery transmits vibration and shock from the seat for seated operators, from the floor for standing operators, which may cause adverse health effects, primarily damage to the spine. The effects of vibration depend on its frequency, direction, intensity, presence of shocks and on the exposure time. They also depend on the operator's posture. It is important to understand that the design and manufacture of mobile machinery is complex, requiring extensive technical background.

The EC Directive 98/37/EC on the approximation of the laws of the member states relating to machinery (Machinery Directive), amended by Directive 98/79/EC, requires that the machinery is so designed and constructed that risks resulting from vibration produced by the machinery are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source. Limiting vibration by design is one of the measures that EN ISO 12100-2 suggests machine manufacturers and designers should consider as part of a strategy to achieve safety by design of machinery in conformity with European Legislation.

The reduction of vibration by design of machinery can make an important contribution to the effective protection of people at work from the harmful effects of vibration. In practical situations, however, a combination of engineering measures and management measures may be necessary.

1 Scope

This Technical Report provides best practices and methods available for limiting the effects of mechanical whole-body vibration on operators' positions. The guidelines given outline practical ways in which whole-body vibration hazards associated with mobile machinery can be reduced by machinery design. The Technical Report covers four important aspects of the reduction of the effects arising from exposure to hazardous machinery vibration:

- a) identification of main sources and operational modes producing vibration that might be hazardous to health and of additional factors worsening the adverse health effects of vibration on the operators;
- b) reduction of vibration magnitudes at source;
- c) reduction of transmission of vibration from source to the operator;
- d) ergonomic adaptation of operators' position: posture, range of vision.

This Technical Report does not provide universal or detailed technical solutions but only a review of engineering methods available. It is not concerned with hand-arm vibration which is covered by CR 1030-1.

This Technical Report is primarily intended as a guideline for people involved in purchasing, using, supplying, marketing or inspecting mobile machinery. It is also intended to be a guidance for writers of type C standards for specific types of machinery.

2 Identification of main sources and operational modes producing vibration that might be hazardous to health

2.1 Identification of main sources and operational modes

The machine manufacturer should make a careful investigation of all possible causes of vibration and shock connected with the full range of likely use of the machinery. In case the machinery is used with tools, the investigation should include the range of tools likely to be used with the machine.

Internal sources of vibration in mobile machinery are engines, hydraulic devices and transmission.

Normally, the engine is not a problem unless it runs at low speed and has only a small number of cylinders. Generally, the engine may be a problem in older, poorly maintained machines and in machines where the user has made changes in the original construction.

Some machinery categories, e.g. vibratory rollers, include intentional vibrating sources. Machinery may also use vibrating attachment, e.g. separators, rotary snow-ploughs, street-sweeping machines, road milling machines, refuse collection lorries. Rough braking and handling of gears can cause large vibration and shocks.

The major source of vibration affecting operators of mobile machinery is the contact between wheels and ground at travelling. The severity is determined by the combination of ground surface, machine dynamics and travelling speed.

For machinery using tools, the contact between the tool and the material, e.g. in digging, rock drilling, loading, compaction, is of vital importance. The vibration magnitude depends on the characteristics of the material and the operator's skill.

Examples where the tools can be the dominant source of vibration are excavators using breakers.

In case of using a trailer, the design of the connection of the trailer to the machine (e.g. truck, lorry) is important as is the position of the centre of gravity of the trailer.