Final Report: Worksite Redesign Project Agreement Contract # 97/99-7

Work Performed By:

Roadmaster, Inc.
Mr. Terry Elstad and Robert Cahill
5602 Skyport Way
Portland, OR 97218

Curt Shaw, MSIH, CIH, CSP
Succeed Safety and Health Services, Inc.
P.O. Box 502
Salem, OR 97308-0502
www.lossfree.com
503.362.2090

Al Duble, PE, Inc.
Acoustical Consultant
16905 NE Kings Grade
Newberg, OR 97132

Date of Report:

August 4, 2000

Summary

The Noise Study Grant was initiated to identify, design, and evaluate various noise control approaches to reduce employee noise exposures caused by hand held grinding equipment. The hand held grinders are used to grind various metal parts. Parts are worked at waist height on metal tables. The parts are components of tow bars and brackets used in the recreational vehicle industry. Employee noise exposures prior to the study were typically in excess of 100 decibels (dBA) on both the low threshold and high threshold assessments. Various control approaches were applied and evaluated in the study. Ergonomic assessments of the work station and hand held grinders were also conducted to ensure that ergonomic issues were enhanced through the study as well. Low and High Threshold Time Weighted Average exposures of employees using the final controls selected (i.e., grinder booth noise enclosure; new grinder equipment equipped with noise control devices) were reduced to less than 90 dBA.

Findings and Discussion

A Noise Study Grant was undertaken at Roadmaster, Inc. to identify, design, and evaluate various noise control approaches to reduce employee noise exposures. Employees were operating hand held grinders used to grind small to medium size mild steel parts.

Prior to the initiation of the study, employee high and low threshold exposures were in some cases in excess of 100 dBA. Grinders that were being used were producing a significant portion of the employee exposures. This was compounded with the design of grinding tables that were allowing reflective noise sources as well. The hand held grinders being used were also relatively large and heavy and produced greater amounts of vibration contributing to ergonomic stresses. Proximate noise sources in the area at the initiation of the study as well as at the completion of the study were several punch presses, drill press equipment, and belt grinding operations (all involving mild steel working).

The application of control approaches were applied and evaluated throughout the course of the study. Control approaches included:

- Different models and manufacturers of grinders to evaluate grinder noise levels, and vibration
- Two types of grinder face shields, and a welding helmet were modified with attenuation materials to evaluate their effectiveness in reducing employee exposures
- Matting on grinder table surfaces
- Grinder booths providing attenuation panels on the sides and rear, with extended heights and sides

Interim reports were generated as the individual controls outlined above were implemented and evaluated.

Improvements were noted from the use of various grinders. Two types of grinders are used in the area. A 90° angle grinder, and a die grinder are used. Original equipment was typically not muffled whereas the new equipment is provided with manufacturer supplied mufflers to attenuate noise levels and/or redirect the exhaust point to an area away from the worker. Significant improvements were noted in the study from the use of different models and manufacturers of grinding equipment.

The use of mats on the surface of the grinding tables, and attenuating panels on the sides and rear (along with extension of the sides and height of the panels) also produced positive results.

Two types of grinder face shields were being used in the facility. One had no chin or brow protection, and one was equipped with chin and brow protection. Noise levels on the interior side of the face shield when equipped with the brow and chin protection was noted to be less than face shields without this additional shielding. Attenuation material was also placed on the inside surfaces of the face shields provided with the chin and brow shields to determine if additional attenuation was provided. The noise levels for this additional control approach indicated positive results in a field test, whereas the lab assessment indicated only slightly enhanced performance (and insignificant). This was not recommended as a control to be implemented in the final design approach.

The ergonomics of the process were also assessed in the course and study to ensure that stressers are not increased through the application of noise control approaches. Vibration assessments of grinders, weight and handling issues, contact points, and body positioning issues were evaluated. Once again, significant differences were noted between various models and manufacturers of grinders in terms of vibration and weight, as well as ease of handling and use of the equipment. The final equipment selected was an AIR ANGLE GRINDER/ STORM AGD-100-2 4 ½ “; AND A STORM ¼ “ DIE GRINDER. These grinders also have a much better gripping surface (original grinders were very large and heavy). The weight of the units was also addressed through the provision of counter balance devices placed above the grinder tables. However, due to the intricacy of the grinds, detailed work, constant movement and repositioning of the grinders was needed. Hence, the attachment point to the counter balance device was viewed by employees to be “interfering” and hence was not recommended for final implementation. Absorbent floor matting was also provided for the grinder work stations.

Final control approaches can be summarized below (see photo #1):

- Design and provision of grinder booths provided with side and rear partitions made of attenuating materials (see attached drawings); perforated panels with 3/16 " holes @ 269 holes per sq. ft. with internal sound absorbing material
- Sound absorbing matting on grinder booth table surfaces
- Use of AIR ANGLE GRINDER/ STORM AGD-100-2 4 ½ "; AND A STORM ¼ " DIE GRINDER providing less noise through both internal design differences, and use of muffler devices
- Provision of the grinders as outlined above providing improved ergonomics
- Provision of cushioned floor matting
- Specification for use in the position of ONLY the full face shield providing the brow and chin protector. This provides further reduction of noise levels on the interior of the device (vs. a Faceshield without full coverage, and increased protection for the grinding debris)

PHOTO #1: Noise Enclosure Workstation

PHOTO #2: Sound Enclosure Material on Backs an Side Panels

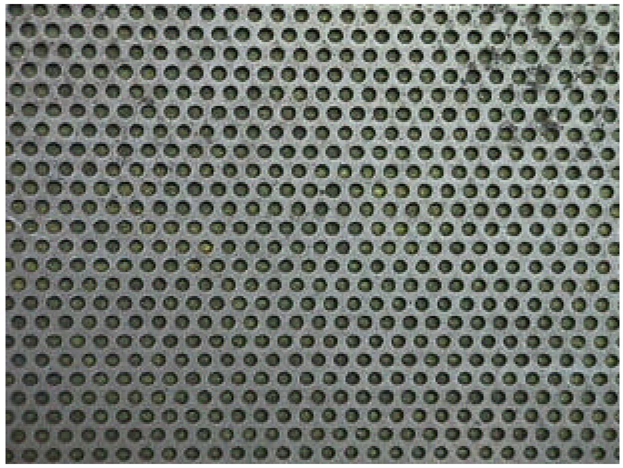

PHOTO #3: Personal Protective Equipment (Faceshield with Chin and Brow Piece)

PHOTO #4: Grinding Operation With New Grinders

Photo # 5: Floor Absorbent Matting

A Noise Evaluation was conducted of employees using the above control approaches. Noise dosimeters were placed on workers performing similar tasks with the same equipment. Three employees assessed were using the new control approaches, and one employee was using only the new grinders, but an unmodified grinder booth. All results are presented in Table I below:

TABLE I
Noise Exposure Assessment
May 24th, 2000

Employee/ Operation	Sample Time	Dose (Low Threshold)	Dose (High Threshold)	Time Weighted Average (Low Threshold) (dBA)	Time Weighted Average (High Threshold) (dBA)
M. Montes-Moreno; Grinding with New Controls	6:08:02	98.1	74.7	91.8	89.8
S. Nikolau; Grinding with New Controls	6:16:07	87.5	67.5	90.8	88.9
I. Ckain; Grinding with New Controls	6:02:39	81.3	62.3	90.5	88.6
J. Garcia; Grinding without New Controls	6:10:22	169.9	156.1	95.7	95.1

In all cases, where the new controls were employed, high Threshold Noise Exposures were less than the High Threshold criteria of the Oregon Occupational Safety and Health Divisions (OR-OSHA) of 90.0 decibels (dBA). This is a dramatic improvement over the situation previous to the control approaches being applied. As noted above, it is apparent that the new workstation design is effective in reducing employee exposures. For comparison purposes, the results of the noise data generated prior to the implementation of any control approaches is outlined below [(results in dBA); Old Grinders, Unmodified Booth And Faceshield]:

- Low Threshold Employee Exposures ranged between 94.4 -104.0 at lapel
- High Threshold Exposures ranged between 93.8 -104.0

Project Costs

The costs for the project (ergonomic evaluations, noise evaluation, and materials and labor for fabrication) totaled $ 33,635.14. The material costs totaled $8,142.58, and all other costs were labor for fabrication and evaluation work performed. Four Grinding stations were fabricated with grant proceeds to evaluate the effect of modifying the area (as opposed to only one booth and then having proximate noise sources contribute to the employees' exposures. A summary of grant costs is attached.

Consideration of Administrative vs. Engineering Controls

The use of Administrative Controls (i.e., rotating employees to lesser exposed positions) was tried prior to the inception of the grant. The problem encountered was that the other laborer positions were proximate to the grinder operation. Their was benefit noted but not significant to reduce exposures to levels below the 85 dBA Low Threshold Criteria and in some cases the High Threshold of 90 dBA. Hence, engineering approaches were considered.

The grinder position is an entry level position as well and rotation of people "back" to this position is not viewed as positive by employees. Wage (including benefits) for this entry level position is $8.22 per hour. Maximum laborer wage is $14.55 per hour. Machinist positions are at $23.77 per hour. Hence, movement of people to these other positions also presents a wage issue, making engineering controls more desirable… i.e., if the area is designed to result in noise exposures less than the 90 dBA High Threshold limit of the noise standard. If the eight people that perform grinding were rotated to other positions in the facility:

1- a significant reduction would not be realized (i.e., they may still fall at 90 dBA or higher (prior to control implementation)
2- would adversely impact production in that an entry level person would be placed in a position that demanded more skill, resulting in quality and productivity decreases
3- employee morale would be impacted in that people that had advanced out if the positions would be placed back into entry level functions
4- cost impact would be estimated at $6.34 per hour per employee (rotating higher paid laborers to entry level positions). With two shifts this equates to about $105,500 per year (eight people @ eight hours per day, five days per week).

Pure cost per booth is estimated at $ 830.00 (material cost at $432.-; and labor and overhead at $398.-). This figure does not include the equipment set-up and engineering costs which were included as part of the grant study. Hence, on a per employee basis, the cost comparison would be $661.36 (one time expense) to use engineering approaches, vs. $2637.44 per year for administrative/rotation approaches.

Summary

The outcome of the grant was the design of noise enclosure workstations and specification of grinders and personal protective equipment resulting in reductions in employee noise exposures to levels less than the OR-OSHA criteria where engineering and/or administrative controls are required (i.e., less than 90 dBA, High Threshold). Noise levels of employees were not reduced to less than 85 dBA where hearing protection would no longer be recommended (and required for use by the organization). Ergonomics of the workstation were also enhanced through the specification of lighter grinders with proper grip sizes, and cushioned floor mats for these standing work positions. The booth design specification and grinder specifications are attached as reference material for others desiring to apply the same approaches to similar metal working applications.

Attachment 1:
Grant Expenditures

Attachment 2: Acoustical Grinding Table Drawings