

BULLET TOOLS

# Respirable Silica Measurement

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For Bullet Tools Siding Shears

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**September 1 2017**

Abstract: A measurement of respirable dust exposure, particularly respirable silica dust exposure, of an operator of a Bullet Tools siding shear when severing cementitious plank materials was performed. Additional samples were taken to measure bystander exposure. The measured exposure, in both cases, was three orders of magnitude below OSHA permissible exposure limits without dust controls or supplemental personal protection equipment.

## Introduction

Respirable silica is a known health hazard. Because of this, the United States Occupational Safety and Health Administration has set exposure limits and operational guidelines for common construction operations which produce airborne silica dust. In particular, OSHA requires dust mitigation and personal respiration filtration equipment to be used when sawing or cutting cementitious material due to the large quantities of airborne silica dust known to be produced by said cutting operations. To improve jobsite safety and improve construction worker quality of life, Bullet Tools has developed siding shears which cut cementitious plank materials which produce significantly less airborne silica dust than conventional methods. Prior to this experiment, the amount of respirable dust produced when using Bullet Tools siding shears, and the silica dust fraction of said dust, were unknown and subject to speculation. This experiment shows with some certainty that negligible quantities of airborne silica dust are produced during an 8 hour work day when using Bullet Tools siding shears to cut cementitious plank material.

## Experimental Apparatus & Procedure

Samples were collected in pre-weighed 5 micron PVC filter cartridges with a continuous 2.5l/min airflow drawn from the sampling location through the PVC filter cartridge. A cyclone separator was used to remove non-respirable debris from each airstream. The airflow was drawn using personal sampling pumps, and flowrate was adjusted to 2.5l/min as measured by a calibrated manometer. Calibration of equipment was performed by EMSL Analytical per relevant NIST standards. The aforementioned equipment was used in accordance with NIOSH procedure [2]. Measurement of collected silica in the filter cartridges was also measured by EMSL Analytical in compliance with OSHA standards [1].

Presumptive respirable dust was generated using a Magnum Siding Shear model# 620 when cutting James Hardie® brand fiber cement siding samples, measuring 8-1/4" wide and 5/16" thick. The samples were cut crosswise to slices 8-1/4" by 1.5" by 5/16". Dimensional measurement of the samples was performed with a Stanley® brand tape measure by a trained operator.

The procedure for dust collection was repeated cutting by an operator equipped with a filter cartridge and vacuum pump, as described above, affixed to his lapel. A second filter cartridge and vacuum pump were placed 36" from the blade of the Magnum Siding Shear in the path of debris ejection. The test was conducted over a period of 8 hours.

The following model construction site was used to derive the number of cuts to make and to determine an appropriate testing environment. The model was derived from common sense (most fiber-cement lap siding is installed on homes, and most homes have four walls etc.) and general assumptions regarding likely worst-case scenarios (i.e. one worker is subject to all direct silica exposure)

The assumed model siding installation construction site has the following attributes:

1. Cutting of cementitious plank siding material is the only construction activity which creates respirable silica dust

2. One individual makes all (or the gross majority) of the cuts on cementitious plank siding material and is subject to the most severe exposure to respirable silica
3. Personnel and bystanders not assigned the task of cutting remain more than 36" away from the blade of the cutting device utilized on the jobsite and the ambient respirable silica dust remains at or below the level measured at a distance of 36" from the blade in the path of debris ejection
4. Negligible airflow carries airborne silica away from the construction site
5. The surface to be clad with siding comprises four walls 2-stories tall (26 ft) and each wall with 4 windows and 1 door, each requiring cementitious plank siding material to be cut along their vertical sides. Each window is 42" tall each door is 84" tall. Each wall has two ends which require cementitious plank siding material to be cut
6. Cementitious plank siding material is installed horizontally with a 6" reveal
7. All cuts on cementitious plank siding material required for the job are performed in a single 8 hour workday

From our model we calculated the number of cuts according to EQ.1, where division is rounded down to the nearest integer:

#### EQ. 1

$$\begin{aligned}
 N = & \left[ \frac{\text{height of walls}}{\text{reveal}} + 1 \right] \times (\text{number of walls}) \times 2 \\
 & + \left[ \frac{\text{height of windows}}{\text{reveal}} + 1 \right] \times (\text{number of windows}) \times 2 \\
 & + \left[ \frac{\text{height of doors}}{\text{reveal}} + 1 \right] \times (\text{number of doors}) \times 2
 \end{aligned}$$

EQ.1 yields N=800 cuts when the assumptions from our model construction site are substituted for the appropriate variables. We therefore planned 800 cutting operations during the testing period

The cutting environment was indoors to prevent wind from carrying away respirable silica dust. The room measured 30ft x 36ft with a 14ft ceiling. The Magnum Siding Shear was operated on a shear stand and was placed over a 5 gallon bucket to catch scrap materials. A 55 gallon waste bin was placed in close proximity for disposal of fiber cement scraps.

Test started at 8:00AM. The operator wore cartridge serial# 441951, sampling from 8:01 to 16:33, and the stationary testing apparatus used cartridge serial# 441930 sampling from 8:02 to 16:34. 800 cuts were performed intermittently during the sampling period.

#### Experimental Results & Discussion

During testing the operator noticed an accumulation of fiber cement particles collecting behind the Magnum Siding Shear. The accumulated debris were not easily disturbed and did not become airborne during operation of the tool. There was no visually apparent airborne dust produced while cutting, but

during the process of dumping fiber cement scraps from the 5 gallon catch bucket into the 55 gallon waste bin some airborne dust was visible.

After the conclusion of the testing period, the PVC sampling cartridges were sealed and sent to EMSL laboratory for analysis.

Analysis of the collected samples measured the following:

**Table 1**

SAMPLE ID	Date Collected	Description	Volume (m <sup>3</sup> )	Total Respirable dust, incl. non silica (mg/m <sup>3</sup> )	Silica Type	% Silica Type	Silica Wt (mg)	Analytical Sensitivity (mg/m <sup>3</sup> )
441930	8/16/17	3Ft from blade	1290	.052	Alpha Quartz	N/A	<0.005	0.004
					Cristobalite	N/A	<0.010	0.008
					Tridymite	N/A	<0.010	0.008
441951	8/16/17	Lapel	1285	<.039	Alpha Quartz	N/A	<0.005	0.004
					Cristobalite	N/A	<0.010	0.008
					Tridymite	N/A	<0.010	0.008

The total respirable silica collected in both cartridges was at or less than the resolution of EMSL laboratories standard analytical equipment and for all intents and purposes was negligible.

#### Conclusions

The OSHA respirable silica dust permissible exposure limit for construction workers is 50 micrograms per cubic meter [1] when calculated as an 8 hour time weighted average. The total silica exposure to an operator of a Magnum Siding Shear was measured to be less than 25 micrograms total-mass, and less than 0.020 micrograms per cubic meter over an 8 hour time weighted average. This is considerably less than the PEL for respirable silica.

#### Recommendations

For a worker who is installing fiber cement is using only Magnum Siding Shears and other equipment which produces equivalent quantities of airborne silica dust during operation then there is no significant benefit to the use of respirators and dust containment equipment such as vacuum and misting systems. In addition, the level of respirable silica exposure during an 8-hour workday when in such a work environment with the equipment described, whether as a cutting operator with direct exposure or as a non-cutting operator with indirect exposure, are well below OSHA permissible exposure limit without the use of personal protection equipment for the purpose of preventing respirable silica exposure.

Therefore, it is recommended that when workers object to the use of (or improperly utilize) OSHA required respirators and dust control equipment when installing fiber cement, to re-equip the crew with Magnum Siding Shears and other equipment which produces negligible quantities of airborne silica dust.

#### References

- [1] *OSHA Standard §1926.1153 Respirable crystalline silica & appendices*
- [2] *NIOSH Manual of Analytical Methods 7602 SILICA, Respirable Crystalline*