

VIBRATION EMISSION MEASUREMENT METHODS FOR GRINDERS

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Introduction

ISO8662-4, “Hand-held portable power tools - Measurement of vibrations at the handle - Part 4: Grinders” is under revision. The new revision shall harmonize ISO 20643 “Mechanical vibration - Hand-held and hand-guided machinery - Principles for evaluation of vibration emission” which, among others, requires measurements in three directions and declared values related to the upper quartile of real-use vibration.

To get the most suitable test method, a round robin test was made for evaluation of the two test methods proposed by the ad-hoc group working with this standard revision.

Methods

Seven laboratories measured the vibration from four grinders of different sizes, with and without autobalancing units. The laboratories come from universities, health & safety laboratories and grinder manufacturers.

Two measurement methods are evaluated with respect to repeatability and reproducibility:

1. Grinding on a well-defined mild steel bar with depressed center wheels according to detailed test instructions. The test sequence starts and ends with 10 seconds of running the grinder in the air, when measuring the unbalance contribution to the vibration coming from the unbalance of the grinding wheel. Between these runs the average vibration during 60 seconds of grinding is measured. Three operators do five grinding tests per grinder.
2. Measurements using an aluminum unbalance disc similar to the one defined in ISO8662-4. Each operator runs the grinder four times, between each run the unbalance is moved 180 degrees to avoid variations caused by the play between the test wheel and the spindle. The averaging time is 10 seconds. Each grinder is tested by three operators.

Repeatability is the spread within a lab between operators and over short time period for one machine and reproducibility is the spread between laboratories and over longer time periods for one machine. Instrumentation and transducer location are chosen according to ISO8662-4 and circulated test instructions.

Results

Both the repeatability and reproducibility is poor for the real grinding test, see figure 1. The coefficient of variation for repeatability is approximately 40% higher for the grinding test and the coefficient of reproducibility is 60% higher for the grinding test than for the unbalance disc test.

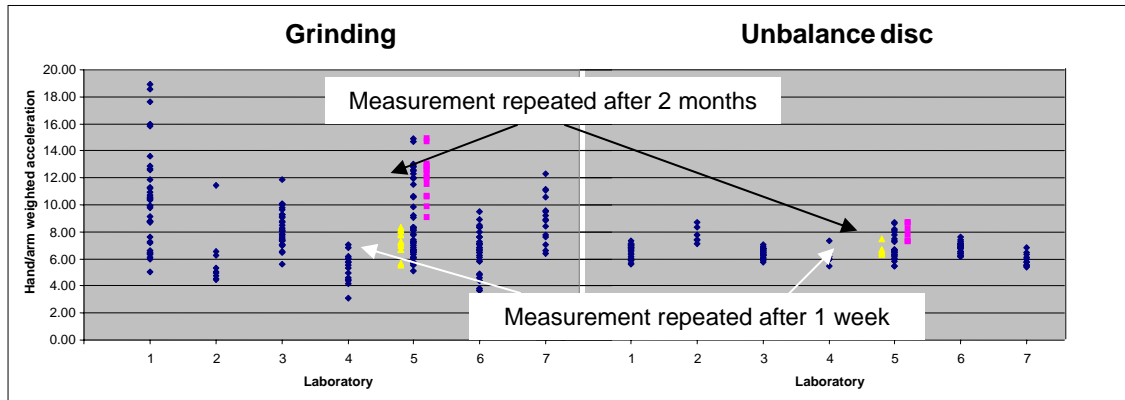


Figure 1. Example of result from grinding test and unbalance disc test. The grinding test shows a larger spread between test runs, operators, and laboratories and over time.

The unbalance disc test gives vibration values corresponding to the upper quartile of the real grinding test for grinders without autobalancing units. This is one requirement in the revised vibration measurement standard. Grinders with autobalancing unit gives lower values for the unbalance disc test, therefore they require additional grinding tests to fulfill this requirement.

Discussion

Unbalance disc test is proven to be the most accurate method for measuring vibrations from grinders, with one exception; grinders with autobalancing units. The result from this study also shows that it is extremely time consuming to get reliable field vibration measurements on grinders. The result is varying depending on many factors that are difficult to control; feed force, grinding wheel quality, work piece etc. The unbalance disc test gives values with good repeatability and reproducibility which well correspond to the upper quartile of the vast amount of grinding measurements made in this study. Thus, it is recommended to use the declared value according to ISO 8662-4 when assessing the vibration emission from grinders instead of doing field measurements. When using emission values from manufacturers, it is important to verify that the value is measured according to appropriate ISO-standard.

References

1. ISO 8662-4 1994(F). *“Hand-held portable power tools – Measurements of vibrations at the handle – Part 4: Grinders.* ISO.
2. ISO 20643 2005(E). *“Mechanical vibration – Hand-held and hand-guided machinery – Principles for evaluation of vibration emission”.* ISO.
3. Smeatham D (2003). *Supporting research for the ad hoc working group for ISO 8662-4, Grinders.* NV/03/01, HSL, UK