TNO innovation for life

Ghibli & Wirbel – Tool PRO WDA 40 M AS

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1 Introduction

In recent years, TNO has focused intensively upon innovative improvements to tools, processes and workplace design in the industrial environment. The main purpose of these efforts is to create low-dust production processes and tools. As well as construction, our product and process development activities have targeted the construction, metal, aircraft and wood industries, working closely with industry organizations, trades unions, governments, employers, employees and manufacturers.

To describe innovative production processes and tools, and to assess their practical functionality, we have developed the TNO Performance Test. This checks that relevant statutory and in-house occupational exposure limits (OELs) for hazardous substances such as crystalline silica, hardwood dust and hexavalent chromium are not exceeded in areas where they may be inhaled by workers in the course of their everyday duties.

The Dutch labour inspectorate, explicitly endorses the TNO Performance Test in its “Basic Inspection Module for Crystalline Silica” (Basisinspectiemodule Kwartsstof). That document states, “If you decide to conduct your working activities using the measures contained in a TNO Performance Test, as described on the TNO website (stofvrijwerken.tno.nl or dustfreeworking.tno.nl), I [the inspector] will regard exposure as being adequately managed”.

This means that an employer using the test is able to communicate unambiguously with the inspectors and that no additional exposure measurements need to be agreed. Moreover, it provides both the employer and its personnel with an objective measuring tool for the accurate assessment of proposed investments. Innovative manufacturers and suppliers of production processes and tools can also highlight their quality by complying with the test criteria.

The dust-free working label has existed since 2014. Over the years, more than 650 tools have been tested. As of 2021, the label has been moved internally within TNO to the Healthy Living and Work department. The TNO dust-free test room has been moved to RPS in Zwolle. In this new setup TNO is responsible for quality assurance and the reporting of the test results. Since the new structure, the format of the performance test has also been slightly adjusted.

2 Assessment criteria

The TNO Performance Test assesses exposure to hazardous substances in the “employee inhalation zone” in the workplace. The applicable norms for each substance, both statutory and in-house, are those contained in the database of Occupational Exposure Limits or OEL (Grenswaarde Stoffen op de Werkplek, GSW) maintained by the Social and Economic Council of the Netherlands (see https://www.ser.nl/en/themes/OEL-Database).

3 Project description

For this project, TNO studied emissions of respirable quartz dust when grinding lime sand bricks using an angle grinder equipped with a TNO/Dusttool extractor hood connected to the Ghibli & Wirbel Tool PRO WDA 40 M AS vacuum cleaner. The tests are performed in the worst-case room located at RPS Zwolle, which is a room of 15 m3 and a ventilation flow of 150 m3/h..

4 System specifications

The tested system consists of a Ghibli & Wirbel Tool PRO WDA 40 M AS vacuum cleaner connected with a 4 meter long extraction hose with a diameter of 33 mm to the standardized 125 mm angle grinder type WE-9-125 Quick, equipped with a TNO/Dusttool extraction hood.

TNO reference 125 mm angle grinder

Ghibli & Wirbel tool PRO WDA 40 M AS

Figure 1. The complete system.

Table 1 shows the technical data of the vacuum cleaner system

Specification	Ghibli & Wirbel Tool PRO WDA 40 M AS
Power supply [V]	220-240 V (50/60Hz)
Motor effect (W)	1100
Filter efficiency (%)	99,9 (M)
Filter surface (M^2)	0,5
Maximum suction capacity (m^3/h)	273
Negative pressure (maximum – mbar)	250
Tank capacity (l)	41 liter (container), 20 liter (useful dust bag capacity)
Dust filter type	Fleece filter (20 liter)
Weight [kg]	21

5 TNO Performance Test

Table 2 lists the key specific test conditions.

Worst-case room specifications: 15 m^3 volume and 150 m^3/h ventilation flow	Operator exposure period: eight-hour working day.
Material: Limestone (450x300x10 mm)	Suction capacity (with dust extractor and hose); 50 m^3/h (initial measurement) to 42 m^3/h (final measurement)
Percentage of quartz in respirable dust: Limestone: 25%	Filter efficiency: 99,9% (M)
Process: 60 minutes of grinding Groove width (2 mm) and Groove depth (21-26 mm)	Dust extractor cleaning: NONSTOPVAC! (automated filter cleaning – extra manual filter cleaning is possible)
	Dust collection: fleece filter (20l)
	Suction hose length: 4 m Suction hose diameter: 33 mm

6 Test results

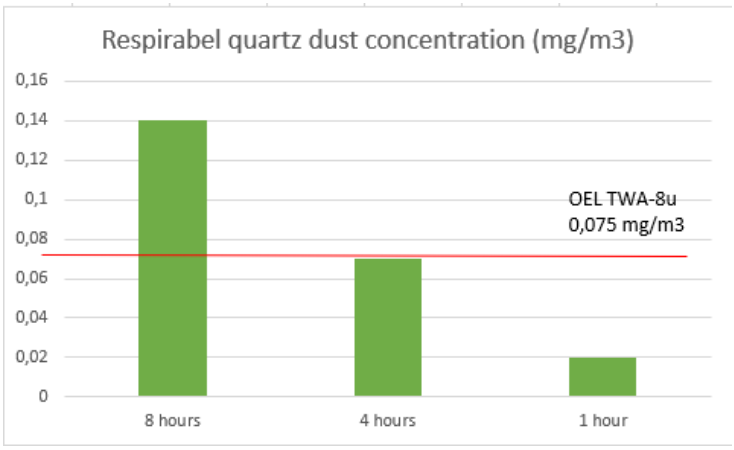
A total of three test cycles were carried out in accordance with the measurement protocol (Meetprotocol 'Testkamer voor label Stofvrijwerken' - TNO2021 R11849) because the vacuum cleaner was not set correctly in the first two cycles, only the results of the last test cycle were used to derive the label. The test results are summarized in Table 3 and Figure 3.

Table 3. Summary of measured data.

Situation	Respirable quartz dust concentration (mg/m3)
OEL, eight-hour time-weighted average (TWA)	0.075
8-hour use	0.14
4 hour use	0.07
1 hour use	0.02
Outdoor use	-
Practical use	-
Quartz percentage in material	25%

Label for sawing in lime stone bricks (25% quartz) in the TNO worst-case room (15 m^3)

Figure 3. Exposure to respirable quartz dust at OEL.



7 Conclusion

TNO measured exposure to respirable quartz dust in the “employee inhalation zone” when grinding lime stone blocks using the Ghibli & Wirbel Tool PRO WDA 40 M AS vacuum cleaner connected to an angle grinder equipped with a TNO/Dusttool extractor hood
In permanent operation (an entire eight-hour working day), average exposure was 0.14 mg/m^3. This is above the statutory occupational exposure limit (OEL) of 0.075 mg/m^3 (eight-hour time-weighted average or TWA), meaning that the system tested does not comply with the applicable standard for exposure to respirable quartz during full workday operations.

As well as “permanent operation” TNO has also defined two more reference situations.
- Heavy use: four hours of operation per eight-hour working day.
- Light use: one hour of operation per eight-hour working day.

For both situations the tested system does comply with the norm. The system is tested in the TNO worst-case room with a volume of 15 m3. This machine is normally not used in such a small room due to the size of the machine.

It should be noted that the results are obtained for a specific source. The source is the dust production which is based on the number, length, thickness and height of the kerfs. If the source is altered (materials with other dimensions) also the dust production will change.

The inaccuracy of the exposure measurements is about 15% (5% for the analysis, 5% sampling and 5% reproducibility of the test operator). Readers are referred to the TNO measurement protocol (see TNO website www.dustfreeworking.tno.nl).

The label present the system’s performance in graphic form. The round label shows the total “responsible operating time” in hours per eight-hour working day.

8 Signature

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