New Low Vibration Tools
Using Reinforced Composite Impact Components

James Glancey, Ph.D., P.E.
Daniel Pron, Senior U of D
University of Delaware

Why Worry About Vibration and Noise?

Problem:
- 2 to 4 Million People exposed to tool vibration in the US annually.
- 50% of people exposed develop injuries.
- Costs associated with ailments estimated to be in the 100's of millions of dollars and growing.

Resulting Injuries:
- Symptoms including
  - Numbness
  - Tingling
  - Decreased grip strength
  - Loss of Dexterity
- Hearing Loss
  - Loss in perception across all sound frequencies
  - High frequency sounds the most damaging
Percent of People With Tinnitus

Non-Noise Exposed Worker
- 94% (No Tinnitus)
- 6% (Tinnitus)

Noise Exposed Workers
- 79% (No Tinnitus)
- 21% (Tinnitus)

Low Vibration Hand Struck Tools

We’ve Reinvented The Chisel.

The World’s Most Comfortable Struck Tool.
Benefits of Composite Capped Tools

Computer simulations of cutting

Key features of Hard Cap

- Impact disc efficiently transfers shock
- Striking surface enlarged by 2.5 times
- Reinforced polymer by DuPont reduces noise by 90%
- Cap and cushion grip reduces amount of shock by 90%
- Eliminates flying metal fragments
- Reduces hammer kickback and trauma to wrist and elbow
- Extra sharp cutting edge
Low Vibration Hand Struck Tools

- Vibration reduced by more than 90%
- Sound Reduced by 80%

On-Going Tool Safety Research

- Power Impact Tools
- Wood-Splitting Wedges
- Capped Hammers

Vibration measurements at the palm, wrist and elbow.
Current Tool Testing

*Composite Capped Hammer*

Positive Results of Hammer Testing

**Positive Points:** (With regards to carpenters’ opinions)

- ☺ Less Vibration felt
- ☺ Less Noise heard
- ☺ Less marring of painted surfaces
- ☺ Performed better or same in regards to driving nails
- ☺ Visibility not affected
- ☺ Thought to help against Hand Arm Vibration Syndrome
- ☺ Carpenters tested would buy
Results of Hammer Testing

Averages

Better

Worse

Nail Driving Capability
Noise Level
Vibrations Felt in Hand
Vibrations Felt in Arm

Negative Results of Hammer Testing

Problems:

- Cant drive nails backward
- Cant hit narrow or sharp edges

Current Research:

- More durable composite material
- Alternative geometry
- Cooperating with Vaughn Hammer in Chicago
Questions?

Demo Areas
- Capped Hammer
- Capped Hand-Struck Tools
Common Vibration Characteristics

<table>
<thead>
<tr>
<th>Tool</th>
<th>Vibration Magnitude</th>
<th>Maximum Exposure Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chipping hammers</td>
<td>10-40 ms$^2$</td>
<td>2-40 minutes</td>
</tr>
<tr>
<td>Sand rammers</td>
<td>25-40 ms$^2$</td>
<td>2-6 minutes</td>
</tr>
<tr>
<td>Angle grinders</td>
<td>2-35 ms$^2$</td>
<td>3 minutes-16 hours</td>
</tr>
<tr>
<td>Disc cutters</td>
<td>4-10 ms$^2$</td>
<td>40 minutes-4 hours</td>
</tr>
<tr>
<td>Disc sanders</td>
<td>10-15 ms$^2$</td>
<td>16-40 minutes</td>
</tr>
<tr>
<td>Rock drills</td>
<td>15-35 ms$^2$</td>
<td>3-16 minutes</td>
</tr>
</tbody>
</table>

Purpose of Composites

- Reduce Vibration
- Reduce Noise
- Less Damage
Effects of Hand-Arm Vibration

- Vibration-induced White Finger (VWF)
- or, Hand-Arm Vibration Syndrome (HAVS)
- or, Raynaud’s Phenomenon
  - Hand-arm vibration causes damage to blood vessels and nerves in the fingers
- Reported effects
  - attacks of whitening (blanching) in one or more fingers when exposed to cold
  - tingling and loss of sensation in the fingers
  - loss of light touch
  - pain and cold sensations between periodic white finger attacks
  - loss of grip strength

Sound Level Benchmarks

<table>
<thead>
<tr>
<th>dBA Level</th>
<th>Approx. Equivalent</th>
<th>Maximum Unprotected Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Faintest sound heard by human ear.</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Whisper, quiet library</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Normal conversation</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Lawn mower, shop tools, truck traffic</td>
<td>8hrs/day</td>
</tr>
<tr>
<td>100</td>
<td>Chainsaw, pneumatic drill, snowmobile</td>
<td>2hrs/day</td>
</tr>
<tr>
<td>115</td>
<td>Sandblasting, rock concert, car horn</td>
<td>15min/day</td>
</tr>
<tr>
<td>140</td>
<td>Gun shot, jet engine – even brief exposure cause pain</td>
<td>Must always have ear protection</td>
</tr>
</tbody>
</table>