DoD Joint Technology Exchange Group (JTEG)
Virtual forum on Ergonomics in DoD Depot Maintenance Activities

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Linking Safety and Productivity to Power Hand Tool Evaluation and Procurement

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Objectives

- Describe safety of power tools with focus upon
  - Improving vibration, noise and ergonomics characteristics
  - Improving tool/process productivity and quality
  - Improving the quality of tools available to Federal workers and the construction industry in general
- Describe a process management approach that can be applied to other occupational health and safety / Human systems integration issues
  - Provide background of a project addressing hand-arm vibration through supply management and education.
  - Describe EG-1B1 Committee of the Society of Automotive development standard approaches for power tool evaluation and procurement
- **Discuss approaches to enhance the influence of safety and health professionals in leading process improvement efforts that enhance safety and productivity**

Pneumatic Tools in History

Samuel Ingersoll invented the pneumatic drill in 1871.

Charles Brady King of Detroit invented the pneumatic hammer (a hammer which is driven by compressed air) in 1890, and patented on January 28, 1894.

Charles King exhibited two of his inventions at the 1893 Worlds Columbia Exposition; a pneumatic hammer for riveting and caulking and a steel brake beam for railroad road cars.

Pneumatic Hammer
Beam, George L. 1868-1935. (George Lytle)
Men use pneumatic hammers to tamp Denver and Rio Grande Western Railroad track base, in Garfield County, Colorado.
http://inventors.about.com/od/weirdmuseums/ig/The-Films-of-Thomas-Edison/Pneumatic-Hammer-.htm

New Technology- New hazards Powered Hand Tools

Process management and equipment selection factors

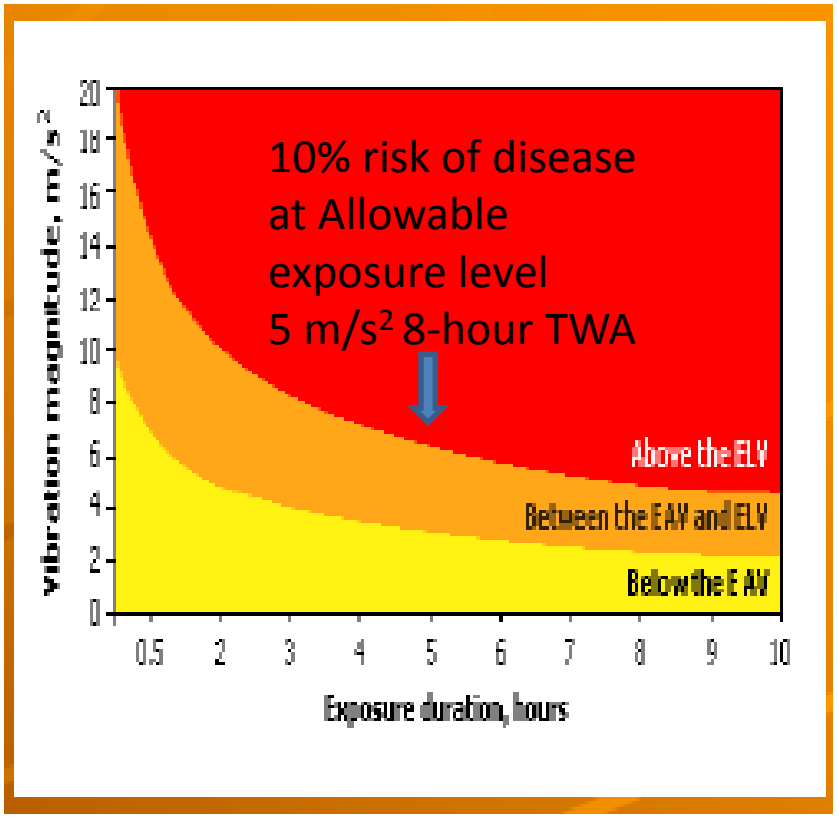
Factor or Risk	Health Impacts	Productivity Impacts	Potential controls
Vibration	Hand-arm vibration disease risk	Long-term impact on skilled workforce	Equipment selection and maintenance, Process selection
Noise	Hearing loss	Communication issues	
Dust-varied respiratory hazards	Silica-containing (silicosis) Heavy metals	Visibility of work	Alternative process, wet work, local exhaust
Ergonomic design of workplace and tools	Long-term disease potential	Direct link between comfort and productivity	Equipment selection and process design
Physical safety hazards/ controls	Potential injuries	Productivity impacts of work-arounds	Equipment selection and maintenance Note that labor and consumables are highest costs (up to 80% for grinding)
Life-cycle costs (replacement/ repair)	Low-cost tools are likely to be noisier, and less “ergonomic”	Decreased productivity and quality (cheap tools are expensive)	

Hand-arm Vibration -An Ignored Disease?

- **In 1918, Alice Hamilton, MD, identified and documented HAVS in Indiana limestone quarry workers. (She was actually looking for silicosis).**
- **Sixty years later in 1978, the National Institute for Occupational Safety and Health, NIOSH (Don Wasserman) completed a study at the same quarry and the incidence of disease was the same, about 80% of the exposed workers had symptoms of HAVS.**
  - **Up to 1978, there were no changes in pneumatic rock-breaking tools**
  - **The "attack rate " was about 50% for "at risk" exposed workers**

Hands of vibrating pneumatic hand-tool operator in later stages of irreversible Hand Arm Vibration Syndrome1

Dose-response Relationships between Exposure and Outcome for Vibration and Noise



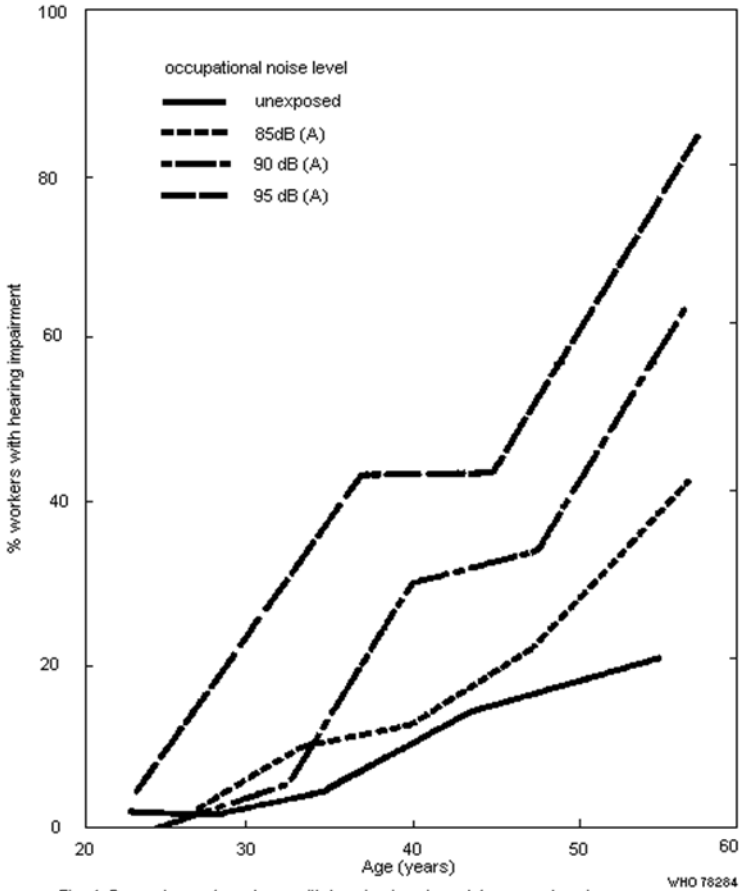


Fig. 4. Percentage of workers with hearing impairment (average hearing loss at 1, 2, and 3 kHz > 25 dB) (From: US National Institute for Occupational Safety and Health, 1972, 1973).

INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY **ENVIRONMENTAL HEALTH CRITERIA 12 NOISE** World Health Organization Geneva, 1980

Project outcomes include

Defense Safety Oversight Council Projects

- Influenced GSA procurement criteria for power hand tools
- Provided certified (third-party) anti-vibration gloves in the Federal supply system via DLA.
  - Berry Amendment compliant (US Mfr) made in the U.S.
- Increased awareness throughout DOD and industry partners of hand-arm vibration issues
- Supported several NIOSH research projects
- Guidelines on how to justify and purchase AV tools and gloves
- **But- still limited influence on everyday-purchase decisions for powered hand tools**
- **Guidelines have not been accepted as policy requirements**

U.S. Regulatory Challenges

Great old music - Not such great old standards

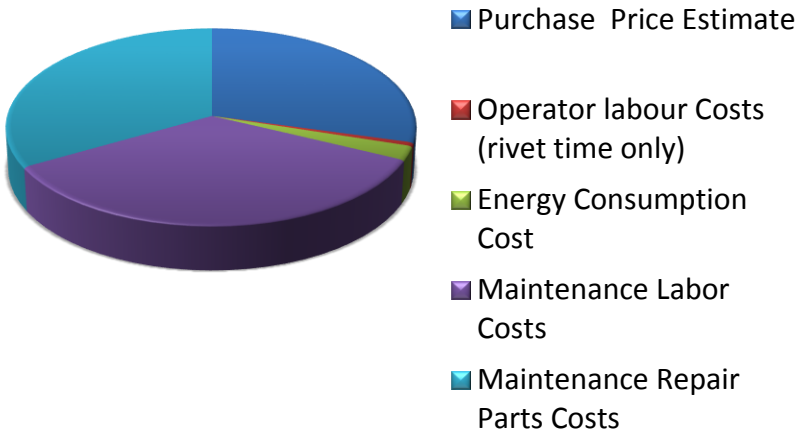
- OSHA Permissible Exposure Limits (PELs) stuck in the 1970s
- Proposed Ergonomics Standard derailed in 1999
- Budget, signed into law Dec. 23, 2011 prohibits OSHA from developing a rule that would add a musculoskeletal disorder column to the OSHA 300 form.
- **Contrast with European Union regulation of vibration since 2003**

Need for "Balanced Scorecard" SAE International E1B Committee Meeting in Kansas City, Mo Jan 18-19, 2012

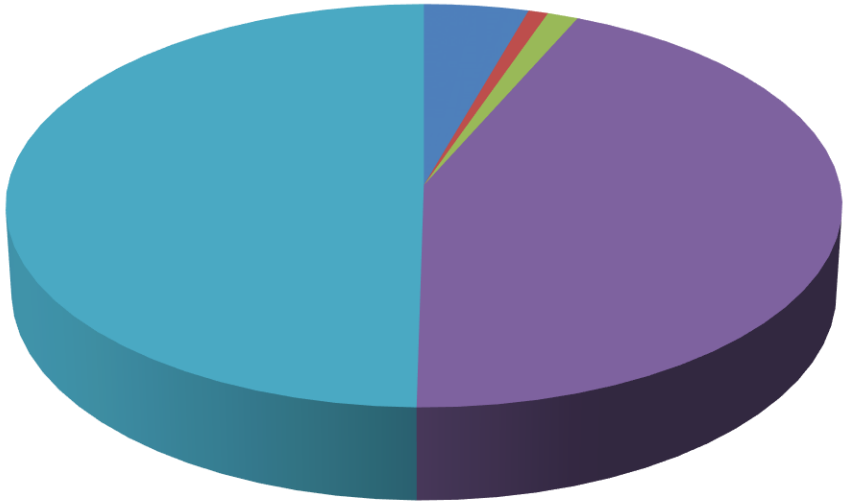
- GSA Power tool leads, tool manufactures, DOD safety and Health and NIOSH represented
- Mutual interest in obtaining and selling better tools
  - Better products can (and will) be undercut if initial cost is the only purchase criteria
  - Safety/ Ergonomics/Productivity and Quality coincide
- Developing rating criteria to consider all aspects of life-cycle
  - Productivity
  - Safety and health – Noise -Vibration - Ergonomics
  - Life-cycle costs
    - Maintenance/parts * Energy-Utilities (especially air) * Injuries/Illness

Total Cost of Ownership (TCO)

Brand "X" Rivet Hammer



Brand "Y" Rivet Hammer



Initial tool cost $1,200 ⟺ **Initial tool cost $312**

5 year cost $15,750 ⟺ **5 year cost $32,312**

Low price ≠ Low TCO

AS 6228 Safety Requirements for Procurement, Maintenance and Use of Hand-held Powered Tools

Factor	Relative Weighting	Notes
Productivity	20%	May include cycle time; amount of material removed, time to accomplish a particular amount of work.
Noise	10%	Depends on relative contribution of noise as a risk factor.
Hand-arm vibration	20%	Depends on relative contribution as a risk factor. For example: 5% of the evaluation based on vibration levels if < 2.5%. 10% if tools operate in the range of > 5.0 m/s^2 15% if tools > 10 m/s^2 and used >2 hours/day
Ergonomic factors other than shock and vibration	20%	Guidance from Atlas Copco Guide to Power Hand tool Ergonomics and associated references.
Initial purchase cost	5%	May depend on anticipated life-span of tool and intensity of use (for example, occasional; periodic; daily).
Life cycle cost	15%	Includes maintenance - parts and labor- and potentially consumables and utilities

NOTIONAL EVALUATION OF ALTERNATIVE NOISE LEVELS IN PORTABLE TOOL OPERATION*

Sound level (dBA)*	>115	114	112	108	105	102	99	96	93	90	87
Score (highest possible rating of 10)	≥ 115 dBA Unacceptable	1	2	3	4	5	6	7	8	9	10
Multiplier 1 (10% of total score)		1	2	3	4	5	6	7	8	9	10
Products evaluated and sound level						Tool 3 101 dBA		Tool 2 97 dBA			Tool 3 88 dBA
Noise "score"		Acceptable, but not optimal				5		7			10

Tool 4- 115 dBA Unacceptable For purchase

← Threshold = Acceptable minimum performance level

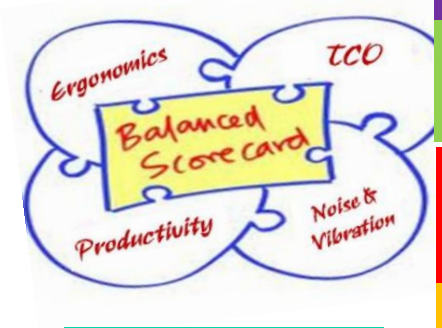
Objective-Preferred (desired) sound level

*From Table A1-4C in AS 6228 Safety Requirements for Procurement, Maintenance and Use of Hand-held Powered Tools (2014)

Balanced Scorecard Evaluation

Used for screening tools- prior to worker trial evaluation

An "ideal" tool could have an maximum score of 100 points



A higher score in a given category indicates more favorable performance Such as higher productivity or lower noise levels

Productivity
Ergonomic Factors
Total Ownership cost
Initial purchase
Noise and Vibration

Model A

Productivity
Ergonomic Factors
Total Ownership cost
Initial purchase
Noise and Vibration

Model B

Productivity
Ergonomic Factors
Total Ownership cost (low)
Initial purchase cost Low)
Noise and Vibration

Model C

Factors Evaluated

Productivity

Ergonomic Factors

Total Ownership cost

Initial purchase

Noise and Vibration

Can a DOD effort provide leadership and suitable equipment that will influence others within this organization and the larger marketplace?

- Role of DOD occupational health establishment
  - Role of DOD in many health and safety areas including noise, heat/cold stress, ergonomics
  - Recent initiatives to reduce mishaps
- Market influence
  - DOD and allied defense industry size
  - International role (Europe, Asia)
  - Corps of Engineers safety and health guidance for Federal contracts

Approaches to Tool and Process Management

- Getting the best (versus best marketing) vendors
- What aspects of European and other approaches might be considered?
- It's not just the tools –it's the process management!
- Cultural issues and organizational impediments to progress
- How integrate safety and health as an indicator of process quality and effectiveness

U.S. General Services Administration

Federal Acquisition Service

The Department of Defense/ Industry Working Group and the General Services Administration's Integrated Facilities Management and Industrial Product Solutions Center (IFMIPS), have been working together to ensure a wide variety of ergonomic, low-vibration tools are offered to the DoD and Federal communities. We have chosen to focus on lower vibration because of the risks of hand-arm vibration, producing Hand-Arm Vibration Syndrome (HAVS), a potentially irreversible disease associated with prolonged and intense exposure to this vibration. While low vibration tools are currently available on GSA Advantage there is little offered in the way National Stock Numbers (NSNs). In an effort to bolster the NSN pool with safer and more ergonomic tools GSA has established the Vibration-Controlled Tools portal (http://www.gsa.gov/portal/content/120150) on the GSA website explaining the initiative and providing a list of NSNs with vibration mitigation technology built into the tool.

Approach- Power Tools and Other products

- Evaluate power hand tools (or other products) where vibration, noise or other safety concerns are a hazard
- Evaluate possible approaches to facilitate and document labs which can provide testing and evaluation
- Identify and communicate with GSA/DLA product manager regarding procurement criteria
  - (See the SD-1 Defense Standardization Program: Standardization Directory (Federal Supply Class FSC and Area Assignments)
  - Available on the Assist data base https://assist.daps.dla.mil/
  - Identify the same need at local and process management level
- Make improved products available via GSA schedule and NSN programs to both Federal and Federal contractor buyers
  - Contractors can buy through GSA for certain government projects
  - Product marketed by GSA have open description and specifications via the Low Vibration Portal on GSA.gov

Wider Applications

- Many Federal contractors can order via GSA under certain conditions
- GSA has done the hard part- providing expert review, establishing technical criteria facilitating the identifying alternative products and greater competition among manufacturers while maintaining the highest quality products for DOD and the Federal Government and development of specifications
- Federal construction contracts invoke Army Corps of Engineers EM-385-10-1 Safety Manual
  - Federal Acquisition Regulations FAR Clause 52.236-13
  - Currently addresses cumulative trauma and tool safety
  - New edition will require control of whole body and segmental vibration and an organizational safety policy
- http://www.usace.army.mil/SafetyandOccupationalHealth/SafetyandHealthRequirementsManual.aspx

Questions/ Discussion?

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