

STANDARD TESTS FOR SUSPENDED SEATS – CAN THESE CONTRIBUTE TO PROTECTION AGAINST WHOLE-BODY VIBRATION? – COMMENTARY ON HISTORICAL DEVELOPMENT AND CURRENT WORK IN CEN/TC231/WG9 (SEATING)

Richard Stayner
RMS Vibration Test Laboratory, Ludlow, U.K.

Introduction

Suspended seats perform two functions: Reduce effect of occasional large bumps; Reduce more continuous vibration at a lower level. The former needs high damping. The latter needs low damping. For most mobile work machines the inevitable compromise is generally better than a simple cushion seat, because that amplifies vibration at around 4 Hz which is a sensitive frequency for human vertical WBV.

Why have standard tests for seat suspensions?

- Seat suspensions are non-linear so any measure of performance depends on operating conditions. For comparison these need to be defined.
- Seat manufacturers need benchmarks for product development;
- Machine makers choose dynamic characteristics appropriate to their products;
- Occupational health specialists wish to control operator exposure to

Standard tests should be representative, repeatable and reproducible. These requirements are reviewed in relation to the history of seat test standards and the current position.

Current position and history

The current position is that we have standard tests for seats for agricultural tractors, earthmoving machinery, industrial (fork-lift) trucks. These tests comprise measurement of vibration transmission and of the rate of damping.

Current standards developed as the technology developed, starting around 1960:

1. Test on machine driven over standard surface¹.
2. Test on shaker reproducing standard surface.
3. Shaker input replaced by representative spectrum².
4. Human subject replaced by dynamic dummy. (Not yet settled).

Are standard tests representative?

The development process has gradually moved seat tests further from reality. 4 hr samples of work exposure suggest that seats do not **on average** provide large reductions of vertical WBV³. For **specific magnitudes** of vibration they can work well. For low vibration, performance is reduced by friction and for severe vibration by length of travel. Recent work has led to a new test to quantify how a suspension controls over-travel⁹.

Are standard tests repeatable?

Tests involving driving a machine were never very repeatable, because the input could not be controlled very closely. Shaker tests can have very repeatable inputs, e.g. KAB Seating has just run a review that shows consistency over a ten year period.

Are standard tests reproducible?

In Europe, inter-laboratory tests gave unacceptable inconsistencies. Dynamic dummies are being trialled to replace human subjects, but even with these there can be 25% difference between laboratories. Current work of CEN Seating WG is aimed at comparing how different laboratories interpret the standard specifications, with the aim of improving these specifications. Then with dummies we should have reproducibility.

Comments

We have standard tests for seat suspensions that are repeatable. Work is in hand to try to make them more reproducible. The question remains: How helpful are such standard tests in protecting workers against harmful effects that are associated with WBV?

References

1. Matthews, J. (1966) Ride comfort for tractor operators IV: Assessment of ride quality of seats. J. agric. Engng. Res. 11 (1), 44-57.
2. ISO 7096 (2000) Earthmoving machinery – Laboratory evaluation of operator seat vibration. International Standards Organization, Geneva.
3. Scarlett, A.J., Price, J.S., Semple, D.A. and Stayner, R.M. (2005) Whole-body vibration on agricultural vehicles: evaluation of emission and estimated exposure levels. Research Report 321, Health and Safety Executive, ISBN 0-7176-2970-8.