Research summary
Performance test

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PULLMAN-ERMATOR S26 STOFZUIGER IN COMBINATIE MET 125 MM HAAKSE SLIJPER EN TNO/DUSTTOOL AFZUIGKAP

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In recent years TNO has focused closely on innovations in tools, processes and workplace designs in industrial work environments. The primary objective has been to realise production processes and means of production that create minimal dust levels. In addition to the building industry, the metal industry, the aircraft industry and the wood industry are all focal points for product/process development. This work involves collaboration with employers' organisations, trade unions, government, employers, employees and manufacturers/producers. As an instrument for assessing a process or tool's functionality during professional use, TNO has developed the TNO Performance Test. This describes innovative production processes and means of production. When these processes/tools are being used, the relevant public/private Occupational Exposure Limits for harmful substances (such as quartz dust, wood dust (hardwood), hexavalent chromium) in the employees' breathing zone, in normal daily use, are not exceeded.

The Inspectorate SZW has included the TNO Performance Test explicitly in one of its internal instructions. Translated quote: "If you decide to carry out the work while applying the measures as they are stated in a TNO Performance Test as stated on TNO's website (stofvrijwerken.tno.nl) then I regard the exposure as being adequately controlled."

For employers, this means that they can communicate unequivocally with the inspectors of The Inspectorate SZW and no additional exposure measurements need be submitted. Both employers and employees gain an objective assessment instrument that can assist them in reaching the right conclusion when next they make an investment decision. For innovative producers/suppliers of production processes and means of production (tools), this provides an opportunity to distinguish themselves from their competitors on the basis of quality.

Test criteria

The exposure to harmful substances in the employee's breathing zone in the workplace is tested. The following standard is applied:
- exposure to the relevant substance: public/private Occupational Exposure Limit (OEL) (see the SER website: http://www.ser.nl/nl/taken/adviserende/grenswaarden.aspx and in English http://www.ser.nl/en/oel_database/about_oels.aspx

Project description for TNO Performance Test

TNO has carried out research into the emission of respirable quartz during grinding in calcium silicase using a right-angle grinder equipped with a TNO/Dusttool dust shroud, connected to a Pullman-Ermator S13 dust extractor.

Specifications of Pullman-Ermator tool system

The tested system consists of a Pullman-Ermator S26 dust extractor (or equivalent*) used in combination with a TNO/Dusttool dust shroud, suitable for the most common right-angle grinders (Makita, Metabo, Bosch, DeWalt, KGS, Hitachi, Flex, Fein). The dust shroud is connected to the dust extractor by a flexible hose (5 metre, diameter 50 mm). The complete system is shown in Figure 1.

* Dust extractors are considered equivalent when their specifications are similar or superior to those of the type tested. The capacity, dust capture, filter cleaning and recirculation are the relevant criteria.

Pullman-Ermator S26 dust extractor with 5 metres, Ø 50 mm suction hose

Metabo 125 mm right-angle grinder with TNO/Dusttool dust shroud

Figure 1. The complete tool system and dust extraction system

Table 1 shows the specifications of the Pullman-Ermator S13 dust extractor (or equivalent).

Table 1. Technical specifications Pullman-Ermator S13 dust extractor or equivalent

Specifications	S26	S36
Power consumption [W]	2.400	3.600
Voltage [V]	230 (AC 50/60 Hz)	230 (AC 50/60 Hz)
Maximum volume flow [m³/hr]	400	600
Filter efficiency [%]	99,995 (H14)	99,995 (H14)
Under pressure [kPa]	22	22
Weight [kg]	47	63

Specifications	T4000	T6000	T7500
Power consumption [W]	3.000	5.000	5.500
Voltage [V]	400 (AC 50/60 Hz)	400 (AC 50/60 Hz)	400 (AC 50/60 Hz)
Maximum volume flow [m³/hr]	420	600	600
Filter efficiency [%]	99,995 (H14)	99,995 (H14)	99,995 (H14)
Under pressure [kPa]	26	28	28
Weight [kg]	95	180	210

Specifications	T8600	T11000
Power consumption [W]	8.500	11.000
Voltage [V]	400 (AC 50/60 Hz)	400 (AC 50/60 Hz)
Maximum volume flow [m³/hr]	650	1.100
Filter efficiency [%]	99,995 (H14)	99,995 (H14)
Under pressure [kPa]	30	33
Weight [kg]	210	390

TNO Performance Test

The most important test conditions are shown in Table 2.

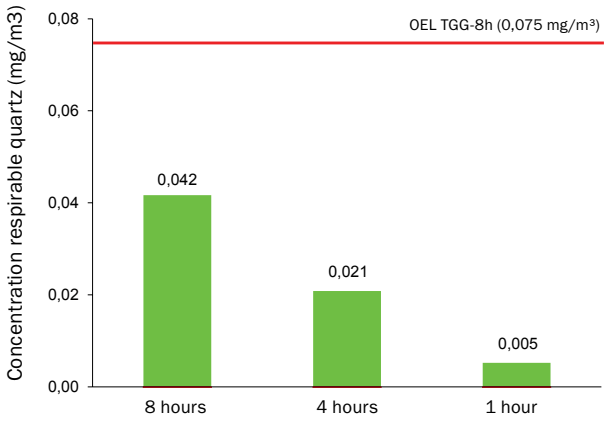
Table 2. Test conditions "Worst Case"

Type of material: calcium silicate blocks CVK L100/198 Percentage respirable quartz in calcium silicate: 25% Source strenght: 30 metres per 30 minutes grinding (480 metre per 8-hour work day) Production: 100% duration of operation Employee exposure time: 8-hour work day Groove width: 2 mm Groove depth: 21 - 26 mm Direction of dust dissimination: perpendicular to suction Speed of machining: 69 m/s	Compartiment of suction suction system: "semi complete" Suction capacity of dust extractor with hose: 275 m³/hr (start measurement) to 245 m³/hr (end measurement Filter efficiency: 99.995% (H14) Cleaning system dust extractor: manual Dust capture in enclosed, plastic dust bag Dust filters "open" Length of suction hose: 5 m Diameter suction hose: 50 mm

Test results for exposure respirable quartz relative to the OEL

Testresultaten

Situation	Concentration respirable quartz dust in mg/m³
Occupational Exposure Limit (OEL) TGG-8h	0,075
100% duration of operation	0,042
"Heavy use"	0,021
"Light use"	0,005
Outdoors	-
Professional use	-



Test results for exposure respirable quartz relative to the OEL

Conclusion

TNO has measured the following: the exposure to respirable quartz in the breathing zone when using the Pullman-Ermator S26 dust extractor while grinding calcium silicate with a right-angle grinder equipped with a TNO/Dusttool dust shroud.

For a duration of operation of 100% (8 hours of use per 8-hour work day) the exposure to respirable quartz in the employee's breathing zone averages 0.053 mg/m3. This value is lower than the statutory threshold limit value of 0.075 mg/m3 (OEL TGG-8h) and, in view of this, when used in this situation, the tool system complies with the prevailing standard for exposure to respirable quartz.

In addition to "100% duration of operation", TNO defines the following references with regard to professional use:

- heavy use: 4 hours grinding per 8-hour work day
- light use: 1 hour grinding per 8-hour work day

Similarly, in these situations the total system complies with the standard.

TNO applies a mass fraction of 25% for respirable quartz in calcium silicate. For concrete and brick 15% is applied. This means that the period during which the tested tool system may be used to grind in concrete and brick is longer than for calcium silicate. Similarly for grinding in concrete or brick, in all the above-mentioned situations the exposure remains under the statutory threshold limit value.

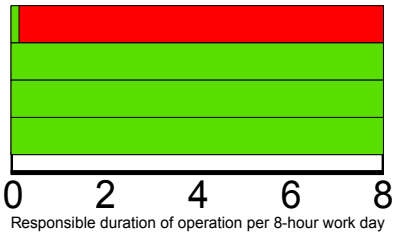
The tables below show how the total system performed in various tests. The round label shows the responsible duration of operation in hours per 8-hour work day. The rectangular label specifies the various professional situations in more detail. Green indicates a use that does not exceed the relevant threshold limit value throughout an 8-hour work day.

Label for grinding in calcium silicate

Reference: 100% duration of operation (8 hours grinding /day)

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 grinding in concrete/brick

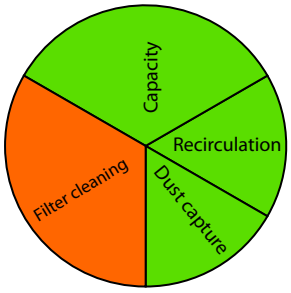
Reference: 100% duration of operation (8 hours grinding/day)

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 dust extractor combined with right-angle grinder with TNO/Dusttool dust shroud

5 metre suction hose (Ø 50 mm) with closed, plastic dust bag



Capacity (operational)
- 150 - 200 m³/hour
- 100 - 150 m³/hour
- < 100 m³/hour

Recirculation air dust extractor
- H-classification according to IEC-norm 60335-2-69
- M-classification according to IEC-norm 60335-2-69
- L-classification according to IEC-norm 60335-2-69

Filter cleaning
- Automatic cleaning (mechanic/air pulse) or filter replacement
- Manual
- None

Dust capture
- Closed system (dust bag)
- Open system (dust container)

N.B. This test involves no decision regarding the prolonged use of dust extractors.