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Hand-arm vibration - Guidelines for vibration hazards reduction - Part 1: Engineering methods by design of machinery

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Hand-arm vibration - Guidelines for vibration hazards reduction - Part 1: Engineering methods by design of machinery

Vibrations main-bras - Guide pour la réduction des risques de vibrations - Partie 1: Mesures techniques lors de la conception des machines

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

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CEN

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Foreword

This CEN report has been drawn up by CEN/TC 231 "Mechanical vibration and shock", working group 2 "Hand-arm vibration".

Contents

Introduction

The habitual and prolonged use of machinery which transmits vibration to the hand may cause disorders of the upper limbs. The effects of vibration depend on its frequency, direction, intensity and magnitude, and on the exposure time and coupling of the hand-arm system to the machine. The effects also depend on the hand-arm position caused by the design of the grip and the working task. They are also affected by forces exerted by the operator such as gripping, pushing and pulling forces, and by the skill and practical experience of the operator. Exposure to cold may be relevant to the vascular symptoms caused by hand-transmitted vibration.

Limiting vibration by design, is one the measures which EN 292-2 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 persons at work from the harmful effects of vibration. In practical situations however, a combination of measures may be necessary which can be categorised under the headings:

- engineering measures;
- management measures;
- personal protection;
- hygiene measures (law, directives, etc.).

These guidelines only deal with engineering methods and in particular with comments to designers and manufacturers of machinery which transmits vibration to the hand leaving to others, the task of defining specific guidelines on management, personal or hygiene protection (see CR 1030-2).

Engineering methods

Machinery vibration may be due to oscillating forces generated internally by the intermittent, impulsive or cyclic way in which machines are designed to work, by unbalance, and/or by impacts in gears, bearings and other mechanisms.

Vibration can also be caused by unbalance of an inserted tool. For example, unbalance of the grinding disc is one factor that determines the vibration values of a hand-held grinder.

Vibration can also be caused by the interaction between operator, machinery and material being worked: for example when the shocks or impulses of a pneumatic chisel, as it hits the surface being chiselled, are reflected into the body of the tool.

In the case of machinery, such as pedestal grinders and linishers, at which the workpiece is hand-held or hand-guided during working, the interaction between workpiece and machine is likely to be the chief source of vibration. The transmission through the workpiece is the principal route by which vibration reaches the operator's hands.

The above parameters should be taken into account by designers, manufacturers, and suppliers of equipment for use at work, who are obliged to ensure that their designs and products satisfy safety requirements; in particular, to design machinery so that the risks from vibration produced by the machinery are reduced to the lowest level, taking into account technical progress and the availability of means of reducing vibration, in particular at source (see annex A of EN 292-2).

To reduce the vibration stress for the user, it is essential to pay attention not only to the vibration magnitude but also to the coupling of the machine to the hand-arm system and to the exposure time. All three parameters can be influenced by technical measures (e. g. coupling can be influenced by an ergonomic design of machinery; the exposure time can be reduced by increasing the performance of the machine).

1 Scope

These guidelines outline feasible ways in which possible hand-arm vibration hazard associated with hand-held, hand-guided and other machinery, may be reduced by machinery design in order to provide practical professional aid to designers and manufacturers of machinery. The document covers four principal aspects of the reduction of the effects arising from exposure to hazardous machinery vibration:

- reduction of vibration magnitude at source;
- reduction of vibration transmission from the source to handles and other surfaces in contact with the hands;
- reduction of vibration transmission from the grips or handles of the machine to the hand-arm system of the operator by ergonomic design measures;
- thermal design to optimise hand temperature.

NOTE: These guidelines are not intended to be universal or detailed solutions but only technical methods which may be used to solve problems.

2 Normative references

This CEN report incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this CEN report only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 563	Safety of machinery – Temperature of touchable surfaces – Ergonomics data to establish temperature limit values for hot surfaces
prEN 894-3	Safety of machinery – Ergonomic requirements for the design of displays and control actuators – Part 3: Control actuators