** Attorney-Client Privilege/Work Product **

Dust Emission Study

Sizing of National Gypsum
5/8" Fire-Shield Type X Drywall

Project No. TLH412340

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RJ LEE GROUP
DELIVERING SCIENTIFIC RESOLUTION

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1.0 Introduction

RJ Lee Group, Inc. (RJLG) was contracted by the Gypsum Association (GA) to study airborne dust emissions during the cutting of 5/8" Type X drywall within a test chamber. The objectives of the study were to characterize emissions and collect data on personal breathing zone and area airborne exposure levels.

The work was performed in a test chamber to evaluate the dust emissions from sizing of the drywall material in a consistent manner in a controlled environment. Use of the chamber is necessary to remove the potential interferences from other sources of dust and other issues such as the variable ventilation conditions that would otherwise be factors on a job site.

On December 29, 2014, RJLG received a pallet containing 40 - 5/8" thick by 4' by 4' Fire-Shield Type X wallboard (Gold Bond® Brand GridMarx®) for the purposes of testing. The material was directly shipped from the National Gypsum facility located in Burlington, NJ and had a production date of December 13, 2014.

The three methods of cutting that were performed included: (1) score, snap and rasp; (2) cutting with a drywall hand saw; and (3) cutting with a powered rotary saw. During each simulation round, two air samples were collected in the breathing zone of the worker, and in two separate area locations in the chamber to test for airborne levels of particulates and respirable crystalline silica.

The results from this study may be used to help develop product stewardship policies and practices, which may include recommendations for controlling potential exposures.

2.0 Methods

The test chamber was located at RJ Lee Group (RJLG) Headquarters in Monroeville, PA. The chamber, constructed of 2"x 4" lumber and painted plywood wall/ceiling panels with a concrete floor, was approximately 2,000 ft^3 in volume. The chamber was accessed by an interior-type wooden door and had sealed windows for external viewing and photo-documentation/video-documentation purposes.

A high-efficiency particulate arresting (HEPA) air filtration device (AFD) was operated continuously at a low flow rate during cutting simulations to provide a slight negative pressure to the surrounding area. The effective flow rate was set to result in three air changes per hour within the chamber. A supplemental AFD that provided air changes at a rate of approximately twenty-four (24) per hour was also present and utilized as needed to ventilate the room between tests. A diagram of the test chamber configuration is provided in Figure 1.

Two oscillating fans were operated at the slow speed setting within the chamber during each study to facilitate mixing of the room air.

Two rounds each of the three cutting techniques were simulated and tested using 4' x 4' x 5/8" thick National Gypsum Type X wallboard product for a total of six (6) simulation rounds. The three cutting techniques which are described below included: score, snap and rasp; hand saw; and rotary saw cutting.

During each simulation round, two personal air samples were collected from the breathing zone of the worker (Figure 2), and two area air samples were collected from each of two locations within the chamber (Figure 3). All samples were sent to the laboratory for analysis. Total and respirable dust samples were collected and analyzed per NIOSH Methods 0500 and 0600, respectively. SKC aluminum cyclones were the size selective samplers used to collect the respirable particulates. The respirable dust samples were also analyzed for silica content per NIOSH Method 7500.

As a quality control measure, field blanks were also submitted to the laboratory for analysis. All samples and field blanks were processed and analyzed by RJLG, an American Industrial Hygiene Association (AIHA) Accredited Laboratory located in Monroeville, PA.

A Personal Data Ram Model 1200 (PDR1200) real-time dust monitor (Thermo Electron Corporation) was used to monitor and log respirable particulate levels in the test chamber. The PDR1200, located inside the test chamber (see Figure 4), was hard-wired to a remote computer on the outside of the test chamber for viewing and downloading recorded data. The PDR1200 was used to evaluate "background" levels prior to beginning a new simulation round, monitor levels during each simulation round, and determine when the chamber was acceptable (criteria level of < 0.050 mg/m^3 resp. dust) to enter after each simulation round.

Score, Snap and Rasp Procedure

For cutting purposes, a 4' x 4' board section was situated horizontally at approximately 30" above the floor and supported by two sawhorses in the approximate middle of the test chamber. The worker was positioned on one side of the board during the simulation, with the working edge positioned off of the end of the support surface. The board was scored four to six inches from the leading edge using a utility knife (Husky Stainless Steel Turboslide™ Utility Knife, product no. SKU 525-812), and while using a 48" drywall T-square (Wal-board Tools, product no. 88-012) as a guide.

The board, while still lying on the sawhorse supports, was then snapped using downward hand force (Figure 5). After snapping the cut section, the utility knife was used to cut the backing paper to release the cut portion of material. The cut sections were placed then on the floor against the wall of the chamber. Finally, a shaping file with rasp edge (Stanley SurForm File, product no. 21-295 and Stanley SurForm Replacement Blade, product no. 21-293) was used to rasp entire surface of the cut edge of the main board section (Figure 6). This process was repeated approximately every three minutes for a total of forty (40) cuts using multiple 4' x 4' board sections.

Razor blades were replaced between each testing event. It should be noted that it is unlikely that a skilled worker in the field would use a rasping file to shape/smooth the entire length of the cut surface when installing drywall in practice. The full length of the cut was rasped each time; whereas, a skilled worker would likely only rasp the uneven portions of the cut edge. As a result, lower dust emissions may be experienced during cutting of the board on an actual job site as compared to those observed in this study.

Hand Saw Cutting Procedure

A 4' x 4' drywall board section was placed on two sawhorses in the middle of the test chamber. The worker was positioned on one side of the board during the cutting tests with the working edge positioned off of the end of the support surface.

A straight 4' line was drawn using a straight edge and edible marker approximately six inches from the edge intended to be cut. A drywall handsaw (Wal-Board Tools, 15" Drywall Saw, product no. 06-001) was then used to manually cut along the line using a repeating sawing action to size the board. Figures 7 and 8 illustrate cutting of the board with the hand saw. This process was repeated every ten minutes until a total of 12 cuts were accomplished using multiple boards. The cut sections were placed on the floor against the wall of the chamber.

Rotary Saw Cutting Procedure

A 4' x 4' board section was placed horizontally on two sawhorses that were set to a height of approximately 30" in the middle of the test chamber. The worker was positioned on one side of the board during the simulation with the working edge positioned in between the ends of the support surfaces. Prior to beginning the simulation, a standard outlet double gang box and an indelible marker were used to outline eight sections to be cut each measuring approximately 4" x 4".

The 4"x 4" section was removed using a rotary saw (Roto-zip Spiracut SCS Spiral Saw, model no. SCS01, Type 1 - 40 amps, 115/120 volt AC, no load rpm 30,000) which was equipped with a new drywall bit (Rotozip Xbit Drywall 5/32", product no. XB-DW2). Figures 9 and 10 illustrate cutting of the board with the rotary saw. The 4" x 4" cut section was allowed to fall to the floor. This process was repeated approximately every fifteen (15) minutes for a total of eight cuts using the same 4' x 4' board section.

Safety Considerations

The chamber was placed under a slight negative pressure using an AFD to minimize any potential dust migration from the room during a simulation round. During cutting activities, the chamber door was closed and access was restricted only to the worker whom had donned personal protective equipment (PPE) including: a full-face powered air purifying respirator (PAPR) which was equipped with a P100 filter; safety footwear; and polypropylene coveralls.

The PPE was used in an abundance of caution as the levels of airborne particulate that would be generated in an enclosed chamber were unknown prior to performing the study. The PAPR was utilized for the comfort of the worker because it provides cooling and eye protection in addition to filtering the air for breathing. The polypropylene suits were used to minimize dustiness on the worker’s clothing and skin.

Chamber Clean-out

After each simulation round, the Thermo Electron PDR1200 instrument was used to determine if the chamber was acceptable to enter without the use of respiratory protection. Between each simulation round, all large debris were removed by hand from the floor, working surfaces, etc. Horizontal surfaces in the test chamber were cleaned using a standard shop vacuum while operating the supplemental AFD at a high flow rate to ‘scrub’ the air of airborne particulate. The test chamber was ‘cleared’ for use for a new simulation round when surfaces were free of loose dust as determined by visual inspection, and when airborne respirable particles were acceptable based on the real-time PDR1200 display (criteria level of < 0.05 mg/m^3 resp. dust).

3.0 Results

The air sample results are presented in Tables 1 through 6. Tables 1 through 3 present the results from the analysis of integrated air samples for total dust (gravimetric – NIOSH 0500 method) with each table representing a different cutting method. Tables 4 through 6 present the results from the analysis of integrated air samples for respirable dust (gravimetric – NIOSH 0600 method) and respirable crystalline silica (x-ray diffraction – NIOSH 7500 method).

The following abbreviations were used in the air sample results tables:

Key for cutting methods performed

SSR = Score, Snap & Rasp

HS = Hand Saw

RS = Rotary Saw

Table 1. Summary of Score Snap and Rasp (SSR) Total Dust Air Samples Analyzed by Gravimetry (NIOSH 0500).

Simulation Round	Location	RJLG Sample ID	Sample Time (minutes)	Air Volume (L)	Net Dust Mass (mg)	Dust Concentration (mg/m^3)
SSR Round 1	Personal	5301923	123	301.4	0.333	1.11
	Area 1	5301925	123	249.1	0.350	1.41
	Area 2	5301927	123	265.7	0.415	1.56
SSR Round 2	Personal	5301934	123	300.1	0.712	2.37
	Area 1	5301936	123	258.9	0.467	1.80
	Area 2	5301938	123	272.4	0.593	2.18

Table 2. Summary of Hand Saw (HS) Total Dust Air Samples Analyzed by Gravimetry (NIOSH 0500).

Simulation Round	Location	RJLG Sample ID	Sample Time (minutes)	Air Volume (L)	Net Dust Mass (mg)	Dust Concentration (mg/m^3)
HS Round 1	Personal	5301943	123	302.6	0.713	2.36
	Area 1	5301945	123	263.8	0.649	2.46
	Area 2	5301947	123	277.4	0.826	2.98
HS Round 2	Personal	5301952	123	305.0	0.727	2.38
	Area 1	5301954	123	270.6	0.577	2.13
	Area 2	5301956	123	287.2	0.715	2.49

Table 3. Summary of Rotary Saw (RS) Total Dust Air Samples Analyzed by Gravimetry (NIOSH 0500).

Simulation Round	Location	RJLG Sample ID	Sample Time (minutes)	Air Volume (L)	Net Dust Mass (mg)	Dust Concentration (mg/m^3)
RS Round 1	Personal	5301961	123	278.0	0.326	1.17
	Area 1	5301963	123	261.4	0.202	0.77
	Area 2	5301965	123	269.4	0.221	0.82
RS Round 2	Personal	5301970	123	277.4	0.396	1.43
	Area 1	5301972	123	262.6	0.365	1.39
	Area 2	5301974	123	276.1	0.558	2.02

Table 4. Summary of Score Snap and Rasp (SSR) Respirable Dust Analyzed by Gravimetry (NIOSH 0600) and Crystalline Free Silica Dust Analyzed by X-Ray Diffraction (NIOSH 7500).

Simulation Round	Location	RJLG Sample ID	Time (min.)	Air Volume (Liters)	Respirable Dust Mass (mg/filter)	Masses of Free Silica Minerals (mg/filter)			Weight % of Crystalline Silica Minerals			Airborne Dust Concentrations (mg/m^3)			
						Quartz	Cristobalite	Tridymite	Quartz	Cristobalite	Tridymite	Respirable	Quartz	Cristobalite	Tridymite
SSR Round 1	Personal	5301924	123	308.7	0.143	<0.005	<0.005	<0.005	< 3.5	< 3.5	< 3.5	0.463	< 0.016	< 0.016	< 0.016
	Area 1	5301926	123	308.1	0.109	<0.005	<0.005	<0.005	< 4.6	< 4.6	< 4.6	0.354	< 0.016	< 0.016	< 0.016
	Area 2	5301928	123	311.8	0.103	<0.005	<0.005	<0.005	< 4.9	< 4.9	< 4.9	0.330	< 0.016	< 0.016	< 0.016
SSR Round 2	Personal	5301935	123	313.0	0.186	<0.005	<0.005	<0.005	< 2.7	< 2.7	< 2.7	0.594	< 0.016	< 0.016	< 0.016
	Area 1	5301937	123	313.0	0.161	<0.005	<0.005	<0.005	< 3.1	< 3.1	< 3.1	0.514	< 0.016	< 0.016	< 0.016
	Area 2	5301939	123	316.7	0.144	<0.005	<0.005	<0.005	< 3.5	< 3.5	< 3.5	0.455	< 0.016	< 0.016	< 0.016

Table 5. Summary of Hand Saw (HS) Respirable Dust Analyzed by Gravimetry (NIOSH 0600) and Crystalline Free Silica Dust Analyzed by X-Ray Diffraction (NIOSH 7500).

Simulation Round	Location	RJLG Sample ID	Time (min.)	Air Volume (Liters)	Respirable Dust Mass (mg/filter)	Masses of Free Silica Minerals (mg/filter)			Weight % of Crystalline Silica Minerals			Airborne Dust Concentrations (mg/m^3)			
						Quartz	Cristobalite	Tridymite	Quartz	Cristobalite	Tridymite	Respirable	Quartz	Cristobalite	Tridymite
HS Round 1	Personal	5301944	123	311.8	0.197	<0.005	<0.005	<0.005	< 2.5	< 2.5	< 2.5	0.632	< 0.016	< 0.016	< 0.016
	Area 1	5301946	123	314.9	0.205	<0.005	<0.005	<0.005	< 2.4	< 2.4	< 2.4	0.651	< 0.016	< 0.016	< 0.016
	Area 2	5301948	123	313.0	0.242	<0.005	<0.005	<0.005	< 2.1	< 2.1	< 2.1	0.773	< 0.016	< 0.016	< 0.016
HS Round 2	Personal	5301953	123	310.0	0.171	<0.005	<0.005	<0.005	< 2.9	< 2.9	< 2.9	0.552	< 0.016	< 0.016	< 0.016
	Area 1	5301955	123	314.3	0.180	<0.005	<0.005	<0.005	< 2.8	< 2.8	< 2.8	0.573	< 0.016	< 0.016	< 0.016
	Area 2	5301957	123	308.1	0.187	<0.005	<0.005	<0.005	< 2.7	< 2.7	< 2.7	0.607	< 0.016	< 0.016	< 0.016

Table 6. Summary of Rotary Saw (RS) Respirable Dust Analyzed by Gravimetry (NIOSH 0600) and Crystalline Free Silica Dust Analyzed by X-Ray Diffraction (NIOSH 7500).

Simulation Round	Location	RJLG Sample ID	Time (min.)	Air Volume (Liters)	Respirable Dust Mass (mg/filter)	Masses of Free Silica Minerals (mg/filter)			Weight % of Crystalline Silica Minerals			Airborne Dust Concentrations (mg/m^3)			
						Quartz**	Cristobalite	Tridymite	Quartz	Cristobalite	Tridymite	Respirable	Quartz	Cristobalite	Tridymite
RS Round 1	Personal	5301962	123	306.9	0.090	< 0.005	< 0.005	< 0.005	< 5.6	< 5.6	< 5.6	0.293	< 0.016	< 0.016	< 0.016
	Area 1	5301964	123	308.1	0.123	< 0.005	< 0.005	< 0.005	< 4.1	< 4.1	< 4.1	0.399	< 0.016	< 0.016	< 0.016
	Area 2	5301966	123	311.8	0.079	< 0.005	< 0.005	< 0.005	< 6.3	< 6.3	< 6.3	0.253	< 0.016	< 0.016	< 0.016
RS Round 2	Personal	5301971	123	309.3	0.110	< 0.005	< 0.005	< 0.005	< 4.5	< 4.5	< 4.5	0.356	< 0.016	< 0.016	< 0.016
	Area 1	5301973	123	309.3	0.116	< 0.005	< 0.005	< 0.005	< 4.3	< 4.3	< 4.3	0.375	< 0.016	< 0.016	< 0.016
	Area 2*	5301975	123	310.6	0.122	< 0.005	< 0.005	< 0.005	< 4.1	< 4.1	< 4.1	0.393	< 0.016	< 0.016	< 0.016

Direct Read Instrument – Respirable Dust

The results from the Thermo Electron PDR 1200 direct reading instrument are presented in a graphical format in Appendix A. Data are presented in milligrams per cubic meter of respirable dust vs. time. It should be noted that the direct-reading instrument was operated for a slightly longer time span than that used for collecting the integrated air samples. The cutting operations can be discerned by the brief elevated concentration (i.e., spiking) observed at the time of the cut.

4.0 Discussion

Total Dust/Gypsum/Calcium Sulfate and Respirable Dust Air Concentrations

The “total dust” concentration is the total amount of particulates that were obtained on the air filter divided by the volume of air sampled. The “respirable dust” concentration is the total amount of size-separated fine particulates (4 µm median cut point) that were obtained on an air filter after separation using a size selective sampler (i.e., cyclone).

The Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have published maximum average exposure concentrations of total and respirable particulates (based on personal samples). OSHA refers to their enforceable reference air concentrations as permissible exposure limits (PEL) and ACGIH designates their recommended limits as threshold limit values (TLV). Both the OSHA and ACGIH limits are applicable to a maximum time-weighted average concentration for worker exposure over an eight-hour work day for 40 hours per week.

Although the PELs and TLVs are not intended for short-term exposures such as the simulation activities performed in this enclosed chamber study (not a typical work environment), they still can be used as a reference for which to index air concentrations. The OSHA PELs for gypsum and respirable dust are 15 mg/m^3 and 5 mg/m^3 respectively. The ACGIH TLVs for calcium sulfate and respirable dust (particulates not otherwise regulated) are 10 mg/m^3 and 3 mg/m^3 respectively. All air sample results in this study <u>were not time weight averaged</u> for comparison purposes; instead the air concentrations determined were compared directly to the reference values cited.

For all three of the cutting methods used in this study, none of the air concentrations obtained exceeded the OSHA PEL or ACGIH TLV for gypsum/calcium sulfate.

In addition, none of the samples obtained for respirable dust analyses using the three cutting methods evaluated exceeded the OSHA PEL or ACGIH TLV for respirable dust.

In order to compare the airborne dust emissions by cutting method, another index was used to normalize the results for the amount of work performed that is specific for this study. The total estimated mass of material emitted was calculated by multiplying the air concentration by the volume of the test chamber and then dividing the average mass by the length of material that was cut. This results in the determination of a metric that has the units of milligrams of airborne dust per board foot-cut as illustrated in Table 7 and are graphically presented in Figures 11 and 12.

Table 7. Average concentrations of total airborne dust (NIOSH 0500 method) and calculated mass of airborne dust emitted per foot of board cut.

Product and Sizing Operation	Personal (mg/m^3)	Area (mg/m^3)	Personal (mg/ft cut)	Area (mg/ft cut)
Score, Snap and Rasp	**1.74**	**1.74**	**0.63**	**0.63**
Hand Saw	**2.37**	**2.52**	**2.85**	**3.03**
Rotary Saw	**1.30**	**1.25**	**7.04**	**6.78**

Based on this indexing method, the score, snap and rasp method used for cutting of the material has been demonstrated to generate the least amount of airborne total dust and the rotary saw the highest emissions per board-foot cut. As compared to the score, snap and rasp method, the hand saw generated about 4-5 times more airborne total dust per board-foot cut. The rotary saw emitted roughly 10-12 times more airborne dust per board-foot cut as compared to the score, snap and rasp technique.

The estimated mass of respirable dust emitted was calculated in a similar manner. The average air concentrations from the three cutting methods studied and the estimated airborne mass emitted per foot of board cut for respirable dust is presented in Table 8. These results are also graphically presented in Figures 13 and 14.

Table 8. Average concentrations of respirable airborne dust (NIOSH 0600 method) and calculated mass of respirable airborne dust emitted per foot of board cut.

Product and Sizing Operation	Personal (mg/m^3)	Area (mg/m^3)	Personal (mg/ft cut)	Area (mg/ft cut)
Score, Snap and Rasp	**0.53**	**0.41**	**0.19**	**0.15**
Hand Saw	**0.59**	**0.65**	**0.71**	**0.78**
Rotary Saw	**0.32**	**0.36**	**1.76**	**1.92**

The score, snap and rasp cutting method generated the least amount of respirable dust air emissions per foot-cut and the rotary saw the highest emissions per foot-cut. The hand saw cutting method was determined to generate about 4-5 times more airborne respirable dust per board-foot cut. The rotary saw emitted roughly 10-12 times more respirable dust per foot cut as compared to the score, snap and rasp technique.

Respirable Crystalline Silica – Air Samples

Currently, respirable crystalline silica is regulated by OSHA as a mineral dust based on the weight percent quartz that is present in an air sample. This air sample must be collected using a size-selective sampler (i.e., cyclone) suitable for sampling respirable particulate. The mass basis OSHA PEL for quartz is calculated based on the following formula:

$$\text{OSHA PEL}^* = \frac{10}{\%\ SiO_2 + 2} \quad (mg/m^3)$$

* The formula shown is for quartz. Tridymite and Cristobalite are ½ this value.

OSHA has recently issued notice of intent to revise the OSHA PEL for respirable crystalline silica (quartz) on a straight air concentration basis as opposed to a weight percent weighted PEL. This newly proposed PEL is 0.050 mg/m^3, which could likely be an enforceable PEL within the next year or two. The ACGIH TLV reference concentration for respirable crystalline silica is 0.025 mg/m^3.

A total of six integrated air samples were collected in the personal breathing zone of the workers during the simulation testing for analysis for respirable crystalline free silica. These samples were analyzed for respirable crystalline silica using x-ray diffraction techniques following the NIOSH 7500 methodology. Respirable crystalline silica was not detected on any of the personal samples. In addition, a total of 12 integrated area air samples were obtained during the studies. Respirable crystalline silica was not detected in any of the area samples.

Since, there was no respirable crystalline silica detected on any of the air samples, the current OSHA PEL for these samples would be 5 mg/m^3 (compare to resp. dust gravimetric analyses – NIOSH 0600). Using these criteria, all samples were below the current OSHA PEL for respirable mineral dusts. All air samples analyzed for respirable crystalline silica for the three cutting methods tested were below a detection limit of 0.016 mg/m^3 which is a concentration that is less than OSHA's proposed new ruling for a revised PEL and the current ACGIH TLV.

5.0 Summary

Within an enclosed test chamber, three different cutting operations were used to cut 5/8” Type X wallboard materials. The three cutting methods used in this study included: (1) score, snap and rasp, (2) hand saw, and (3) powered rotary saw techniques. Both personnel and area air samples were obtained using generally accepted industrial hygiene methods during the work activities to sample for airborne dusts.

Each cutting simulation operation was performed in duplicate. The air samples obtained were analyzed for total dust, respirable dust and respirable crystalline silica. Sample results were evaluated based on recommended airborne exposure levels put forth by ACGIH as well as OSHA for airborne dusts. Laboratory results were directly compared to these exposure levels for indexing purposes as opposed to using time weight averaging methods that are often used for assessing occupational exposure.

Based on the parameters used during this study, none of the air samples obtained during the tests exceeded recommended standards for exposure. Respirable crystalline silica was not detected to be present on any of the 18 air samples obtained for respirable crystalline silica analysis.

Sample results were also normalized by the amount of material cut to compare the relative airborne emissions of particulate between each cutting technique based on the amount of work performed (i.e., distance cut). The score and snap method was found to generate the least amount of airborne particulate per amount of material cut.

6.0 Figures

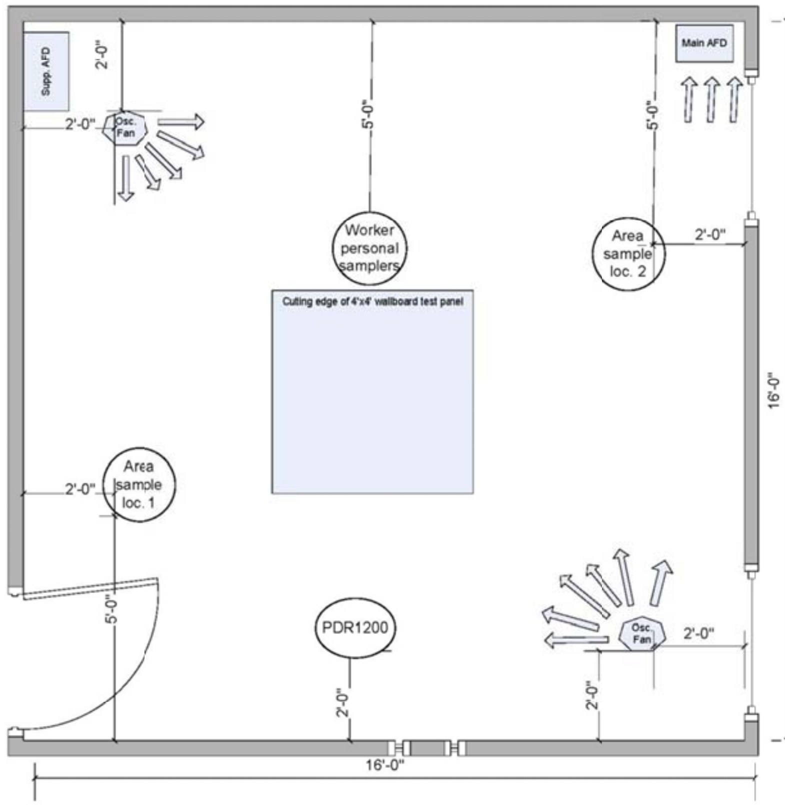

Figure 1. Diagram of Test Chamber

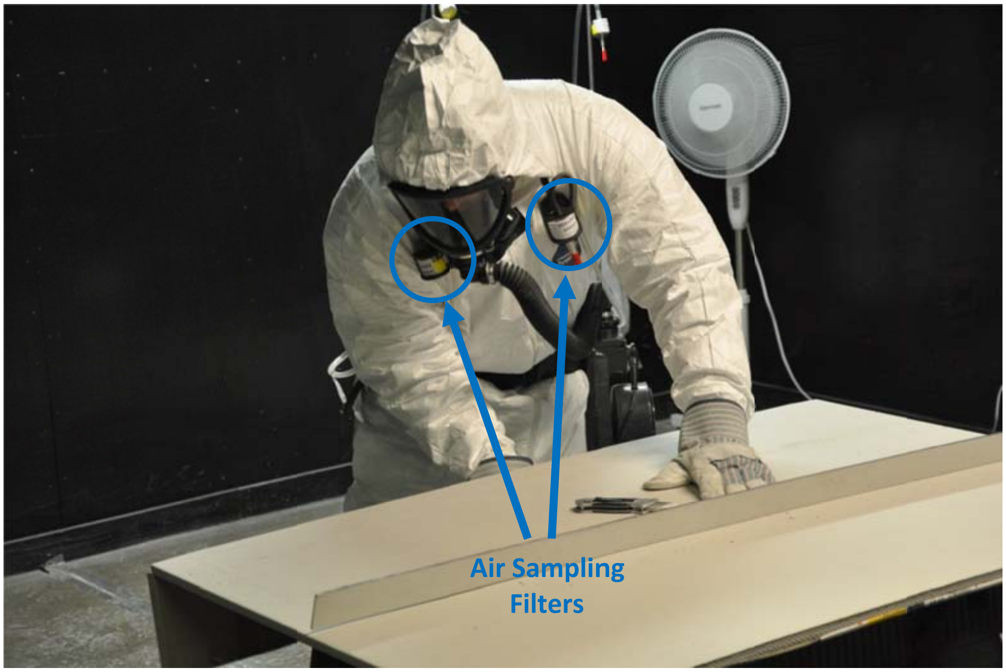

Figure 2. **Personal air samples in the breathing zone obtained during snapping of a 5/8" Type X drywall board panel using utility knife and T-square.**

Figure 3. Area air sampling and test chamber configuration.

Figure 4. PDR1200 configuration.

Figure 5. Snapping a 5/8” Type X drywall board using downward hand force.

Figure 6. **Rasping the rough cut edge of the main drywall board section using the shaping file/forming plane.**

Figure 7. **Cutting a 5/8” Type X drywall board section with the hand saw.**

Figure 8. Cutting a 5/8” Type X drywall board section with the hand saw.

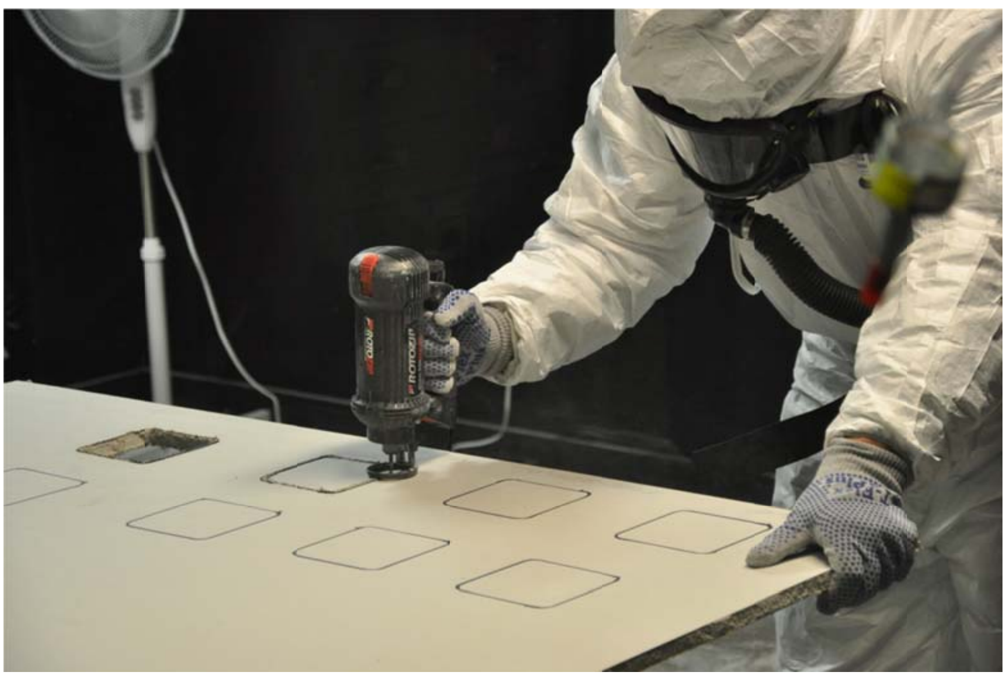

Figure 9. Cutting a 5/8” Type X drywall section with the rotary (i.e. rotozip) saw.

Figure 10. Cutting a 5/8” Type X drywall section with the rotary (i.e. rotozip) saw.

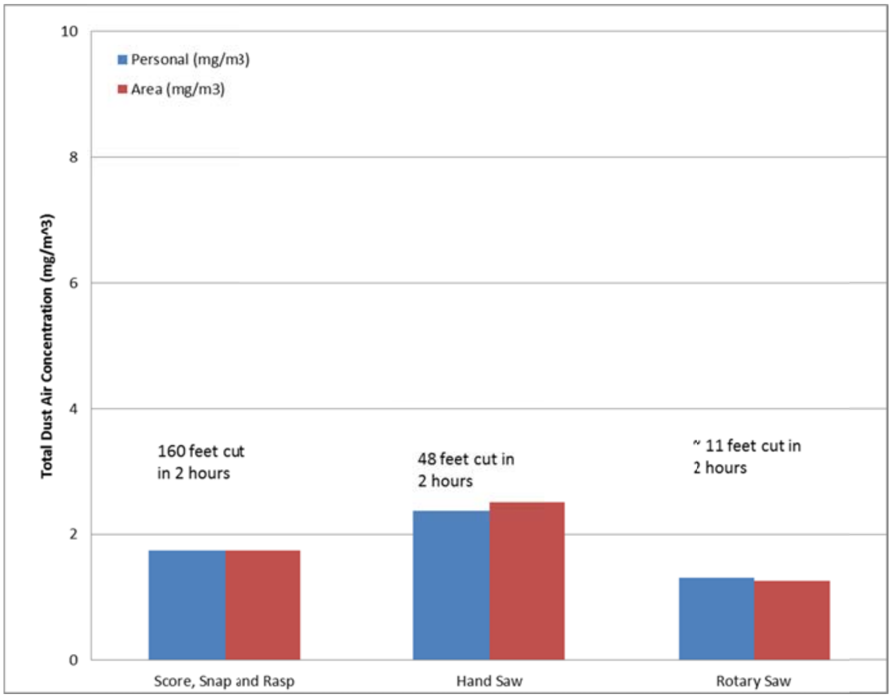

Figure 11. Average concentrations of airborne total airborne dust determined during simulation study by cutting method.

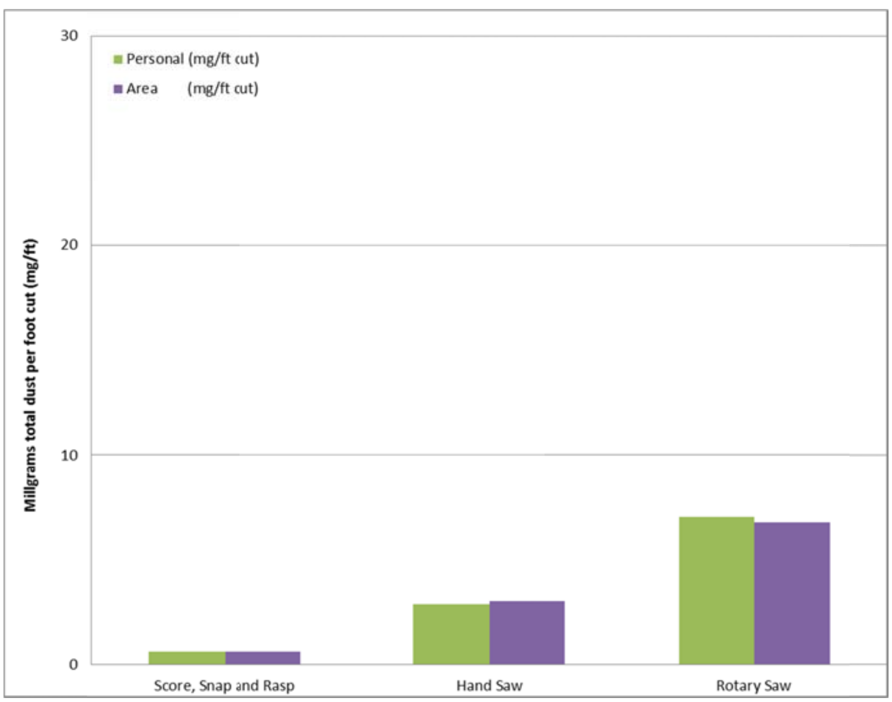

Figure 12. Average calculated airborne total dust mass emissions per cut distance for each cutting method.

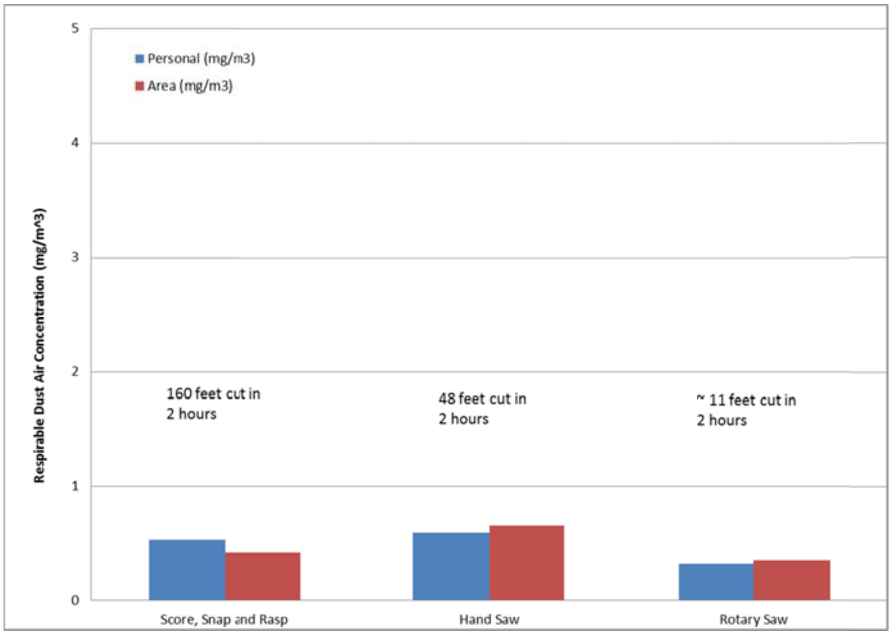

Figure 13. Average concentrations of respirable airborne dust determined during simulation study by cutting method.

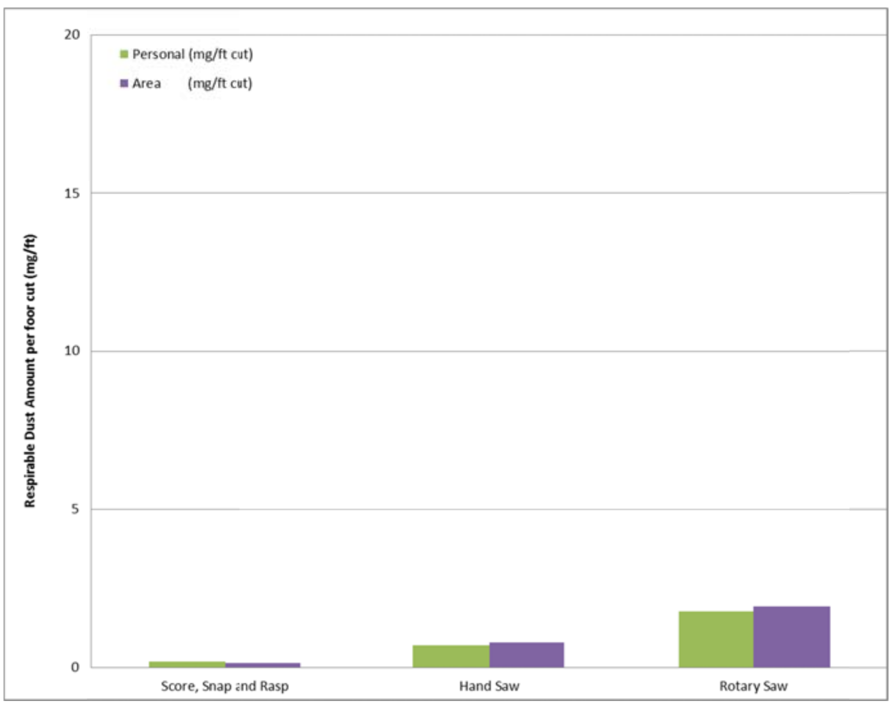

Figure 14. Average calculated airborne respirable dust mass emissions per cut distance for each cutting method.

Appendix A

National Gypsum Company
Dust Emission Study
Cutting of 5/8" Fire-Shield Type X Drywall

Thermo Electron PDR1200
Direct Reading Instrument Summary

Respirable Airborne Dust vs. Time Plots

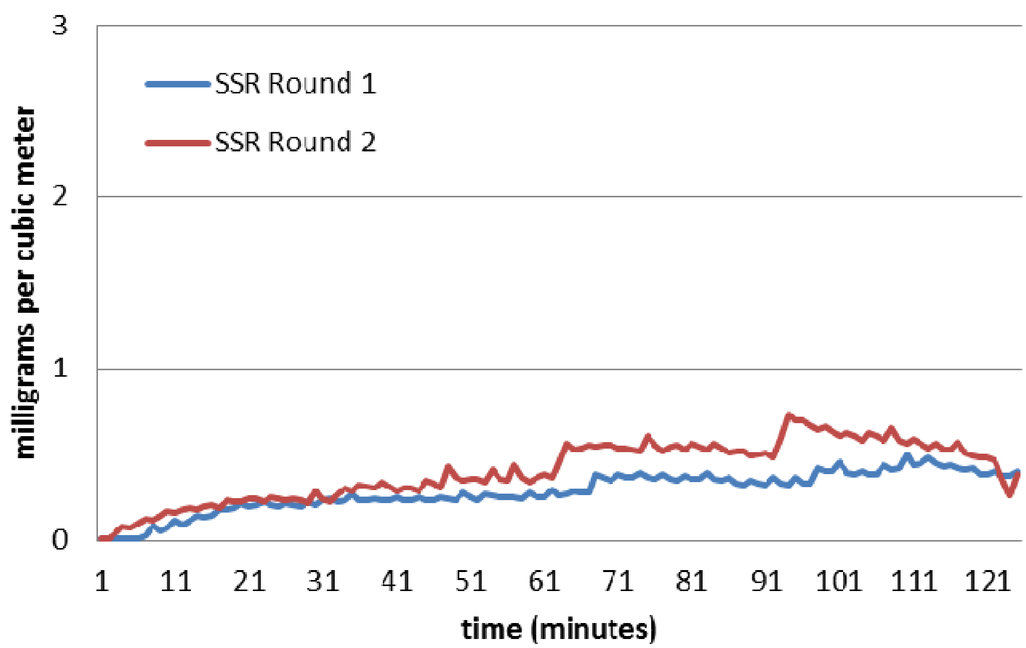

Figure A1. PDR direct read respirable dust concentrations for Rounds 1 and 2 – National Gypsum 5/8" Type X Drywall cutting simulation using the score, snap and rasp (SSR) technique.

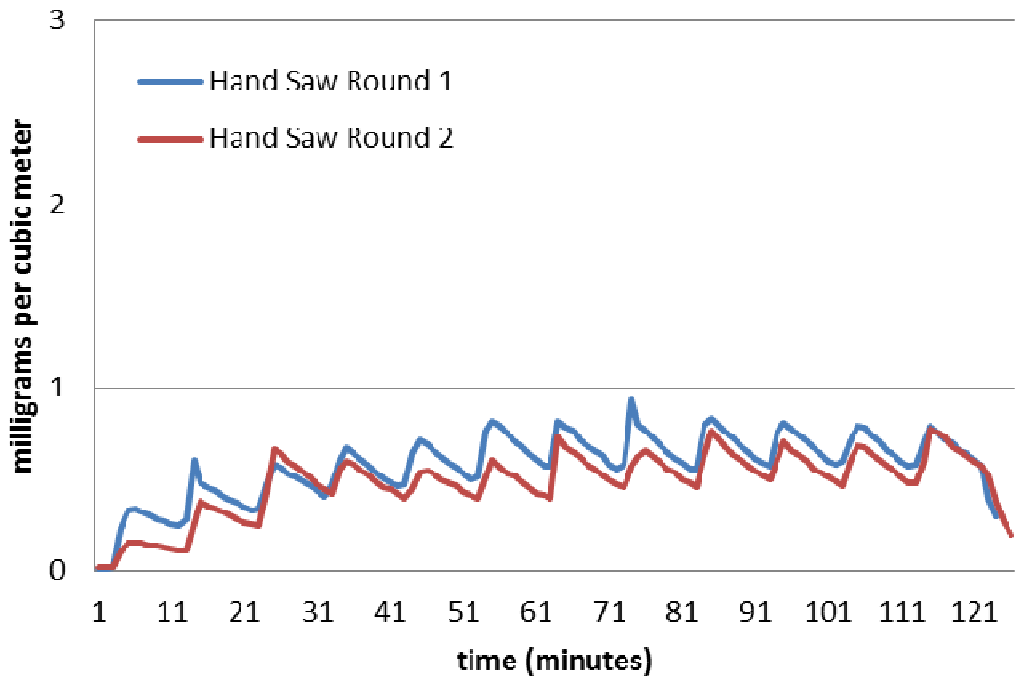

Figure A2. PDR direct read respirable dust concentrations for Rounds 1 and 2 – National Gypsum 5/8" Type X Drywall cutting simulation using the hand saw cutting method.

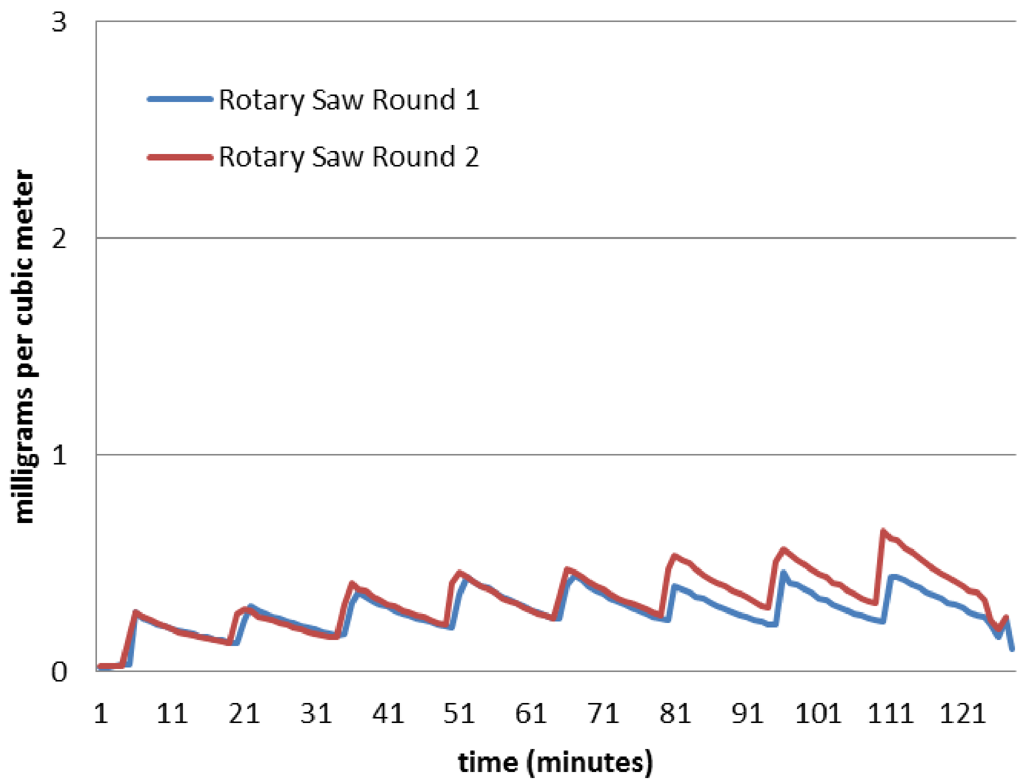

Figure A3. PDR direct read respirable dust concentrations for Rounds 1 and 2 – National Gypsum 5/8” Type X Drywall cutting simulation using the rotary saw cutting method.