

# Selling Use of LEV\* in Construction - Factors to Consider

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Research and Training

AIHCE San Antonio, TX  
June 4, 2014

\*LEV = local exhaust ventilation

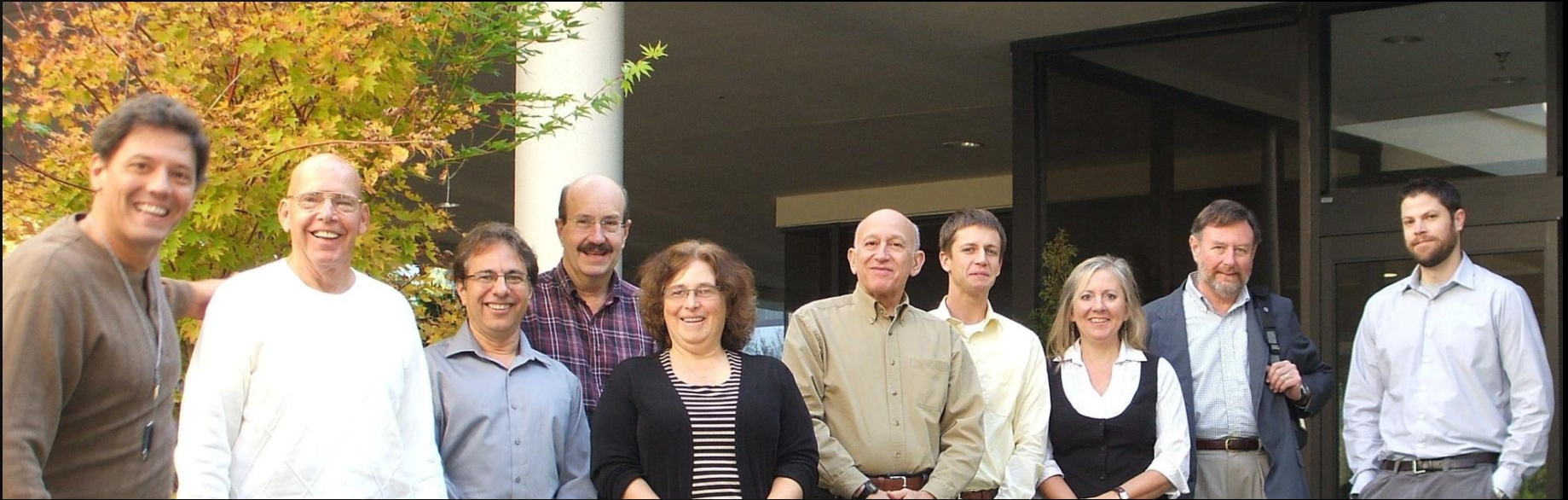


# Adoption of Innovations to Minimize (AIMs) Exposure to Dusts & Fumes in Construction



- focus: welding fumes & silica from tuck-pointing
- Project Timeframe: Sep 2010-Aug 2014

# Project Team



**CPWR:** Pam Susi (project manager)

**Universities:** Puerto Rico (Sergio Caporali), Florida International (Marc Weinstein), Harvard (Robert Herrick);

**Consultants:** Dave Feldscher (UA 120,retired); Mike Flynn, Mark Goldberg (formerly with Hunter), Mike Cooper, John Meeker, Univ. of MI,

# Specific Aims

- Develop diffusion & dissemination strategies for LEV
- Identify, rank and rate LEV for tuckpointing and welding
- Test the efficacy and effectiveness of most highly PACT rated LEVs(M. Cooper & J. Meeker)
- Develop and test a pilot training program on correct use of LEV for welding (S. Caporali)



3rd yr apprentice pipefitter/welder,  
Cambridge, OH

# Innovation adoption

## A Roadmap to Diffuse Ergonomic Innovations in the Construction Industry:

There Is Nothing So Practical as a Good Theory

MARC G. WEINSTEIN, PHD, STEVEN F. HECKER, MSPH, JENNIFER A. HESS, MPH, DC, PHD, LAUREL KINCL, PHD

Despite the availability of resources and practices that would reduce work-related morbidity and mortality in the construction industry, their diffusion to workers has been slow, partly because the ties between management and trade workers are weak. In promoting an innovation, it is necessary to target the stakeholders who will be making the decisions related to it. The authors' focus is on ergonomics, but their observations may be applied more broadly to other areas of intervention-effectiveness research. *Key words:* construction industry; ergonomics; occupational health and safety; intervention-effectiveness research.

INT J OCCUP ENVIRON HEALTH 2007;13:46-55

Construction workers across most trades are at significant risk of musculoskeletal disorders. The physically demanding nature of the work, awkward and static postures, vibration, harsh outdoor environment, and related risk factors help explain why strains and sprains are the most common type of work-related injury in construction, accounting for over 37% of work-related lost-time injuries in the United States.<sup>1</sup> Moreover, musculoskeletal disorders are more common in the construction industry than in any other industry sector except transportation in the United States.<sup>2</sup> In response, there have been numerous efforts to develop, validate, and promote ergonomic improvements for construction workers. These efforts have had varying degrees of success, and there is a growing body of research documenting the effectiveness of particular tools, personal protective equipment, new equipment and materials, and changed work practices in reducing musculoskeletal injury risk.<sup>3-5</sup> Despite these advances, ergonomic solutions have been slow to diffuse in the construction industry, even where such solutions have low financial costs and potentially large benefits to workers, contractors, and owners.<sup>6,7</sup> We explore this

paradox and suggest that future progress in translating ergonomics research into improved workplace practices in the construction industry may require a paradigm shift in how researchers conceptualize and undertake efforts to diffuse ergonomic innovations. While the focus of our paper is on construction ergonomics, our observations may be applied more broadly to other areas of intervention-effectiveness research in occupational health and safety.

### CURRENT U.S. CONSTRUCTION ERGONOMICS RESEARCH

The slow diffusion of ergonomic innovations in the construction industry is ironic considering that Frank Gilbreth's time-motion and productivity studies of bricklaying in the early twentieth century had clear implications for reducing musculoskeletal health risks to these workers.<sup>8</sup> Despite the early recognition of ergonomic risks of construction work, several factors probably account for the relatively slow adoption of corrective measures. In contrast to modern manufacturing, the construction work environment constantly changes, limiting employer-initiated work-design solutions that might reduce ergonomic risks. A further encumbrance is the inherent need for much construction work to take place at either floor or ceiling levels and in outdoor environments. Moreover, the employment relationship in construction is distinctive for the weak ties between contractors and trade workers and the limited supervision provided by the general contractor.<sup>9</sup> These factors are exacerbated by social norms and power relationships characteristic of construction work sites, which create further difficulty in both studying and ameliorating construction-site ergonomic risks. The absence of steady employment relationships in construction reinforces a climate in which workers are hesitant to complain about work conditions for fear that they will simply be replaced by other craftsmen, and this same dynamic reinforces a masculine culture in which it is assumed working hurt and feeling sore after work are just part of the job.<sup>10</sup>

The same factors, while perhaps initially impeding ergonomics research in construction, have also in some ways facilitated innovative, field-based, and participa-

Chicago Masonry Contractor – Early Adopter of EC

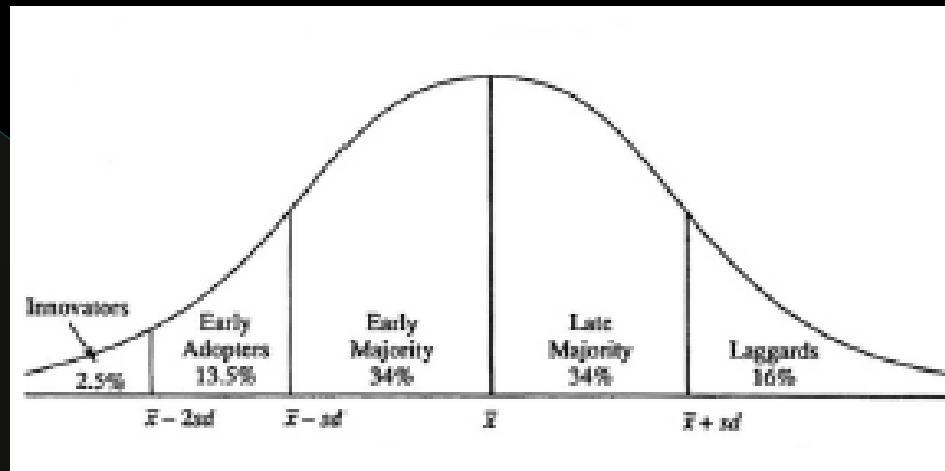


An innovation can be something old ....



...but “new” to an industry – like  
LEV in construction

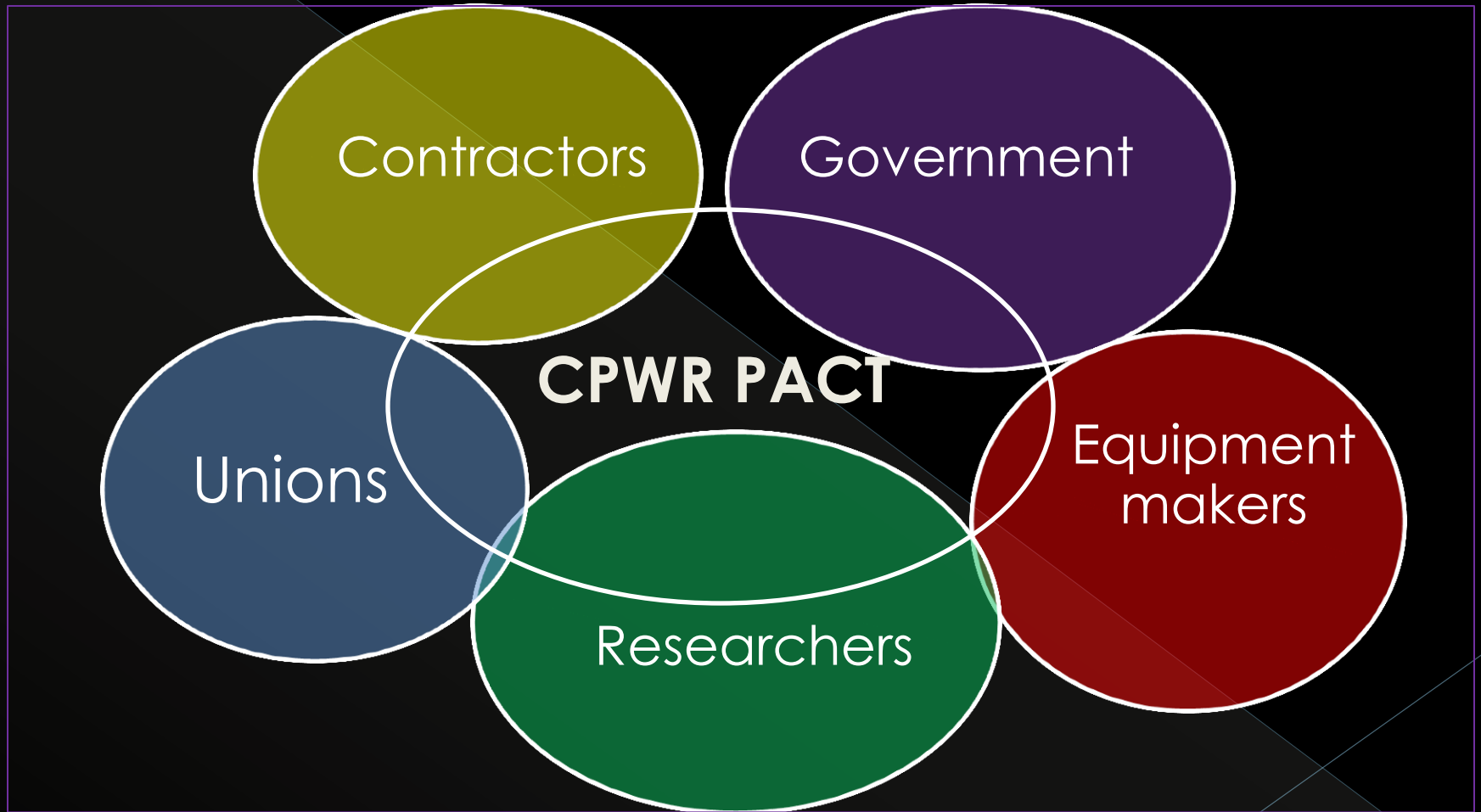
# Theories of Innovation Adoption



**TABLE 1 Target Population Attributes**

|                | Penetration Level at Time of Adoption | Attributes  | Factors Influencing Adoption   |
|----------------|---------------------------------------|---|--|
| Innovators     | < 2.5%                                | Self-perception as lead organization<br>Slack resources   | Promise of prestige<br>Expert opinions from those outside peer group                                   |
| Early adopters | 2.5–16%                               | Integrated in social system<br>Aspires to be a leader among peers<br>Influential as opinion leaders | Actions of innovators<br>Expert opinions from those outside peer group<br>Preliminary performance data |
| Early majority | 16–50%                                | Most integrated in social system<br>Desire to remain modern/<br>competitive                         | Peer groups<br>Performance data  |
| Late majority  | 50–84%                                | Cautious<br>Tight resources   | Competitive pressures<br>Stakeholder pressure  |
| Laggards       | > 84%                                 | Marginal position in community  | Regulation   |

Partnerships are a core part – brings together different organizations, expertise & perspectives for a common shared goal



# PACT LEV Selection Criteria – most important



Welding PACT, 2012

- ◎ Welding PACT
  - > Ease of use
  - > Compatibility
  - > Portability
- ◎ Silica PACT
  - > Impact on productivity

# General engineering control selling points (which includes LEV)

- It's more effective
- It's required by law
- Can be integrated into the job more seamlessly without hindering
  - > communication
  - > reducing peripheral vision, or
  - > adding a physiological burden on workers
- They eliminate the hazard at the source

# Engineering Controls

- More comfortable for the worker
- Reduces exposure and exposure variability
- Reduces exposures to other workers
- If effective, may be able to eliminate respirators and associated costs of a respiratory protection program

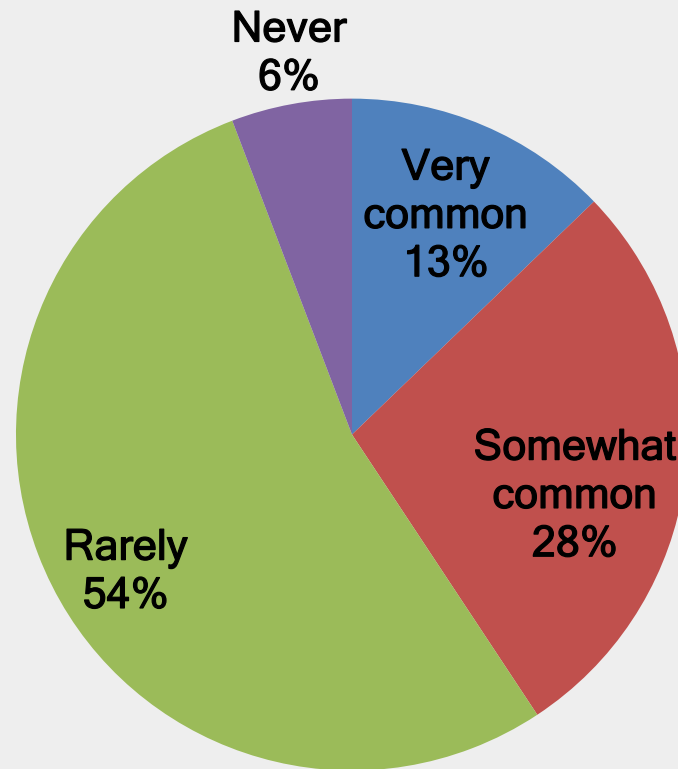


Use of engineering controls not common  
and understanding of hierarchy weak



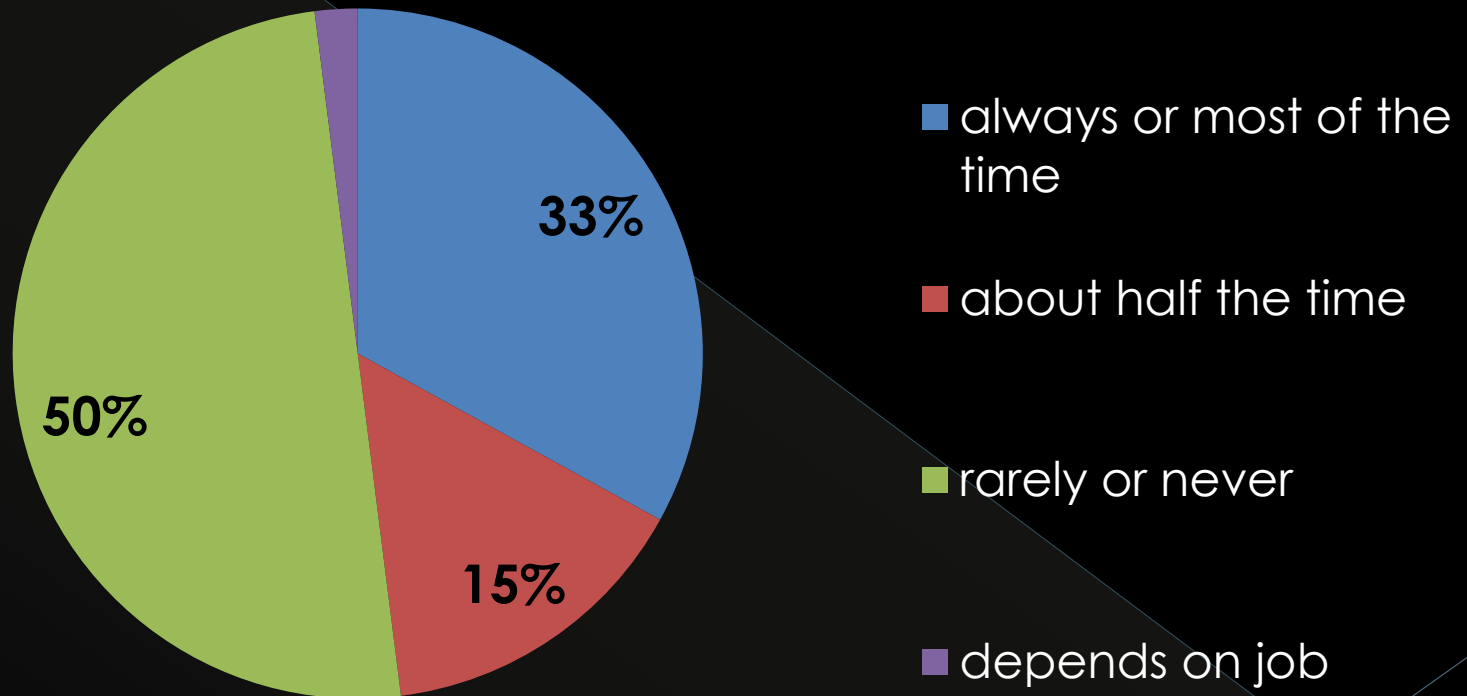
# Use of LEV for welding fumes on job sites according to apprenticeship coordinators from 3 major welding trades (n=86, survey conducted in 2011)

How common is use of local exhaust ventilation for welding fumes in your trade for CONSTRUCTION SITES in your area?



# Baseline data on LEV use based on survey of masonry contractors & union representatives

## All Contractors (n=136)



# The historical context and environment of construction – or why LEV is often a tough sell

- Very dangerous industry with disproportionate number of deaths
- Work is hard, heavy and often requires working in the elements under harsh, dirty conditions (= \$\$)
- Until recent decades (maybe years), awareness of the prevalence of chemical hazards & severity of exposures has been under appreciated

Past perceptions – work is outdoors  
with lots of fresh air....



# Construction worker breathing zone exposures substantial & general ventilation isn't adequate to control the hazard



# Acute safety related outcomes v. chronic health related outcomes

- more difficult to sell than a control that would prevent a fall, electrocution, serious injury or death having an immediate and direct effect on the employer
- Unions important allies in this regard since they are made up of:
  - Workers that experience the later suffering or shortened life span
  - Have health & welfare funds that will be hit by costs associated with chronic disease

# Construction worker hospitalized after equipment falls from Fort Worth bridge



FORT WORTH -- A construction worker was rushed to the hospital Tuesday afternoon after a piece of equipment he was working on fell 50 feet from the under-construction Chisolm Trail Parkway bridge off of Southwest Loop 820 – KEN5 News, Dec 17, 2013



Latent illness (like silicosis)  
surface later in life



# The market - construction is large and diverse

- Includes numerous types of contractors
- Dozens of trades
- Range of construction owners/users
  - > Public v. private
  - > Industrial & commercial
  - > Residential (developers and home owners)
- **These factors are important in the “sell” – Know your market!**

# Types of Construction Work

- Residential
- Commercial
- New Construction
- Renovation/Maintenance
- Demolition
- Industrial Renovation/Maintenance (e.g. pharmaceuticals & petrochemicals)
- Highway/Bridges/Tunnels
- Power Plants/Sewage Treatment
- Public building/schools/hospitals

# Lots of different trades – top 10 by employment

| Trade               | Number    | Percent |
|---------------------|-----------|---------|
| Carpenter           | 1,622,000 | 14.5    |
| Laborer             | 1,427,000 | 12.8    |
| Electrician         | 636,000   | 5.7     |
| Painter             | 621,000   | 5.6     |
| Plumber/pipe trades | 455,000   | 4.1     |
| Operating engineer  | 318,000   | 2.8     |
| Roofer              | 264,000   | 2.4     |
| Heat AC mechanic    | 261,000   | 2.3     |
| Carpet/tile         | 253,000   | 2.3     |

There are a number of “players” involved with and influencing use of engineering controls (ECs)

- OSHA
- Unions
- Equipment manufacturers
- Contractor Associations
- Regulators beyond OSHA
- Construction Client Users

# Unions

Sep. 26. 2013 9:19AM Bricklayers local #1

No. 7117 P. 2

## RESOLUTION REGARDING THE RECENTLY ISSUED SILICA STANDARD

September 23, 2013

For far too many years BAC's members have suffered and died needlessly from silica related illnesses and diseases. BAC has fought for more than four decades for stronger and more comprehensive occupational health standards for dust containing crystalline silica for the construction industry. The Union has been continuously committed to action by BAC Conventions including through the adoption of Resolution 97 by the 2000 BAC Convention, Resolution 87 by the 2005 BAC Convention and Resolution 34 by the 2010 BAC Convention. On September 12, 2013, the Occupational Safety and Health Administration finally released an improved silica standard. It is vital to our members that this long-overdue rule be finalized.

THEREFORE, BE IT RESOLVED that the Executive Council of the International Union of Bricklayers and Allied Craftworkers supports the IU Executive Board's actions and the commitment of the IU's resources to seeing this rule finalized.

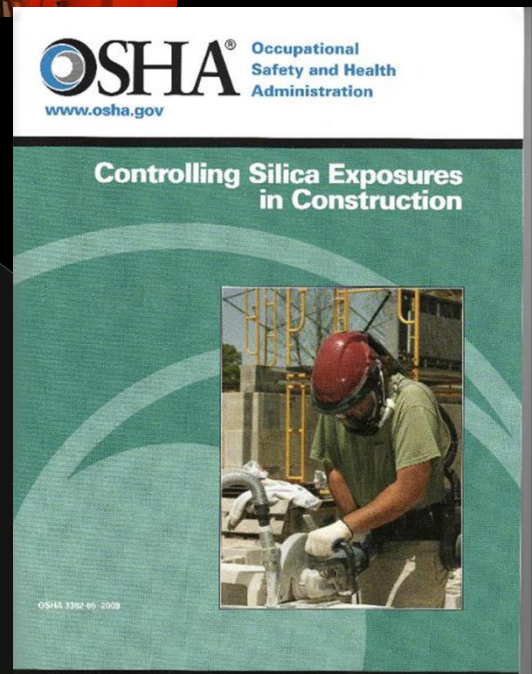
BE IT FURTHER RESOLVED that the Executive Council calls on each US Local to designate a contact person to work with us on comments and testimony; to work with labor and community partners to get more involvement and support for finalizing the standard; to identify a contractor willing to support our efforts; and to find a victim or family member of a victim of silica-related illness, or someone willing to relate their experience with silica exposure on the job.

- Influences the market as a whole in setting norms and standards
- Varies locally with depending on union density
- Uses political process to influence support of measures to protect workers nationally & locally
- Conducts training thereby raising awareness & expectations of workforce

# OSHA



- Enforcement
- Awareness and training
- Technical support through consultation program
- Networking through liasions & alliances



# Contractors

- Use of engineering controls often not standard practice, so that means new technology and work methods
- Impact on productivity a concern
- Not always averse to use, but generally must be required for them
  - > OSHA regs
  - > Owner requirements

Productivity impact usually a contractor concern but that may not always be well founded



# The HYTILE Roof Tile Cutter – a “green” alternative



- 35 lbs
- No cords (trip hazard) or blade
- eliminates noise, dust and safety hazards assoc. with use of power saws
- Chisel lasts 6 mos/\$35 v. diamond saw blades, about \$30+, 2/week
- Respirator costs eliminated

HYTILE vs Grinder

|                               | HYTILE                 |                  |                  |                   |                   |                   |                    |                    |
|-------------------------------|------------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|
|                               | Initial Purchase Price | First Month      | Second Month     | Sixth Month       | First Year        | Second Year       | Fifth Year         | 5 Year TOTAL       |
| HYTILE Roof Tile Cutter       | \$949.00               | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$0.00             | \$949.00           |
| Chisels and Wheels for HYTILE | \$0.00                 | \$0.00           | \$0.00           | \$0.00            | \$70.00           | \$140.00          | \$350.00           | \$350.00           |
| Safety Glasses                | \$7.00                 | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$14.00           | \$28.00            | \$35.00            |
| <b>TOTAL</b>                  | <b>\$956.00</b>        | <b>\$0.00</b>    | <b>\$0.00</b>    | <b>\$0.00</b>     | <b>\$70.00</b>    | <b>\$154.00</b>   | <b>\$378.00</b>    | <b>\$1334.00</b>   |
|                               | GRINDER/SAW            |                  |                  |                   |                   |                   |                    |                    |
|                               | Initial Purchase Price | First Month      | Second Month     | Sixth Month       | First Year        | Second Year       | Fifth Year         | 5 Year TOTAL       |
| Grinder/Saw                   | \$100.00               | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$100.00           | \$200.00           |
| Diamond Blades for Grinder    | \$30.00                | \$240.00         | \$540.00         | \$1560.00         | \$3120.00         | \$6240.00         | \$15600.00         | \$15630.00         |
| Generator                     | \$250.00               | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$250.00           | \$500.00           |
| Extension Cords               | \$75.00                | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$75.00            | \$150.00           |
| Blowers                       | \$160.00               | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$160.00           | \$320.00           |
| Full Face Respirator          | \$100.00               | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$100.00           | \$200.00           |
| Filters for Respirator        | \$0.00                 | \$32.00          | \$64.00          | \$192.00          | \$384.00          | \$768.00          | \$1920.00          | \$1952.00          |
| Hearing Protection            | \$20.00                | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$0.00            | \$20.00            | \$40.00            |
| Safety Glasses                | \$7.00                 | \$0.00           | \$0.00           | \$0.00            | \$0.00            | \$14.00           | \$28.00            | \$35.00            |
| Fuel for Generator            | \$0.00                 | \$18.25          | \$36.50          | \$109.50          | \$319.00          | \$638.00          | \$1595.00          | \$1595.00          |
| <b>TOTAL</b>                  | <b>\$742.00</b>        | <b>\$290.25</b>  | <b>\$640.50</b>  | <b>\$1861.50</b>  | <b>\$3823.00</b>  | <b>\$7660.00</b>  | <b>\$19848.00</b>  | <b>\$20622.00</b>  |
| <b>Profit/Loss</b>            | <b>\$214.00</b>        | <b>-\$290.25</b> | <b>-\$640.50</b> | <b>-\$1861.50</b> | <b>-\$3753.00</b> | <b>-\$7506.00</b> | <b>-\$19470.00</b> | <b>-\$19288.00</b> |

Data provided by HYTILE USA

## Use of LEV and other engineering controls more common outside the U.S. – comments from and observations from manufacturers

- “The U.S. is 40 years behind Europe” (Swedish LEV manufacturer)
- “they sale superbly well in Australia and in New Zealand, ... decently well in Europe; a new push is being made to introduce them into the North American market in advance of the proposed silica rule; beginning to gain traction in South FL and in CA where there are stricter regulations...”  
(HYTILE)

# Ermator investing in product development based on CPWR research findings



# What we've learned - factors that influence LEV use

- LEV characteristics
- Trades involved
- Type of contractor
- Client/user
- regulatory & public impact factors
- Costs of controls relative to costs of equipment and tools already in use

# Factors influencing LEV adoption



- Use of ECs on milling/paving machines
- Use of LEV on tuckpoint-grinders
- Use of LEV for welding
- Dust controls for “taping” – drywall sanding

# EC Adoption Factors

| Operation & control          | Trades   | Contractors            | Prominent Clients            | Regulatory & public impact                       |
|------------------------------|--|------------------------|------------------------------|--|
| Asphalt paving & milling LEV | Operators/<br>Laborers                                 | Larger road building   | Largely public sector/fed \$ | NIOSH Ca designation/<br>asphalt                 |
| Welding/LEV                  | Pipefitters,<br>boilermakers<br>& other welding trades | Mechanical contractors | Often industrial             | OSHA Cr VI                                       |
| Tuckpointing /LEV            | Masonry trades   | Masonry                | Public & private bldg owners | Building occupants & fugitive dust emission stds |
| Drywall sanding/LEV          | Painters   | Painting               | Commercial & residential     | Weak regs;<br>some bldg occupant pressure        |

# Control cost ratio (EC/equipment & tools used)

| Operation & control | Primary equipment/tools  | Cost ratio        |
|---------------------|--------------------------|-------------------|
| Asphalt paving/ LEV | Paving machines          | \$\$\$/\$\$\$\$\$ |
| Welding/LEV         | Welding machine          | \$\$/\$\$\$       |
| Tuckpointing/LEV    | Tuckpoint grinder        | \$\$/\$           |
| Drywall sanding/LEV | Sandpaper or pole sander | \$\$/¢¢           |

# Reasons for using ECs and Success Stories

- Use of sand prohibited by state DOTs (e.g in NJ going back decades)
- biggest driver - costs assoc. with disposal of hazardous waste



# Use of LEV for tuck-pointing

- Municipal dust codes & permitting requirements
- Owner mandates



# Owner mandates – CPWR silica specifications



... and keeping the cars clean



worker assigned to wash dust off cars in the vicinity of masonry restoration project

Eliminate need for respirators desirable for both workers and contractors (and an important selling point)



# May sometimes need to supplement EC with an Administrative Control – Tuck-pointing



# Schedule Work to Reduce 8 hour time weighted average (TWA)

Mortar removal (4 hrs @ 10 mg/m<sup>3</sup>)

Repointing (4 hrs @ 0 mg/m<sup>3</sup>)

8 hour TWA = 5 mg/m<sup>3</sup>

Hypothetically, assume PEL is 5 milligrams per cubic meter (5 mg/m<sup>3</sup>) which is what it would be if there was NO silica in the mortar being ground out)

# Strategies for success

- Utilize partnerships and enlist support of and/or collaborate with allies
- Involve EC users in selection & design
- Be strategic and persistent



LEV most effective means of minimizing fugitive dust emissions and reduce public health risk



City of Philadelphia is improving dust codes to require use of dust controls - effort fostered by partnership with OSHA, CPWR and Bricklayers



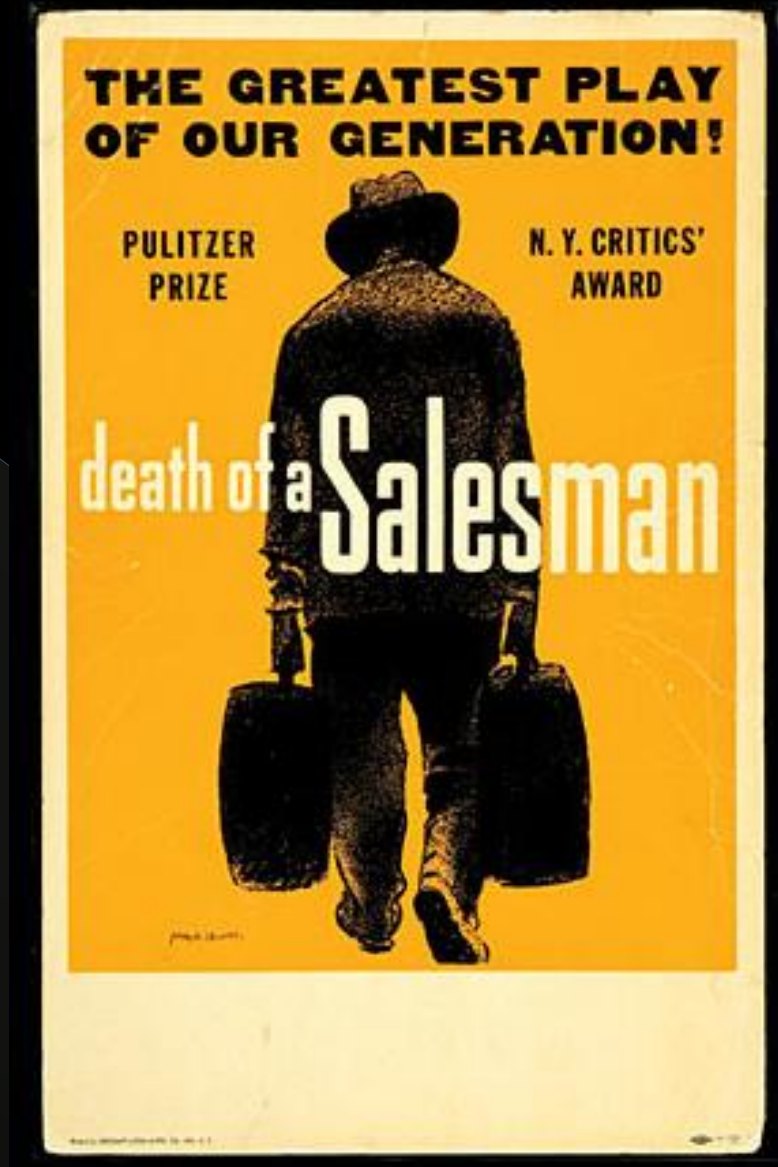
# Tuckpointer union rep talks with LEV equipment manufacturer (left) and Philly Air Mgmt. Services inspector observing LEV evaluations



# Strategies & Focus

- Largest impact on reducing illness
  - > Severity of hazard
  - > No. of workers exposed to hazard
- Consider characteristics and receptivity of the workforce/sub-specialty/client and regulatory/public impact climate
- Find and utilize allies

It's not always easy being an industrial hygienist...



But sometimes, with a little help  
and tactical thinking we prevail!!

