Summary

Performance test

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The TNO quality system is ISO 9001 certified.

Rupes S145 EM dust extractor in combination with 125 mm angle grinder and TNO/DUSTTOOL dust shroud

Commissioned by
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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 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.

Inspectie SZW, 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), 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.

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 (Grenswaarde Stoffen op de Werkplek, GSW) maintained by the Social and Economic Council of the Netherlands.
(see http://www.ser.nl/nl/taken/adviserende/grenswaarden.aspx).

Project description

For this project, TNO studied emissions of respirable crystalline silica (RCS), or respirable quartz, when grinding calcium silicate using an angle grinder fitted with a TNO/Dusttool dust shroud and connected to a Rupes S145 EM dust extractor.

System specifications

The tested system consisted of a Rupes S145 EM dust extractor (or equivalent*) in combination with the TNO reference angle grinder, a Metabo WE 9-125 Quick 125 mm, fitted with a TNO/Dusttool dust shroud. The dust shroud fits most common brands of angle grinder (Makita, Pullman-Ermator, Bosch, DeWalt, KGS, Hitachi, Flex, Fein). A flexible hose (length 3.0 m, diameter 29 mm) connects the shroud to the extractor. Figure 1 shows the complete system.

* An "equivalent" dust extractor is one with specifications for capacity, dust collection, filter cleaning and recirculation which are the same as or better than those of the model tested.

Rupes S145 EM dust extractor.

TNO reference 125 mm angle grinder.

Figure 1. The complete system.

Table 1 lists the key technical specifications of the system tested and its equivalents.

Table 1. Technical specifications of Rupes dust extractor.

Specification	S145 EM
Motor effect (W)	1200
Power supply (V)	230 (50/60 Hz AC)
Filter efficiency (%)	99.5 (M)
Maximum suction capacity[1] (m^3/h)	200
Vacuum[2] (kPa)	20
Tank capacity (l)	45
Weight (kg)	13.5

[1] At ventilator.

[2] At end of hose.

TNO Performance Test

Table 3 lists the key specific test conditions.

Table 3. "Worst case" test conditions.

Material: calcium silicate CVK L100/198 RCS (respirable quartz) content of material: 25% Process: 60 m per 60 minutes of grinding (480 m per eight-hour working day) Productivity: permanent operation. Operator exposure period: eight-hour working day. Groove breadth: 2 mm. Groove depth: 21-26 mm. Direction of dust generation: directly into extractor system. Maximum machining speed: 69 m/s.	Extractor system compartmentalization: "semi complete". Suction capacity (dust extractor with hose): 138 m³/h (initial measurement) to 38 m³/h (final measurement). Filter efficiency: 99.5% (M) Dust extractor cleaning: automatically. Dust collection: container. Dust filters: "open" Suction hose length: 3 m. Suction hose diameter: 29 mm.

Test results

Table 4 and Figure 2 summarize the test results.

Table 4. Summary of measured data (calcium silicate).

Situation	RCS concentration (mg/m³)
OEL, eight-hour time-weighted average	0.075
Permanent operation	0.40
"Heavy" use	0.20
"Light" use	0.05
Outdoor use	-
Practical use	-

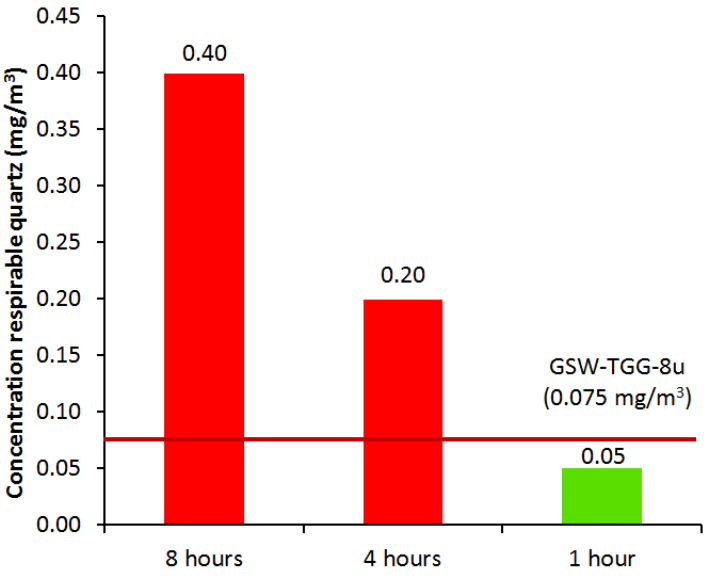


Figure 2. Exposure to RCS (respirable quartz) at OEL.

Conclusion

TNO measured exposure to respirable crystalline silica (RCS) in the “employee inhalation zone” when grinding calcium silicate using a 125 mm angle grinder fitted with a TNO/Dusttool dust shroud and connected to a Rupes S145 EM dust extractor.

In permanent operation (an entire eight-hour working day), average exposure was 0.40 mg/m³. This is above the statutory occupational exposure limit (OEL) of 0.075 mg/m³ (eight-hour time-weighted average), meaning that the system tested does not comply with the applicable standard for exposure to RCS in this situation.

As well as “permanent operation” TNO has also defined two more realistic reference situations.

- Heavy use: four hours of operation per eight-hour working day.
- Light use: one hour of operation per eight-hour working day.

The light use situation the system complies with the norm.

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).

TNO assumes that the mass fraction of RCS in calcium silicate is 25 per cent. For concrete and brick, that figure is 15 per cent. This means that the tested system can be used to work on those materials for longer than with calcium silicate. When grinding concrete or brick, exposure remains within the statutory OEL in all the situations described above.

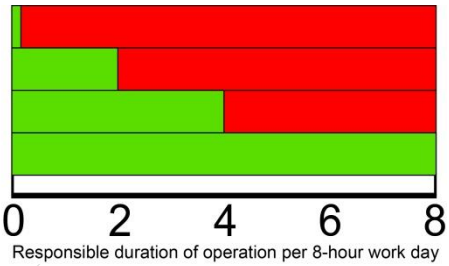
The labels below present the system’s performance in graphic form. The round label shows the total “responsible operating time” in hours per eight-hour working day. The rectangular label provides more detailed information for the situations tested, with the green bars indicating what proportion of each type of use during an eight-hour working day remains within the OEL.

Label for calcium silicate grinding

Reference: permanent operation.

No measures
100% duration of operation (8 hrs grinding/8 hrs)
Heavy use (4 hrs grinding/8 hrs*)
Light use (1 hrs grinding/8 hrs*)

* given proportional operation during an 8 hour work day

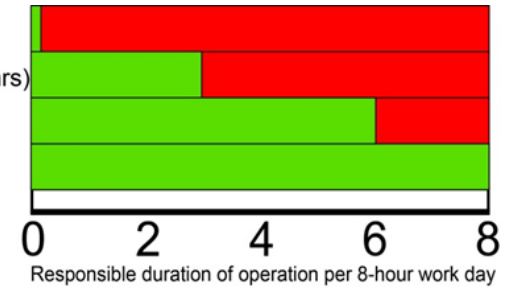


Label for concrete grinding

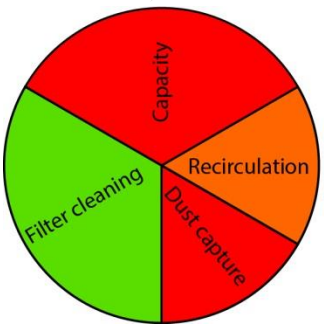
Reference: permanent operation.

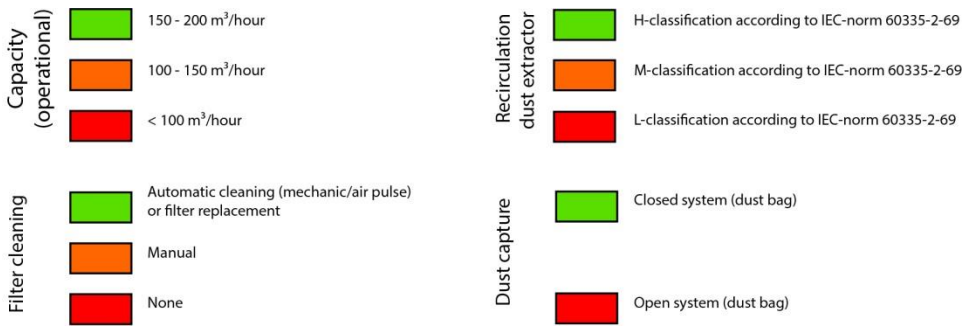
No measures
100% duration of operation (8 hrs grinding/8hrs)
Heavy use (4 hrs grinding/8hrs*)
Light use (1 hrs grinding/8hrs*)

* given proportional operation during an 8-hour work day



Dust extractor with 3-metre suction hose (diameter 29 mm), without dust collection bag





NB. This test says nothing about the long-term use of dust extractors.

Initials: