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

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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 $\frac{1}{2}$” 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/m³ – Gypsum, PEL-TWA
- 5 mg/m³ – Respirable Dusts, PEL-TWA
- 0.050 mg/m³ – Proposed Resp. Silica, PEL-TWA

ACGIH

- 10 mg/m³ – Calcium Sulfate, TLV
- 3 mg/m³ – Respirable Particles Not Otherwise Specified, TLV
- 0.025 mg/m³ – 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/m³ (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**

<table>
<thead>
<tr>
<th>Product and Sizing Operation</th>
<th>Personal (mg/m³)</th>
<th>Area (mg/m³)</th>
<th>Personal (mg/ft cut)</th>
<th>Area (mg/ft cut)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score, Snap and Rasp</td>
<td>2.0</td>
<td>1.4</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Rotary Saw</td>
<td>2.6</td>
<td>1.9</td>
<td>28.9</td>
<td>20.9</td>
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<tr>
<td>Circular Saw</td>
<td>4.5</td>
<td>5.2</td>
<td>65.6</td>
<td>74.9</td>
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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

<table>
<thead>
<tr>
<th>Product and Sizing Operation</th>
<th>Personal (mg/m³)</th>
<th>Area (mg/m³)</th>
<th>Personal (mg/ft cut)</th>
<th>Area (mg/ft cut)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score, Snap and Rasp</td>
<td>0.3</td>
<td>0.3</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Rotary Saw</td>
<td>0.8</td>
<td>0.6</td>
<td>8.3</td>
<td>7.0</td>
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<tr>
<td>Circular Saw</td>
<td>1.8</td>
<td>2.0</td>
<td>26.7</td>
<td>29.1</td>
</tr>
</tbody>
</table>

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.