Process Management Approaches to Power Hand Tool Selection and Use

or

How to finally control hand arm vibration syndrome and other occupational diseases

In collaboration with
Johan Hedekall, Atlas Copco, Sweden,
Ergonomics of Hand tools

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Disclaimer

Material and views presented are the responsibility of the author and do not necessarily represent official Navy/DOD policy.

Members of the Society of Automotive Engineers standards activities participate on their own behalf as technical experts and do not necessarily represent the views of their employing organizations.
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 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

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
**Powered Hand Tools**

Process management and equipment selection factors

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

Current Trends –Some Safety-related

- Atlas Copco- sustainable productivity
  - Tool design and process focus on ergonomics
    - [http://www.atlascopco.us/usus/](http://www.atlascopco.us/usus/)
- European Union regulation of vibration Exposures 2003- stimulated production of low-vibration tools
- Increased use of electric tools
  - Portable belt mounted battery packs
  - Lithium ion battery technology
- Assistive Technology –stabilized arm
  - ZeroG for Sanding Aircraft: 53% Reduction in Labor Hours
- Increased concerns for silica and other dusts
  - Unfortunately, not universally
    - High-velocity-low volume local exhaust and other controls
Role of Technology and Process Management in Powered Tools

Are you still using 1960s Design Power Tools?

Technology advances 1960 to 2015 include

- Quieter
- Lighter
- Case and handle vibration isolated
- Auto-balancing of grinding wheel
- Lower vibration
- Better ergonomics
- Easier to maintain quality
- Reduced use/wastage of consumables
- Better machine guarding - less likely to injure user
- Improved productivity and quality
- Better power to weight ratio

- Labor and consumables are 80% of cost for grinding - Un-economical not to spend a little more for a better tool!

Hand-arm Vibration An Ignored Disease?

- In 1918, Alice Hamilton, MD, identified and documented HAVS in Indiana limestone quarry workers
- 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
  - “attack rate” was about 50% for “at risk” exposed workers
Hand Vibration Injuries

Hand Arm Vibration Syndrome (HAVS) is an illness caused by vibration when working with tools or holding a vibrating work piece.

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

Copyright 1990, D.E. Wasserman, Inc.
Image of hands (not US Navy worker).
Used with Permission.

common “White Finger” effect termed Reynaud’s Disease

Occupational exposure limits for hand-arm vibration demonstrate a good correlation between exposures to vibration (measured as acceleration) and the incidence & prevention of disease.

An example from the forestry industry in Finland (Koskimies et. al. 1992):

<table>
<thead>
<tr>
<th>Equipment Type (Chain Saw)</th>
<th>Vibration</th>
<th>Prevalence of HAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing equipment (unimproved)</td>
<td>14 m/s²</td>
<td>40%</td>
</tr>
<tr>
<td>(1972)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anti-vibration design</td>
<td>2 m/s²</td>
<td>5%</td>
</tr>
<tr>
<td>(1990)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Product Selection is Vital for Vibration (and Noise) Control

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/unfocused influence on everyday-purchase decisions for powered hand tools
- Guidelines have not been accepted as policy requirements
U.S. Regulatory Challenges

- 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

Challenges

- Educating industrial hygienists and safety professionals to understand and engage in existing processes for feedback
- Integrating information for change as opposed to traditional surveys and reports
- Streamlining and clarifying current processes and policies
- Establishing new policies and procedures, if needed
Need New Approach Systems Engineering!

• Tried the moral approach – failed due to perceived budgetary constraints
• Only looked at initial tool cost and ignored Total Cost of Ownership (TCO)
  – DOD term is TOC (total ownership cost)
• Need to make a “business case” to show total cost to shop

Total Cost of Ownership (TCO)

<table>
<thead>
<tr>
<th>Brand “X” Rivet Hammer</th>
<th>Brand “Y” Rivet Hammer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase Price Estimate</td>
<td>Initial tool cost $1,200</td>
</tr>
<tr>
<td>Operator labour Costs (rivet time only)</td>
<td>Initial tool cost $312</td>
</tr>
<tr>
<td>Energy Consumption Cost</td>
<td>5 year cost $15,750</td>
</tr>
<tr>
<td>Maintenance Labor Costs</td>
<td>5 year cost $32,312</td>
</tr>
<tr>
<td>Maintenance Repair Parts Costs</td>
<td></td>
</tr>
</tbody>
</table>

Low price ≠ Low TCO
Need for “Balanced Scorecard”
Society of Automotive Engineers (SAE) 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

SAE TECHNICAL COMMITTEE EG-1B1, POWERED HAND TOOLS - PRODUCTIVITY, ERGONOMICS AND SAFETY

- Addresses evaluation, procurement, use and support of powered hand tools
  - Integrating safety, health and productivity into procurement and process management.

- Complements the SAE EG-1B Aerospace Hand Tool Committee which addresses all facets of aerospace hand tools and tool kits.

- Focus on development of Aerospace Standard AS6228,which provides programmatic guidance for sustainable tool evaluation, procurement, maintenance and use.
  - Will educate tool users and program managers.
  - Promote economic effectiveness and efficiency.

- Members include government, original equipment manufacturers, and tool users
**AS 6228 Safety Requirements for Procurement, Maintenance and Use of Hand-held Powered Tools**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Relative Weighting</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>20%</td>
<td>May include cycle time; amount of material removed, time to accomplish a particular amount of work.</td>
</tr>
<tr>
<td>Noise</td>
<td>10%</td>
<td>Depends on relative contribution of noise as a risk factor.</td>
</tr>
<tr>
<td>Hand-arm vibration</td>
<td>20%</td>
<td>Depends on relative contribution as a risk factor. For example: 5% of the evaluation based on vibration levels if &lt; 2.5%. 10% if tools operate in the range of &gt; 5.0 m/s². 15% if tools &gt; 10 m/s² and used &gt;2 hours/day</td>
</tr>
<tr>
<td>Ergonomic factors other than shock and vibration</td>
<td>20%</td>
<td>Guidance from Atlas Copco Guide to Power Hand tool Ergonomics and associated references.</td>
</tr>
<tr>
<td>Initial procurement cost</td>
<td>5%</td>
<td>May depend on anticipated life-span of tool and intensity of use (for example, occasional; periodic; daily).</td>
</tr>
<tr>
<td>Life cycle cost</td>
<td>15%</td>
<td>Includes maintenance - parts and labor- and potentially consumables and utilities</td>
</tr>
</tbody>
</table>

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**Balanced Scorecard Evaluation**

Used for screening tools- prior to worker trial evaluation

- **Factors Evaluated**
  - 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
  - Initial purchase
  - Noise and Vibration

- **Model C**
  - Productivity
  - Ergonomic Factors
  - Total Ownership cost
  - Initial purchase
  - Noise and Vibration

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.
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

Alternative Views of Federal Procurement
The 800 pound Gorilla and/or Hopeless Maze

The 800 pound gorilla with widespread market influence

Amazing complexity
- Each organization has their own maze
- Progress is slow and inconsistent- even if the process can be understood
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

The Department of Defense/Industry Working Group and the General Services Administration Heartland Acquisition Center (HAC) have been working together to ensure a wide variety of ergonomic, low-vibration tools are offered to the DoD community. 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. Tools developed to reduce vibration often also have other desirable performance properties such as longer life-spans, improved ergonomics and lower noise levels. This brochure outlines program details. General Ergonomic Program Details can be found at the following sites, or at your unit safety officer office. [https://www.gsaglobalsupply.gsa.gov/](https://www.gsaglobalsupply.gsa.gov/)
The Approach - Power Tools
(and other products)

• Evaluate power hand tools (or other products) where vibration, noise or other safety concerns are a hazard
• Identify and communicate with GSA/DLA product manager regarding procurement criteria (See SD-1 Standardization Directory)
  – Identify the same need at local and process management level
• Establish procedures for the Qualified Products List (QPL)
  – Evaluate possible approaches to facilitate and document labs which can provide testing and evaluation
• Make improved products available via GSA schedule both to Federal and Federal contractor buyers
  – Contractors can buy through GSA for certain government projects
  – Product marketed by GSA have open description of specifications
    (Usable to any prospective purchaser—even if they don’t buy from GSA)

I’m not a Fed - Why should I care?

• Many Federal contractors can order via GSA under certain conditions
• GSA has done the hard part- providing expert review, identifying alternative products, developing specifications
  – You can use this information to review alternative products and specifications—even if you can’t buy directly from GSA
• 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
Wrap-up – Systems Engineering Approach is Needed!

- HAVS and other safety/health risk factors will be addressed through a tool evaluation process employing a Balanced Scorecard approach.
- Society of Automotive Engineers EG1-B1 Committee developing evaluation guidance
  - Members include DOD Health and Safety, General Services Administration and industry representatives
  - Standard is intended to allow a common approach to procurement without needing to justify each purchase individually
- DOD and allied defense industry size = market influence
  - International role (Europe, Asia)
  - Corps of Engineers safety and health guidance for Federal contracts a possible consideration
- Regulatory challenges will need to be addressed.
- Link with NIOSH is vital to this effort
  - Health Effects Research Laboratory (Vibration evaluation)
  - Construction Safety and Health
  - Prevention through Design
- Support for outreach to industry and Federal agencies

AS 6228 What’s Next?

- Outreach- webinars sponsored by SAE explaining the standard and its application
  - Probably beginning in April 2015
  - Presentation to Defense Industrial Association Symposium in November 2014
  - Collaboration with NAVSEA Shipyard Ergonomics Working Group (prototype for other DOD groups)
- Re-access the standard in about a year
  - Potential updates as appropriate
  - Develop an Aerospace Technical Report describing how to implement the standard
- Continued collaboration and outreach with GSA, DOD and industry
Thank you

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SAE EG-1B1 Committee Powered Hand Tools – Productivity, ergonomics and safety (www.sae.org)

References and Resources

• SD-1 Manual- Standardization Directory
  – Assist database https://assistca.dla.mil/
• Logistics 101- Defense Acquisition University
• General Services Administration GSA
  – www.gsa.gov
  – http://www.gsa.gov/portal/content/104772
• Defense Logistics Agency (DLA)
  – http://www.dla.mil/Pages/default.aspx
  – Customer support network
    • http://www.dla.mil/Pages/Customers.aspx
Consistency with Other Safety and Health Standards

• Overlapping with ANSI Z10-2012 Occupational Safety and Health Management Systems
• Many other process standards cited and/or used in development
• AS 6228 intended to be integrated into organizational process management approaches

Back-up Materials
Naval Safety Center Outreach Efforts

Data Sources for Power Hand Tool Noise and Vibration


Publications

• Society of Automotive Engineers Standard AS 6228 Safety Requirements for Procurement, Maintenance and Use of Hand-held Powered Tools September 2014 (available www.sae.org)


DEVELOPMENT OF A BALANCED SCORECARD FOR EVALUATION AND PROCUREMENT OF POWERED HAND TOOLS

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Steve Chervak, Army Public Health Command, Aberdeen Proving Ground, MD
Ren Dong, National Institute for Occupational Safety and Health, Morgantown, WV
Mark Geiger, Naval Safety Center Liaison Office, Pentagon, Arlington, VA
Craig Henderson, retired, previous Puget Sound Naval Shipyard
Keith Herbster, Atlas Copco, Auburn Hills, Michigan
Roy Jardin, M.S., Dynamics Research Corp DRC, Robbins AFB, Robbins, Georgia
Craig Kuznia, General Services Administration, Kansas City, MO
Mark Lehnert, Stanley Black and Decker, New Britain, CT
Thomas McDowell, National Institute for Occupational Safety and Health, Morgantown, WV
Magnus Persson, Atlas Copco, Stockholm, Sweden
John Ster, JMS Aerospace Engineering and Consulting (previously Engineering Director GSA Kansas City)
Don Wasserman, Consultant, Frederick, MD
Andrew Wells, USAF Health Risk Assessment Division, Wright Pat AFB, Dayton, OH
Vibration Monitoring

- Identify operations of concern
  - Current complaints/medical monitoring
  - Process information re frequency, duration and specific risk factors (especially similar operations)
- Measure vibration levels
  - RMS using tri-axial pick-up (typically weighted)
  - Accelerometer mounting is key
  - Estimate dosage based on intensity and duration
  - Observe work operations
  - Reference ANSI S2.70
- Evaluate alternative products, as appropriate
  - See NIOSH and European Union databases for initial evaluation
  - Worker evaluation should be the final assessment
  - Medical monitoring
    - ACGIH/ DOD Medical Monitoring Manual, Guide 508
    - Anti-vibration –full finger gloves (ANSI S2.73/ISO 10819)
NIOSH Data Base for Powered Hand Tools
Includes noise and vibration

NIOSH provides a power-tool data base on their website with information on belt sanders, circular saws, drills, grinders, hammer drills, impact wrenches, jigsaw, miter saw, orbital saw, reciprocating saw and powered screw drivers


European Union Database
Provides for search of tools and manufactures products for sound and vibration levels

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Phone: +46 (0)90 - 786 00 00
Fax: +46 (0)90 - 786 24 56

http://www.vibration.db.umu.se/HavSok.aspx?lang=en

Hand-Arm Vibration as a Risk Factor in Systems Design, Development, and Support

Paper/Presentation at International System Safety Conference
San Diego August 2005

Carol Lavery, MPH, CIH* Nancy Estrada, MPH*
Alec Wong, MS* Jane Nowell, MS, CIH*
LT Kristen Harrer, MS* Mark Geiger, MS, CIH, CSP**

* Naval Medical Center, San Diego

**OPNAV Safety Liaison Office
Evaluation of Three Pavement Breakers

- Construction Battalion 405 (CBU) cement pad removal (40X80 ft)
- Comparison
  - standard pavement breaker
  - 2 anti-vibration pavement breakers

Before and After Pavement Breaker Substitution
Work done by Naval Medical Center, San Diego

<table>
<thead>
<tr>
<th>Work method</th>
<th>Initial Pavement breaker (jack hammer)</th>
<th>Alternative Bobcat equipped with pavement breaker</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool type/brand</td>
<td>Hand-arm Vibration exposure (re 5 m/s² criteria)</td>
<td>Hand-arm Vibration exposure (re 5 m/s² criteria)</td>
<td>5 m/s² criteria applied</td>
</tr>
<tr>
<td>Chicago (standard)</td>
<td>382 (m/s²)</td>
<td>--</td>
<td>Initial efforts to select better tools</td>
</tr>
<tr>
<td>Chicago (anti-vibration)</td>
<td>277 (m/s²)</td>
<td>--</td>
<td>Slightly better</td>
</tr>
<tr>
<td>Atlas Copco (anti-vibration)</td>
<td>18.9 (m/s²)</td>
<td>--</td>
<td>Much better but &gt;&gt; 5 m/s²</td>
</tr>
<tr>
<td>Bobcat – with pavement breaker</td>
<td>--Nil-</td>
<td>--</td>
<td>Final control by process change</td>
</tr>
<tr>
<td>Man-hours</td>
<td>80</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Labor cost</td>
<td>$2000</td>
<td>$200</td>
<td></td>
</tr>
</tbody>
</table>
**Sanding Aircraft**

- Paint Shop prepares surfaces for painting
- All aircraft require some sanding prior to painting
- Thickness of previous layers of paint dictates how much sanding

---

**Frequency-weighted rms Acceleration of a Random Orbital Sanders for the Dominant Axis (Z-Axis)**

<table>
<thead>
<tr>
<th>Sander</th>
<th>Average Acceleration Dominant Handle Axis (m/s²)</th>
<th>Allowable Vibration Exposure Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Detroit</td>
<td>14.4</td>
<td>&lt;1 hour</td>
</tr>
<tr>
<td>George Renault</td>
<td>6.0</td>
<td>&lt;4 hours</td>
</tr>
<tr>
<td>Dynabrade</td>
<td>7.0</td>
<td>2 hours</td>
</tr>
<tr>
<td>Clayton</td>
<td>6.3*</td>
<td>Less than 1 hour</td>
</tr>
</tbody>
</table>

*The HVM 100 registered an overload while taking measurements generated by the Clayton sander. Therefore, this value is not accurate and the actual value could not be determined.*

This study used the ACGIH TLVs (dominant axis) to evaluate exposures.
Effects of Process Substitution
Sanding versus Blasting Parts
F/A-18 Wing Corrosion Shop
Small parts have paint removed to look for corrosion

- Dirty, corroded small parts
- Hand sanding with power tools
- Because the parts are small and have corners and tight areas to get into it took 3-4 hours to remove paint and corrosion from the parts.
- High hand-arm vibration exposures
- Clean, un-corroded parts
- Whereas, in the blasting cabinet (glove box) it takes about 20 minutes.
- Other advantages include: Less stress to hands and arms due to vibration and repetitive motion, dust control (chromates), less damage to part.

Mishap Risk Assessment Matrix Before and After Process Change
Using Military Standard 882 System Safety per DOD Acquisition Regulations

<table>
<thead>
<tr>
<th>Probability (Frequency)</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I Catastrophic</td>
</tr>
<tr>
<td>A Frequent</td>
<td>IA - 1</td>
</tr>
<tr>
<td>B Probable</td>
<td>IB - 2</td>
</tr>
<tr>
<td>C Occasional</td>
<td>IC - 4</td>
</tr>
<tr>
<td>D Remote</td>
<td>ID - 8</td>
</tr>
<tr>
<td>E Improbable</td>
<td>IE - 12</td>
</tr>
</tbody>
</table>

Initial Exposures – SERIOUS- PEO Initial risk level IIIB to IIC, depending upon length of exposure

Modified risk level IIID or IVC, Medium to Low (somewhat dependent on length of exposure) PM or local risk acceptance.
Comparison of Bucking Bars
Richard Borcicky, Ergonomist
Fleet Readiness Center, East, Cherry Point, NC
February 2008

Bucking Bars Vibration Testing May 4th, 2007

- With Grip Wrap
- Without Grip Wrap
- New Design Tool Bar
- Straight Bar

L Bar
23.53 Times

4.5 Times
7.53

1.85
4.1 Times
4.1

1.72
32
7.53

0
1
2
3
4
5
6
7
8
1
1.41
1.85
.41
1.72
.32
7.53
4.5 Times
4.1 Times
23.53 Times
New Design Tool Bar
Straight Bar
L Bar
With Grip Wrap
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Bucking Bars Vibration Testing May 4th, 2007

- With Grip Wrap
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23.53 Times

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<table>
<thead>
<tr>
<th>Vibration m/s²</th>
<th>L-Bar bar</th>
<th>New design bar</th>
<th>Straight bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
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<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
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Productivity Losses from Inefficiency

Resulting loss in productivity

Newly Repaired Tool
Efficiency lost over time
Productivity Savings

- Example Productivity Calculation
  - (1) fully burdened labor hour = $45
  - Cost of a PM = $150
  - Tool operating at 85% of max. power
  - If tool is not PM’d:
    - Each 1 hour job now takes 1 hour, 9 minutes
    - Additional cost per hour = $6.75
  - If tool is PM’d:
    - PM cost = $150
    - Payback = 23 hours
  - Assuming (4) PM’s per year:
    - Annual savings per tool = $6,450
Application to Other Issues
(Notes for Federal Workers)

• How to determine who “owns” a product
  – SD-1 Standardization Manual identifies GSA/DLA product managers and service coordinators
• Inputs to product managers
  – Technical manuals
  – Comments on particular specification
  – Assist database
• Inputs to service and systems command process managers
• Application for non-Federal/Non-DOD users (i.e. other taxpayers)
  – Corps of Engineers E 385-10 Construction Safety Manual –applied to DOD contracts –now includes safety programs and hand arm vibration
  – Specifications and procurement criteria are public information-
  – Developing procurement specs and proving their use is the hardest task- The government has already done this for you (even if you don’t buy government products). www.gsa.gov.assist

Project Relevance to Department of the Navy
Goals and Objectives for Fiscal Year 2015

1. Take Care of Our People
   – Support Health and Quality of Life for Military and Civilians
2. Maximize Warfighter Readiness and Avoid Hollowness
   – Continually Improve Safety Through Predictive, Hazard-Based Analysis
     – Build and Strengthen Partnership Capacity and Key Alliances
4. Promote Acquisition Excellence and Integrity
   – Increase Cost Effectiveness through Enhanced Competition
   – Preserve the Core Industrial Base
   – Leverage Strategic Sourcing
6. Drive Innovative Enterprise Transformation
   – Leverage the DON Enterprise to Maximize Efficiencies and Promote Technology Innovation