# Evaluation of Airborne Releases from Cutting Gypsum Drywall Using Various Cutting Methods in a Controlled Environment

PO 114, CS-114-04 (006 C-D) – AIHCE 2014
June 3, 2014

**Keith Rickabaugh, Matt Zock and Mike Lynn**

RJ LEE GROUP
DELIVERING SCIENTIFIC RESOLUTION

# Objectives of Study – Sizing of ½”Drywall

## Product Stewardship

- Evaluation of dust emissions from multiple cutting methods
- Determine if Airborne Respirable Crystalline Silica is of a potential concern when sizing drywall
- Obtain data for modeling potential dust emissions based on work activity metrics

## Scientifically Credible and Controlled Study

- Testing performed in duplicate for each product tested (14 tests total)
- Generally accepted sampling methods used
- Controlled Conditions – Use of Test Chamber
  - Exclude Sources of other dusts possible on construction sites
  - Consistent ventilation conditions

# Study Design

## Materials Evaluated

- Standard ½” thick gypsum based drywall
- Drywall obtained from seven different plants (United States Gypsum Company)

## Test Chamber Features

- Reasonable size (~ 2,000 cubic feet) to perform work activities
- Under negative pressure to prevent leaks (e.g., 3 AC per hour)
- Black walls to observe dust emissions
- Oscillating Fans to Promote Air Mixing
- GFI Protected Outlets
- Chamber cleaned and ventilated between tests

# Air Sampling Strategy

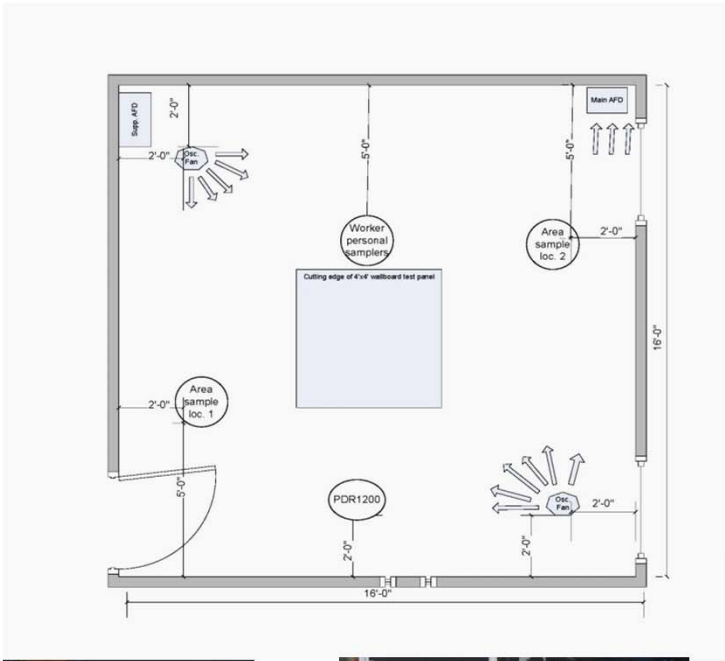
## Direct Read Instrumentation

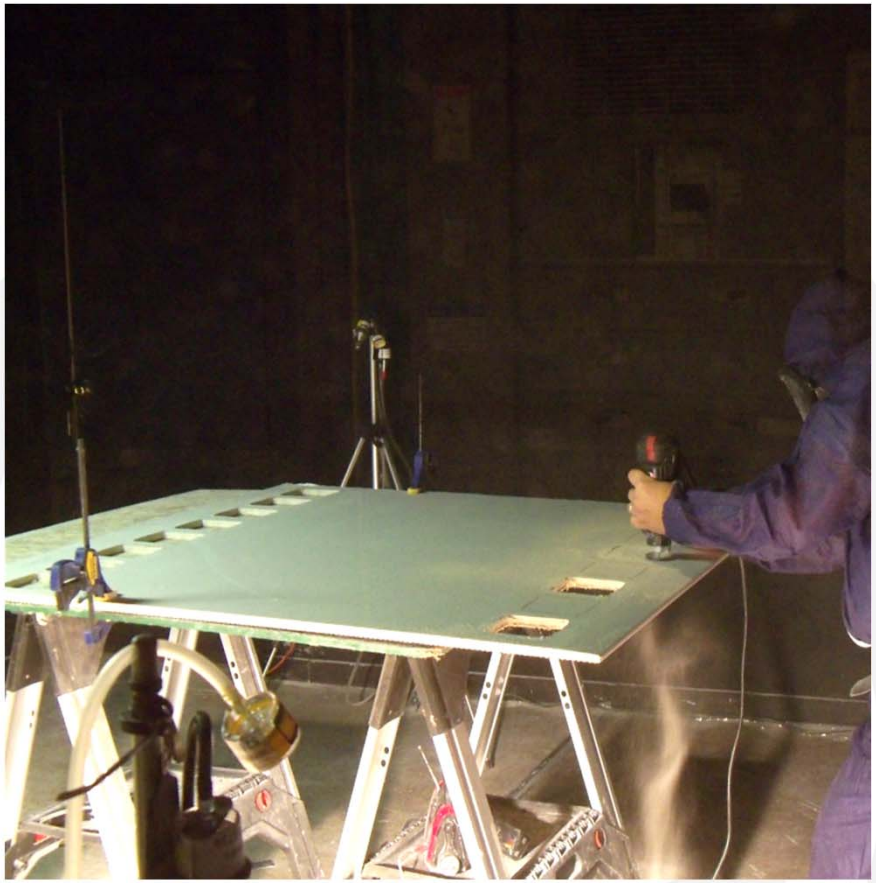
- Thermo-Electron PDR 1200
  - Configured and calibrated to sample respirable dust (BGI Cyclone)
  - Results directly monitored on laptop outside chamber
    - » Enables immediate feedback for evaluation of safety levels
    - » Assists in determining of cutting rate and filter loadings
  - Integrated Air Filter also obtained for evaluation

## Integrated Air Samples

- Personnel Samples and Area Air Samples (two locations)
  - Total Dust (NIOSH 0500)
  - Respirable Dust and Crystalline Silica (NIOSH 0600 and NIOSH 7500)
  - Field Blank Samples (min. 10% of all samples)
- Samples collected over a two hour time period for each study

# Test Chamber Illustration



# Study Design (cont.)

## Cutting Methods

- Score, Snap and Rasp
  - Utility knife with retractable razor blade and T-Square guide used to score material
  - Hand pressure used to cleanly break drywall
  - Shaping file used to rasp entire cut edge for each cut
  - Four foot cuts performed every three minutes, 40 cuts (160 feet total)
- Rotary Saw
  - Can be used to create openings of installed product (e.g., electrical and plumbing)
  - Roto-zip Spiral Saw (30,000 rpm – no load) and 5/32" drywall bit
  - Eight 4" x 4" openings; one cut every 15 minutes
- Circular Saw
  - Not recommended in work place
  - Generates heavy loadings on filters for lab analysis
  - 7 ¼" diameter, 18 teeth/inch carbide blade used
  - Four foot cuts performed every 30 minutes (16 feet total)

# Reference Air Concentrations

## OSHA

- 15 mg/$m^3$ – Gypsum, PEL-TWA
- 5 mg/$m^3$ – Respirable Dusts, PEL-TWA
- 0.050 mg/$m^3$ – *Proposed* Resp. Silica, PEL-TWA

## ACGIH

- 10 mg/$m^3$ – Calcium Sulfate, TLV
- 3 mg/$m^3$ – Respirable Particles Not Otherwise Specified, TLV
- 0.025 mg/$m^3$ –Resp. Silica, TLV

# Summary Results – Integrated Air Samples

## NIOSH 0500 Analysis for "Total Dust"

- 126 integrated air samples obtained and analyzed
  - 42 personnel samples
  - 84 area samples
- None of the air concentrations exceeded the OSHA PEL or ACGIH TLV

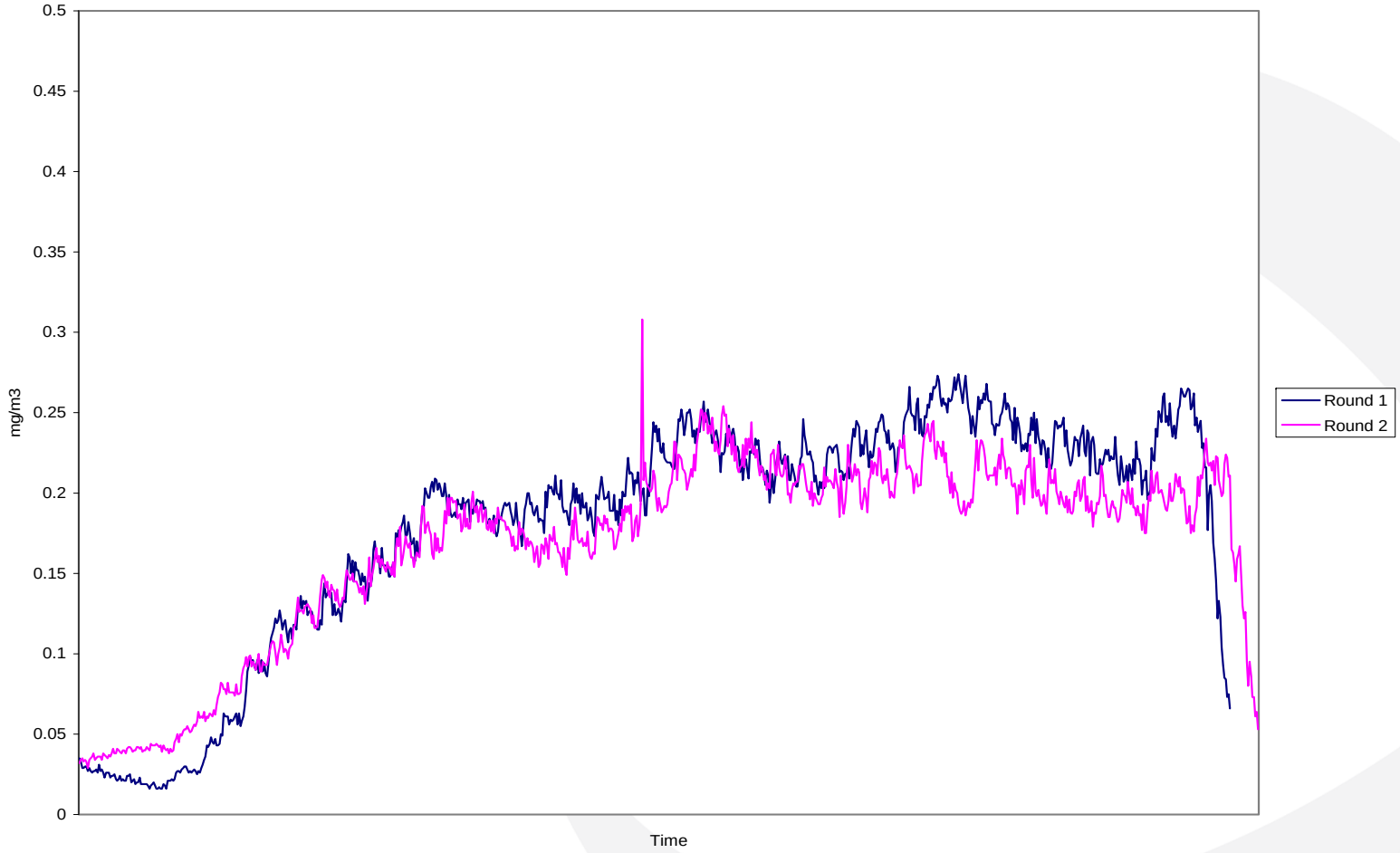
## NIOSH 0600 Analysis for "Respirable Dust"

- 126 integrated air samples obtained and analyzed
  - 42 personnel samples
  - 84 area samples
- None of the air concentrations exceeded the OSHA PEL or ACGIH TLV

## NIOSH 7500 Analysis for Respirable Crystalline Silica

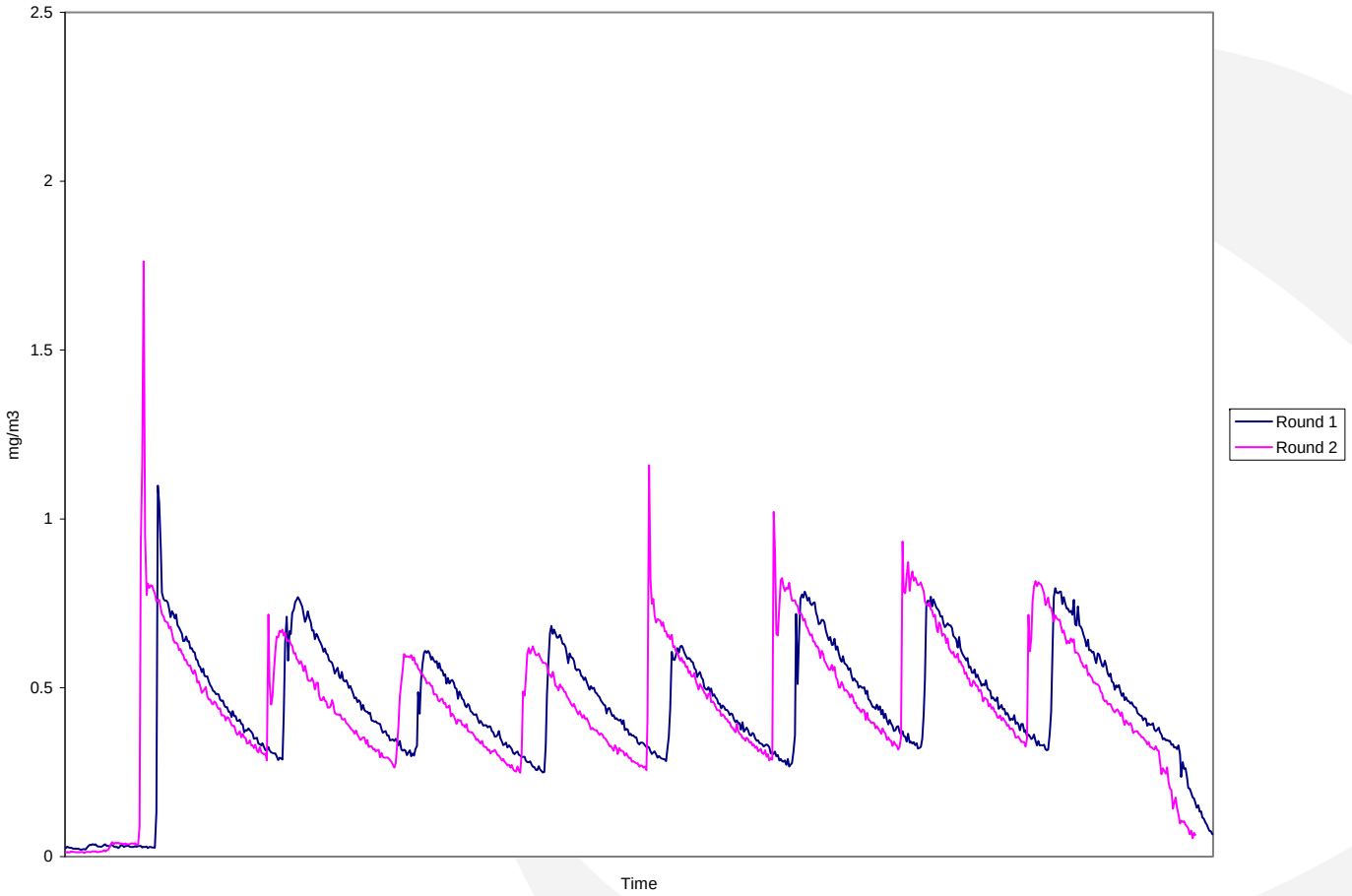
- All results were non-detect (126 samples analyzed)
- Reporting limits for each sample was at or less than 0.017 $mg/m^3$ (quartz, cristobalite and tridymite by x-ray diffraction)

# Score, Snap and Rasp
# Direct Read Instrumentation Results



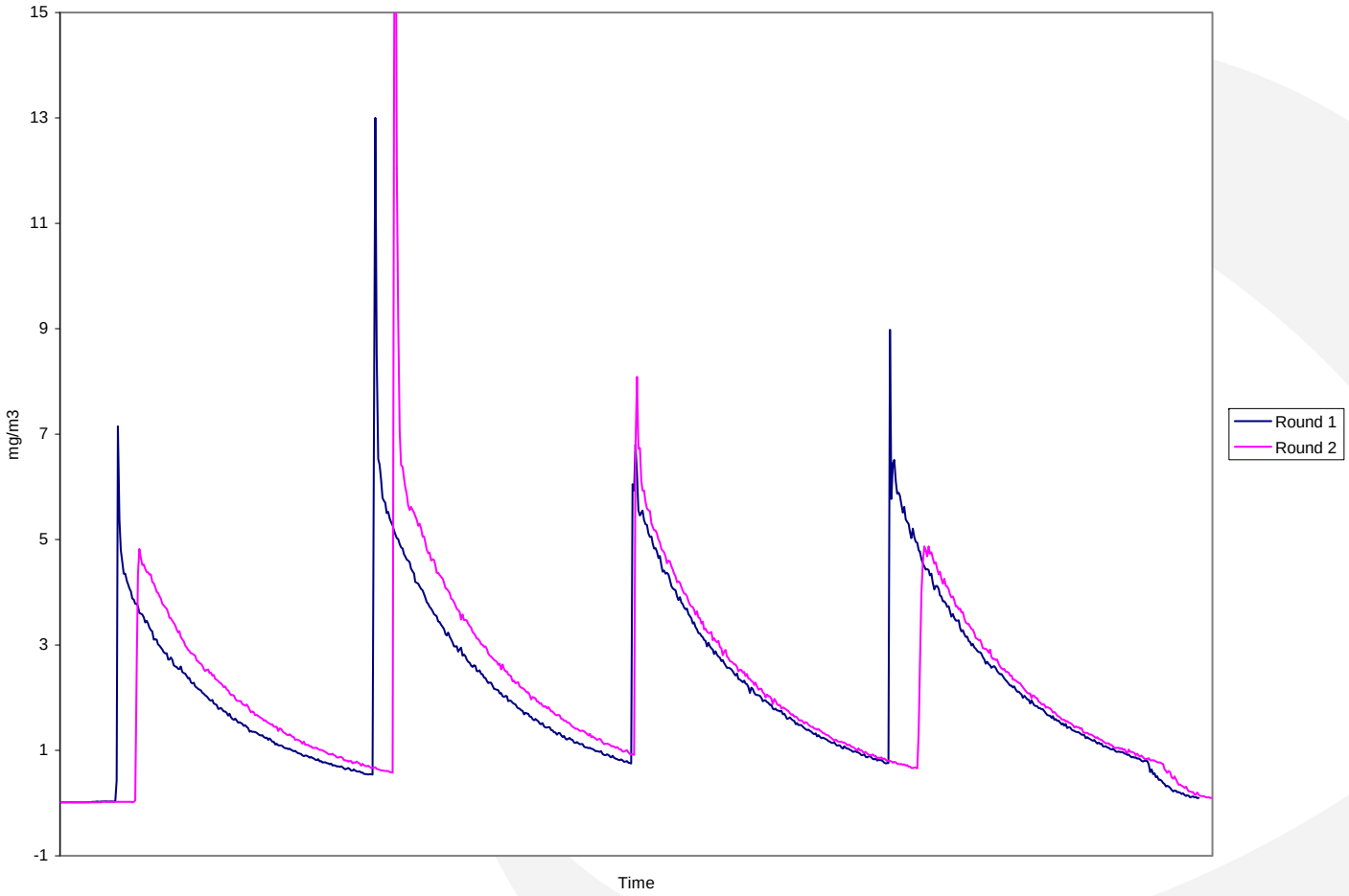

PDR direct read respirable dust concentrations for Rounds 1 and 2 –360 Shoals board cutting simulation using the score, snap and rasp method.

# Rotary Saw
# Direct Read Instrumentation Results




PDR direct read respirable dust concentrations for Rounds 1 and 2 –284 Washingtonville board cutting simulation using the rotary saw method.

# Circular Saw
# Direct Read Instrumentation Results

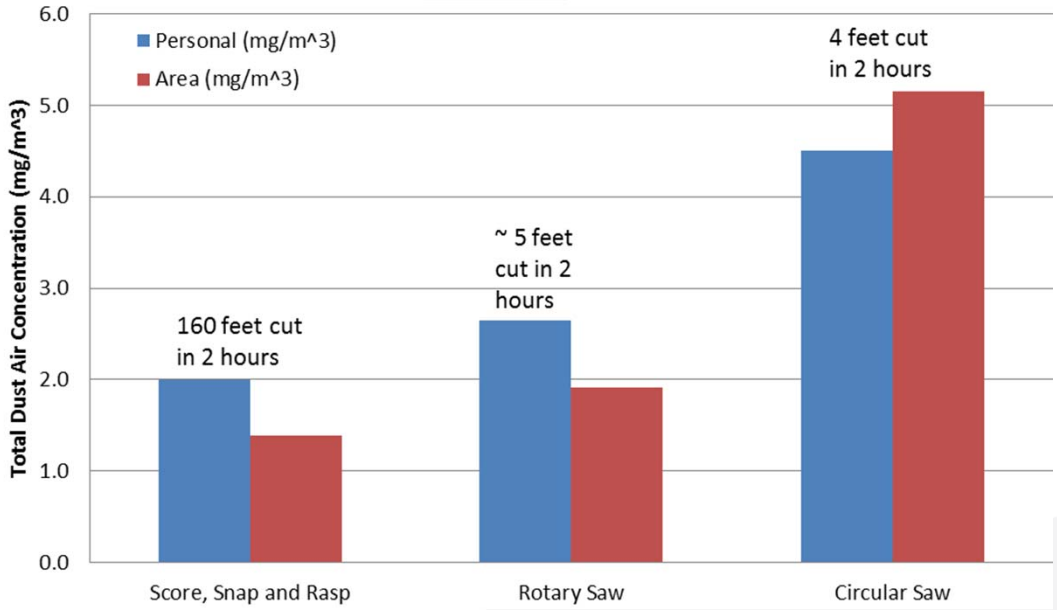



PDR direct read respirable dust concentrations for Rounds 1 and 2 –024 Montreal board cutting simulation using the circular saw method.

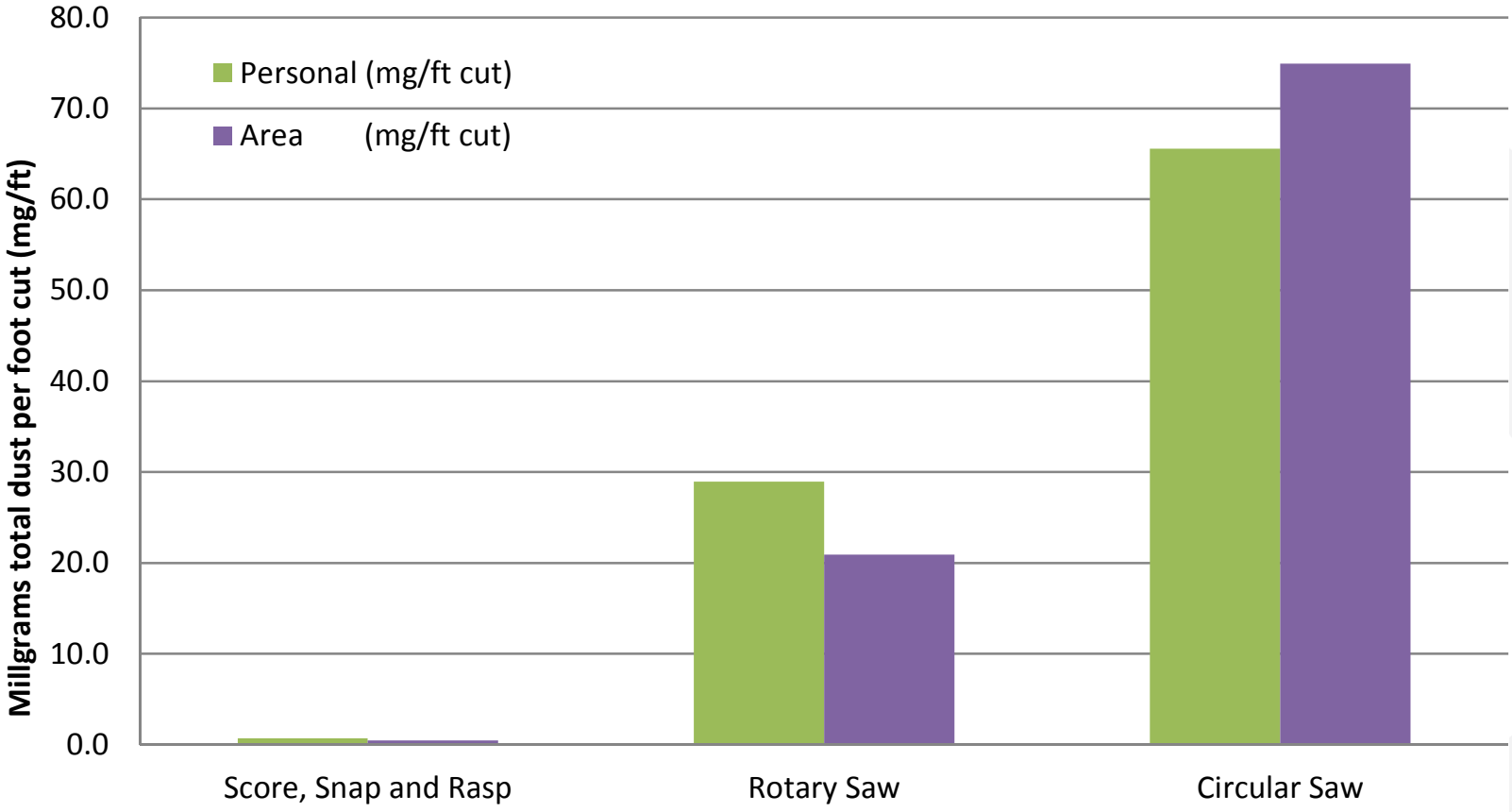
# Summary Results by Cutting Method
# NIOSH 0500 – All Samples

| Product and Sizing Operation | Personal ($mg/m^3$) | Area ($mg/m^3$) | Personal (mg/ft cut) | Area (mg/ft cut) |
|---|---|---|---|---|
| **Score, Snap and Rasp** | **2.0** | **1.4** | **0.7** | **0.5** |
| **Rotary Saw** | **2.6** | **1.9** | **28.9** | **20.9** |
| **Circular Saw** | **4.5** | **5.2** | **65.6** | **74.9** |

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



# Modeled Mass Emission per Foot Cut
# NIOSH 0500 – All Samples

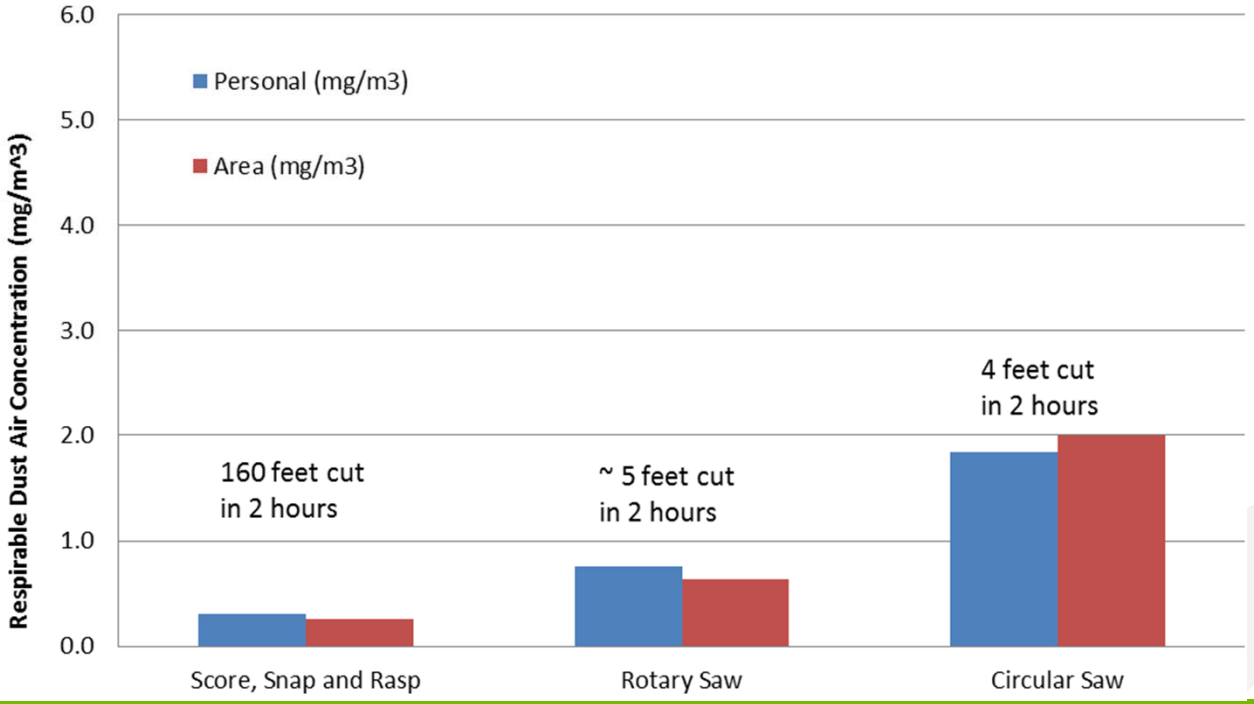



**Average calculated airborne total dust mass emissions per cut distance for each cutting method.**

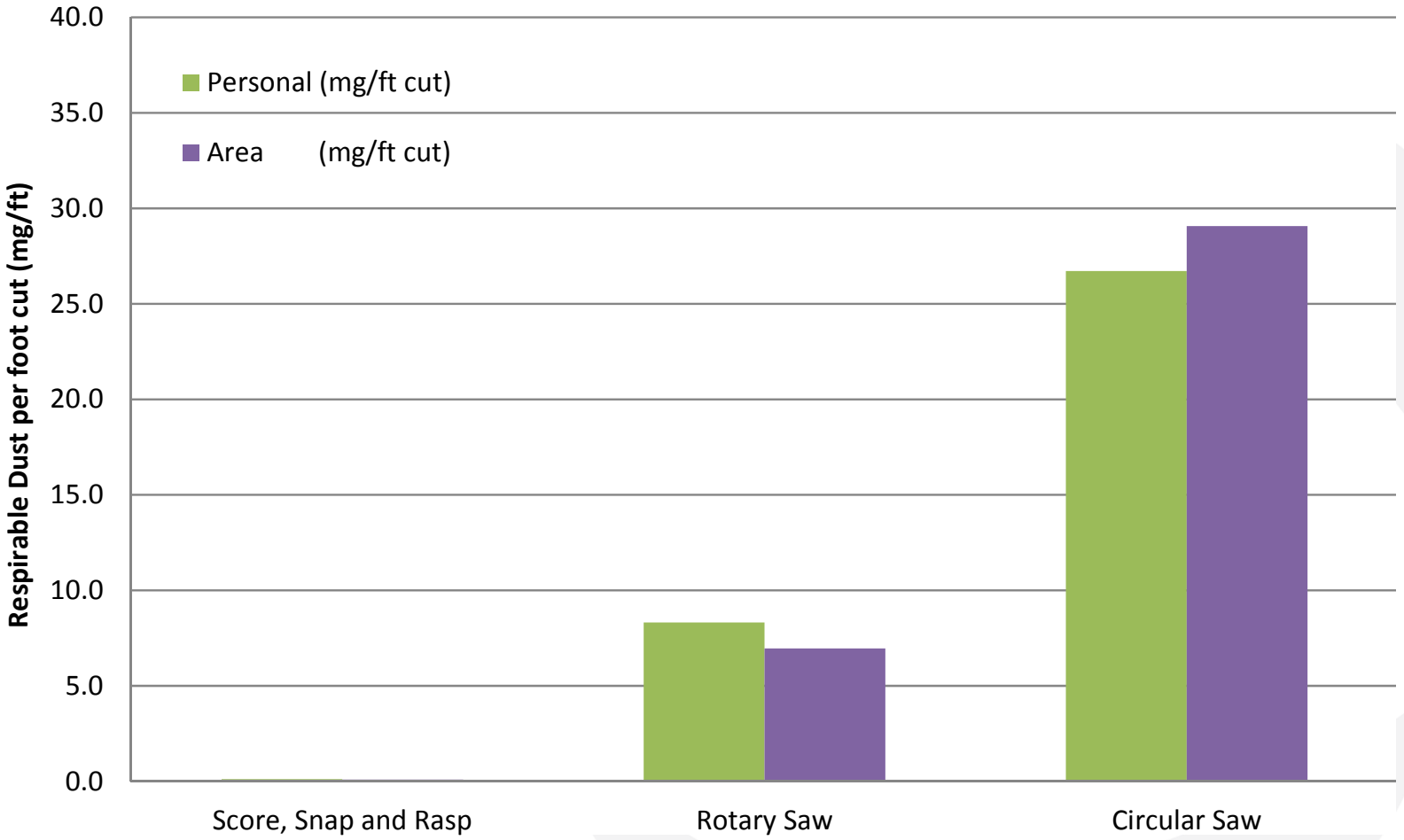
# Summary Results by Cutting Method
# NIOSH 0600 – All Samples

| Product and Sizing Operation | Personal ($mg/m^3$) | Area ($mg/m^3$) | Personal (mg/ft cut) | Area (mg/ft cut) |
|---|---|---|---|---|
| **Score, Snap and Rasp** | **0.3** | **0.3** | **0.1** | **0.1** |
| **Rotary Saw** | **0.8** | **0.6** | **8.3** | **7.0** |
| **Circular Saw** | **1.8** | **2.0** | **26.7** | **29.1** |

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



# Modeled Mass Emission per Foot Cut
# NIOSH 0600 – All Samples




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

# General Conclusions and Summary

- There was no measurable exposure to respirable crystalline silica from sizing drywall materials.
- The score, snap, and rasp method of sizing drywall exhibited the lowest emission of particulates.
- No exceedances of the OSHA PELs were observed using any of the cutting techniques used during this study when comparing non-TWA measured concentrations to regulatory levels.
- The use of the circular saw provided the highest levels of dust emissions and it is not a recommended practice for sizing drywall.
- The results from this study can provide a basis for modeling/estimating potential emissions of dust(s) from cutting drywall materials.