Industrial Hygiene Evaluation

Desco Dust Free Tools

<u>Prepared for:</u>

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Revised October 2011

AN IMPORTANT NOTE:

The following test was initially conducted February 11, 1994, and evaluated seven locally exhausted power tool systems, each manufactured by DESCO MANUFACTURING CO. INC. The purpose of these tests were to evaluate the effectiveness of DESCO designed engineering controls in protecting workers and the environment from hazards resulting from lead abatement operations. Substitutions of similar type tools and vacuums produced by other manufacturers are not validated by this test report, and may result in excessive exposure levels!

For your information, two pages have been added to the lead test report illustrating tools tested, as well as a copy of Steel Structures Painting Council specification; SSPC SP-11.

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Industrial Hygiene Evaluation of

DESCO Dust FreeTools

I. Introduction

Pacific Safety Solutions, under contract to Desco Manufacturing Company, Inc. (Desco), evaluated seven surface conditioning tools under a variety of controlled conditions. The goal of this evaluation was to quantify worker airborne lead exposure and the amount of residual surface contamination generated from the use of these tools. The working hypothesis was that Desco's dust collector equipped tools are an effective engineering control during lead paint removal and will not cause significant worker exposure and surface contamination when used according to the manufacturers instructions.

The Construction Lead Standard, (29 CFR 1926.62), and common industrial hygiene practice, require employers to use engineering controls first, whenever possible, to lower exposure. The use of needle guns, circular sanders, and percussion based surface preparation tools has been common in the protective coating industry for many years. However, industry groups and regulatory agencies have recently identified normal use of these tools as potentially dangerous to the workers and environment when surfaces are coated with lead paint or other toxic materials.

This study will examine whether the Desco line of dust collector equipped coating removal and surface preparation tools offer an effective engineering control for the control of lead exposure and contamination under the conditions of the experiment. In particular, it will review the effectiveness of the floating, spring biased, shroud found on many Desco Dust Free tools.

II. SUMMARY

In a controlled environment, steel surfaces with known amounts of lead paint were subjected to treatment with Desco dust collector equipped tools connected to Desco Portable HEPA vacuum systems. Multiple trials and samples were taken for each tool and vacuum combination. Each tool was used for approximately 30 minutes. Control samples were taken between each trial to assure that airborne lead from a previous trial did not bias subsequent trials. Wipe samples in a constant location were taken after the completion of each tool/vacuum trial series.

This evaluation showed that airborne lead exposure to the tool operator was well below the OSHA Action Level (30μg/m^3) and the Permissible Exposure Limit (50μg/m^3). The mean exposure for all tools was 0.443± 0.064μg/m^3 (Mean ± Standard Error). All surface contamination wipes taken in the standard area after each tool period showed contamination below HUD guideline (floor, 200μg/ft^2) for public housing abatement at 30 minutes of active surface preparation. The average removable surface contamination was 62.25 ± 19.13μg/ft^2 (Mean ± Standard Error). However, all of the tools except the Right Angle Sander produced visible paint chips that were apparently too large for the small, back mounted vacuum used in the tests to pickup. The amount of debris was

very small for the surface area of paint removed by the tool, compared to personal observation of unventilated tools.

Statistical analysis of the data showed that there was no systematic bias or loading of the containment structure. However, airborne concentration data was so close to the limit of analytical detection that detailed statistical analysis is difficult with this sample size.

Desco dust control tools appear to be a valuable and effective engineering control for airborne lead exposure and surface contamination.

III. METHOD OF INVESTIGATION

A. Site Preparation

1. Enclosure

An approximately 11 by 10 by 9 foot (L x W x D) enclosure was constructed by Desco for this project. The enclosure was constructed of 2 by 4 inch studs and 6 mil plastic sheeting on all six sides. One entire end was hinged as a door to admit a forklift carrying the painted steel plates used in the project. A plan drawing of the enclosure, Figure 1, is located on page 3.

2. Ventilation

A Red Baron ST2000 HEPA filtration unit was attached to the enclosure at the end opposite of the door. This unit was measured to exhaust 1455 CFM when operating. A TSI 8315 termoanemometer was used in a 9 point face traverse to determine the exhaust volume.

Calculation of the enclosure volume determined that the HEPA system would cause about 1.44 air changes per minute when operating.

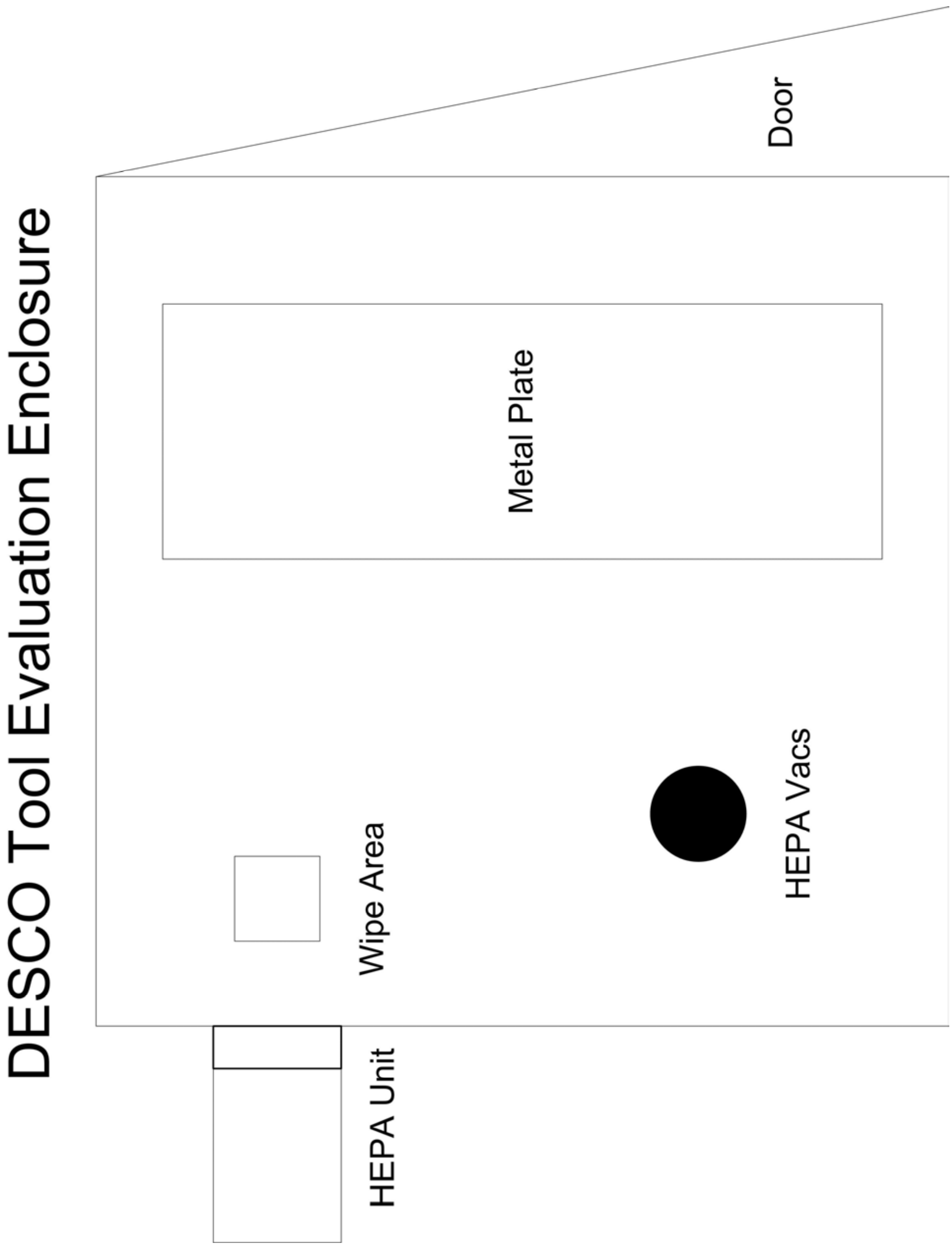
Air inlets were provided in the door area to allow for air to be admitted into the enclosure when the HEPA unit was operated. At least 0.2 inches of water negative pressure was maintained in the enclosure when the HEPA system was operating.

The negative air unit was only operated to clean the air between trials and tools. It was not operated during tool use in order to produce the worse case exposure situation.

3. Painted Surfaces

Steel and aluminum 0.25 inch thick plates measuring 8 by 4 feet were painted with three rolled coats of Pervo 3082 lead chromate traffic paint (Pervo Paint Company, Los Angeles, California.)

Figure 1


DESCO Tool Evaluation Enclosure
Door
Metal Plate
Wipe Area
HEPA Vacs
HEPA Unit

The paint lead density and concentration of the applied coating was determined by 1.25 inch square paint chip analysis. Five samples were taken in equal area portions of two of the plates. A heat gun was used to lift the intact chip from the substrate. Analysis of these samples showed an average paint density of 1.53 ± 0.03mg/cm^2 (Mean ± Standard Error). The lead concentration of the chips averaged 73,407 ± 699ppm by weight (Mean ± Standard Error). This concentration is well above the HUD Guideline by atomic absorption of 5,000ppm.

A steel I-beam was also painted with three coats of the paint for testing of the corner needle gun attachment.

4. Personal Protection

The tool operator wore PE coated Tyvek coveralls, booties and gloves with taped junctures, safety glasses, ear plugs and muffs, and a half-face air purifying respirator with HEPA cartridges.

B. Sampling Methodology and Analysis

1. Laboratory Analysis

All samples were analyzed by a laboratory accredited by the American Industrial Hygiene Association for metals analysis. Wipe and paint chip samples were analyzed according to AIHA/EPA Environmental Lead Laboratory Accreditation Program (ELLAP) protocols. The laboratory has applied for ELLAP accreditation. Air samples were analyzed according to NIOSH method 7105 using graphite furnace atomic absorption spectrometry.

Detection limits for breathing zone and control air samples were approximately 0.245µg/m^3. Detection limits for wipe samples were approximately 0.625µg/ft^2.

2. Air Sampling Protocols

NIOSH method 7105 was generally used for this study. 37mm Mixed Cellulose Ester (MCE) filters with a 0.8µm pore size (SKC 225-3-01) were used for sample collection.

Left and right breathing zone samples were taken during each trial on the operator from lapel locations. Flow rates of approximately 3 Liters Per Minute (LPM) were used for each approximately 15 minute sampling period. SKC Air Check 50 personal sampling pumps were mounted on the belt line of the equipment operator. This flow rate was required to assure adequate detection levels with a relatively short sample duration.

Enclosure control samples were taken at the center of the face of the HEPA exhaust unit between trials as described below. A flow rate of approximately

8 LPM from a Thomas RR-0015 high volume sampling pump was used for approximately 5 minutes during the clearance sampling.

A control for exposure outside the enclosure was taken each day by personal sampling pump and MCE filter. Flow rates of approximately 2 LPM were used for an entire day. These samples reviled an insignificant background level of lead on the property of 0.069μg/m^3 ± 0.012 (Mean ± Standard Error).

Daily blanks were taken and submitted for analysis.

Sample pumps were calibrated before and after each trial with a SKC rotameter calibrated against a primary standard.

Approximately the same volume of air was drawn through both the high volume control and breathing zone samples to maintain detection levels at approximately the same concentration.

3. Surface Contamination Wipes

Wipe of the same, one foot square area were taken after each tool had been used for two trials. This area was in front of the HEPA air unit's intake face. A 6 by 7.5 inch inexpensive house brand baby wipe was used according to HUD protocols for public housing. This wipe was folded and placed in a ziplock bag for storage and transportation to the laboratory. Daily blanks were taken and submitted for analysis.

C. Equipment Description

Equipment used in this evaluation are described on Table 1, located on page 6. They are listed in order of application.

Table 1 – Equipment Used for Exposure Evaluation
Desco Manufacturing Company, Inc.
Test Date: February 11, 1994
Updated: September 30, 2011

1) **Mini Flush Plate with Rotopeen Hub**
   a. Power source: Pneumatic
   b. Part number: 100.212
   c. Abrasive: 3M heavy duty rotopeen
   d. Abbreviation on graphics: RP

2) **Mini Flush Plate with Rotohammer Hub**
   a. Power source: Pneumatic
   b. Part number: 100.214
   c. Abrasive: Desco rotohammer hub
   d. Abbreviation on graphics: RH

3) **Needle Gun**
   a. Power source: Pneumatic
   b. Part number: 130.224
   c. Needles: 0.7" by 3mm, flat tip
   d. Abbreviation on graphics: NG

4) **Corner Needle Gun**
   a. Power source: Pneumatic
   b. Part number: 130.2243 with inside corner attachment.
   c. Needles 0.7" by 3mm, flat tip
   d. Abbreviation on graphics: NG

5) **Right Angle Sander**
   a. Power source: Pneumatic
   b. Part number: 151.210 with floating shroud
   c. Abrasive: 3M metal conditioning disk, coarse, Desco 810.714 7 inch diameter
   d. Abbreviation on graphics:
      - With large vacuum: RBV
      - With small vacuum: RSV

6) **Mini Die Grinder**
   a. Power source: Pneumatic
   b. Part number: 140.219 fixed shroud
   c. Abrasive: 3M metal conditioning disk, Desco 810.224 2 inch diameter

7) **Vacuums, HEPA Filtered**

   - *Standard*: Desco 305.006
     Backpack mounted, 87cfm at 75 inches of water lift (static pressure)

     This unit was used with all tools except the Mini Die Grinder

   - *Large*: Desco DE017915
     Floor mounted. 191 cfm at 75 inches of water lift (static pressure). Used with Mini Die grinder and one trial with the Right Angle Sander.

D. Experimental Methodology

The tool/vacuum combination tests were performed in order of increasing hypothetical contamination potential. The cleanest tools were used first, the dirtiest last. It was hoped to prevent contamination of the enclosure with biasing amounts of lead.

The metal plates were placed on blocks on the floor of the enclosure. The tool operator kneeled on or near the plate to perform his work. His breathing zone was within two to three feet of the tool at all times of operation.

A fixed cycle of tool use was used to allow for comparison between each tool. The cycle for a given tool/vacuum combination is shown on page 8 as Table 2.

E. Smoke Tests

Each tool was photographed operating with the vacuum on and off in the presence of irritant smoke. The purpose of this test was to qualitatively demonstrate the effectiveness of the exhaust capture systems on each tool.

IV FINDINGS

A. Summary

Findings are summarized in Table 3, located on page 8. Raw data is presented for inspection in Appendix A.

B. Airborne Exposure

All tools produced operator exposures well below the OSHA Action Level and Permissible Exposure Limits (30 and 50μg/m^3, respectively). High volume control samples averaged 0.593 ± 0.131 μg/m^3 (Mean ± Standard Error). The average breathing zone exposure was 0.443 ± 0.064μg/m^3 (Mean ± Standard Error). Individual exposures by tool are graphically presented in Figure 2, located on page 9.

Table 2 – Experimental Cycle
Desco Manufacturing Company, Inc.
Test Date: February 11, 1994

Event	Minutes from Start	Action
1	0 to 10	HEPA unit on.
2	10 to 15	High volume sample taken. HEPA unit on.
3	15 to 30	Trial 1, HEPA unit off. Tool in use.
4	30 to 40	Tool off, HEPA unit on. Change breathing zone cassettes.
5	40 to 45	High volume sample taken. HEPA unit on.
6	45 to 60	Trial 2, HEPA unit off. Tool in use.
7	60 to 70	Tool off. HEPA unit on. Change breathing zone cassettes.
8	70	Wipe sample. Change tool. Return to event 2 and repeat.

Only one trial with the corner needle gun was performed. The available substrate was striped of paint within 9 minutes of the start of the first trial.

Work was performed over two consecutive days.

Table 3 – Summary of Experimental Results
Desco Manufacturing Company, Inc.
Test Date: February 11, 1994

Tool	Mean Breathing Zone Concentration $\mu g/m^3$ (Mean ± Standard Error)	Removable Contamin. $\mu g/ft^2$
Mini-Flushplate with rotopeen	0.477 ± 0.609	120.75
Mini-Flushplate with rotohammer	0.350 ± 0.059	26.75
Needle Gun	0.757 ± 0.362	12.50
Needle Gun with corner attachment	0.804 ± 0.054	NA
Right Angle Sander large vacuum	0.261 ± 0.010	28.75
Right Angle Sander backpack vacuum	0.270 ± 0.016	50.50
Mini Die Grinder large vacuum	.0365 ± 0.182	144.75

A small, electric backpack mounted vacuum (305.006) used except where noted for exhaust ventilation.

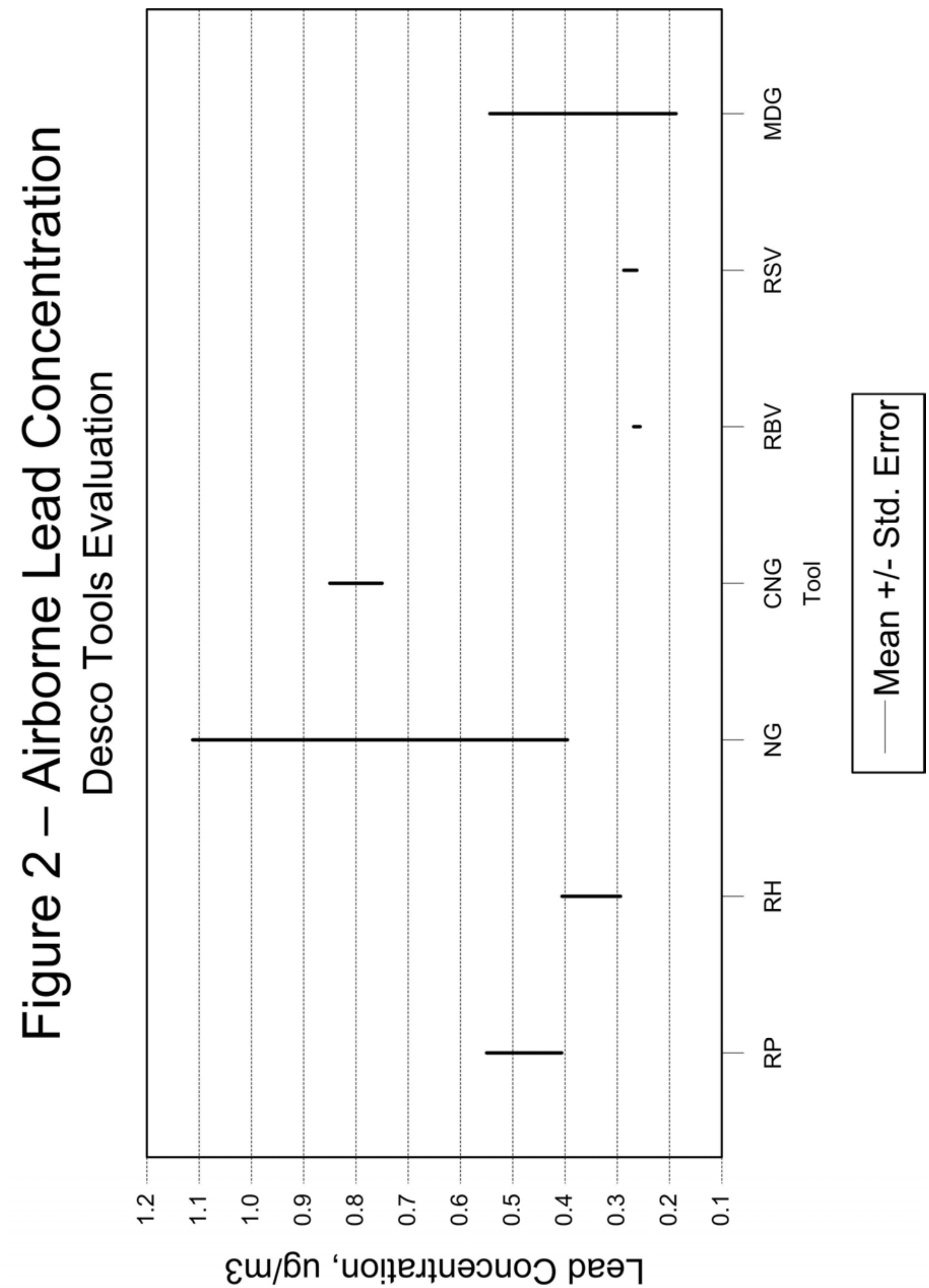


Figure 2 – Airborne Lead Concentration
Desco Tools Evaluation
Lead Concentration, ug/m3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
RP
RH
NG
CNG
RBV
RSV
MDG
Tool
Mean +/- Std. Error

C. Removable Surface Contamination

Removable surface contamination averaged 62.25 ± 19.13 μg/ft^2 (Mean ± Standard Error). All samples taken were below the HUD Interim Guidelines floor standard of 200μg/ft^2. Individual exposures by tool are graphically presented in Figure 3, located on page 11.

In spite of the finding, visible chips and debris were noticed in the enclosure after each trial. The Mini Flush Plate produced a large, scaping-like debris which could be vacuumed with the tool if it escaped initial capture. The needle gun produced chips about 5mm square that, at times, escaped capture. The Mini Die Grinder produced the most visible debris. A fine, sand-like grit was deposited by the tool. Only the right angle sander trials, regardless of the size of the vacuum, did not leave some visible paint debris. Visible debris was vacuumed between trials. The smallest vacuum in the Desco line was used except as noted in these trials. The Mini Die Grinder was not equipped with the more effective floating shroud during the trials.

D. Paint Removal Effectiveness

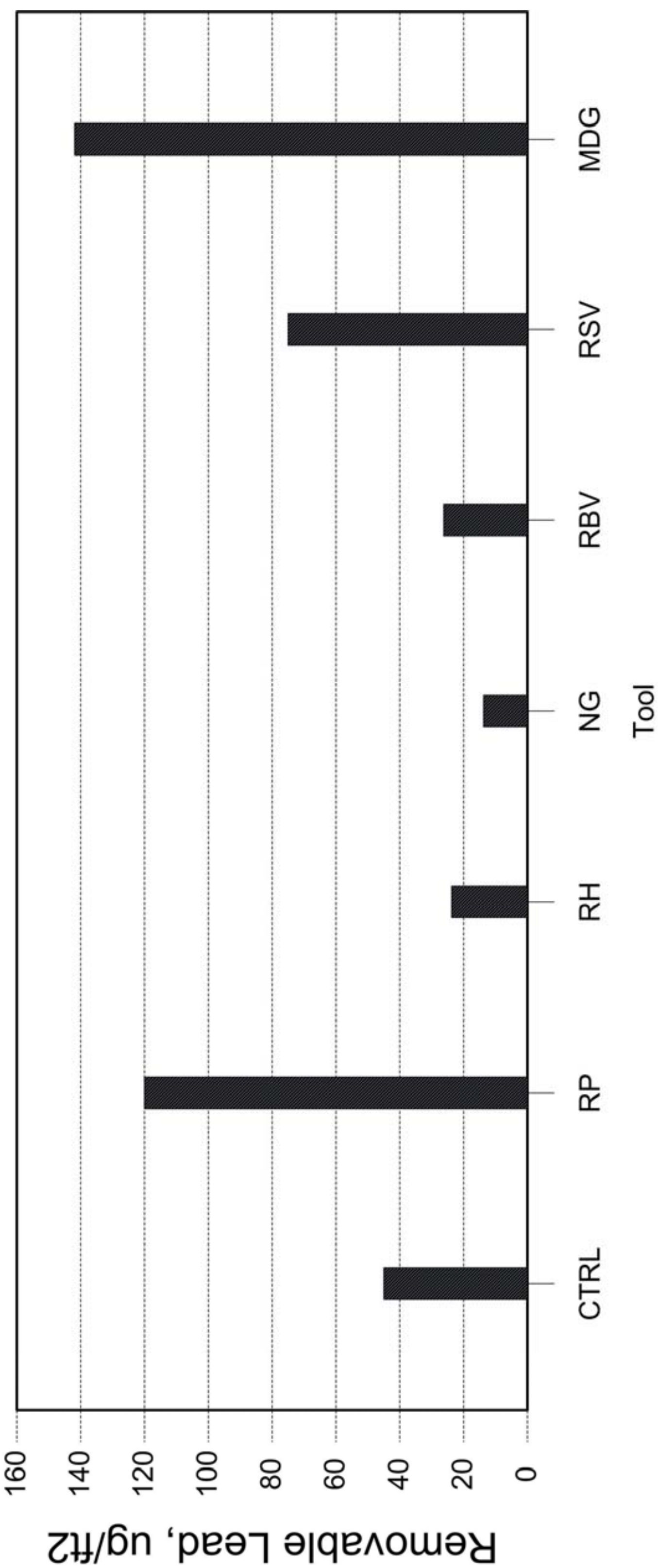
The degree of paint removal was generally good to excellent with these tools. All tools except the Right Angle Sanders removed paint and metal scale with gusto. The Right Angle Sanders polished the paint surface to a dull sheen. This situation was not unexpected as they are designed for fine surface preparation.

E. Irritant Smoke Capture Experiments

All tools effectively captured smoke from a smoke tube at approximately 4 inches from the flange of the dust collector. Air from the pneumatic motor occasionally disturbed the capture. However, since the tools are designed to capture fine dust before it leaves the enclosed area, this finding is not significant.

Figure 3 – Lead Surface Contamination

Desco Tools Evaluation



F. Statistical Analysis

Data was subjected to Analysis of Variance (ANOVA) tests for systematic bias. Although the scale of this project precluded the sample size required for rigorous analysis, no bias was found in the data that could be analyzed. Particularly of interest was the finding that no exposure or wipe sampling data is likely significantly different between tools. It was also statistically shown that the paint application to the substrate was even and that no area was likely to be significantly different in paint application than any other area.

Data was determined to suffer from "floor effect". Floor effect is a truncating of the lift hand tall of the distribution that occurs when data is near the detection limit (floor) of a given analysis.

An example of this effect is the fact that the mean between trial control airborne concentration appears higher than the breathing zone data. These numbers are not likely to be statistically significant due to floor effect. Even if they were, airborne exposure was still approximately 100 times lower than the PEL.

V. DISCUSSION

This data shows that these tools are highly effective at capturing the aerodynamic particles of concern under the conditions of the experiment. The airborne exposures realized are remarkably low for the amount of paint removed during the experiment.

Surface contamination levels should be used for comparison only as 30 minute values are too short to be representative of conditions at an actual work site. As was stated above, limited statistical analysis showed that the levels of contamination produced were not different between the different tools. This fact is contradicted by visible emissions from the tools. The wipe site was chosen to represent settled dust downwind of the work area thus this apparent discrepancy can be reconciled.

The amount of paint chips and debris produced by these tools was not insignificant. However, the qualitative contamination was far lower with the Desco dust collector equipped tools. These tools clearly helped control surface contamination. They would have likely been even more effective had a larger vacuum been used and a floating shroud been installed on the Mini Die Grinder.

Results such as these could leave one with the impression that containment and protective equipment for the operator is no longer necessary. This approach is not recommended for the following reasons.

Lead work sites can often be contaminated from years of abrasive blasting, paint leaching, and the presence of other hazardous wastes. Work in these sites can expose workers before the existing paint is even touched.

Another reason to generally require protection is that lead dust and debris may be made airborne by the vibration that percussion tools induce in the substrate. Loose and peeling paint has been observed to fall off of steel structures in poor condition from tool vibration. No tool-mounted ventilation system could protect workers from such exposure.

A further concern is that vacuum systems must operate properly while the tools are being used to assure that exhaust ventilation is continuous. Blockage or accidental disconnection of vacuum systems can occur at any site. With the degree of hearing protection required by these tools, an operator could easily not notice if the vacuum system was impaired. Use of static pressure monitoring systems on the vacuum could be a valuable addition in this regard.

A final concern is operator error. As with any tool, these systems are as safe as the person using them. Worker training and proper use is essential if the full benefits of the exhaust systems and Desco's floating shroud are to be realized. Particular care to not let the shroud pass an edge or lift the tool away from the substrate must be taken. The floating shroud greatly limits the effects of improper tilting of the tools. Nevertheless, exposure to lead or other hazardous materials can occur with these tools if there are human or equipment failures.

Basic personal protective equipment and simple containment, appropriate to the specific situation, would be in order for any lead removal project.

It should also be stated that these results are for a specific paint under closely controlled operating conditions. An experienced, trained worker was used to operate the tools. Distractions and interruptions were minimized. As required in the Construction Lead Standard, individual exposure and necessary protection, including the use of protective equipment and safe work practices, must be evaluated for each job site and work task to fully assure worker safety.

VI. CONCLUSIONS

A. Desco's line of dust collector equipped surface conditioning tools produced very limited operator exposure to lead as used in this experiment.

B. Removable surface contamination was confined to the immediate work area and was reduced over that which would have been expected from non-dust collector equipped tools.

C. The requirements for personnel protective equipment and containment are lowered by the proper use of the Desco Dust Free line of surface preparation tools.

D. Use of Desco dust collector equipped tools is an effective way to help comply with the Construction Lead Standard's requirements for engineering control of lead exposure.

VII. ACKNOWLEDGEMENTS

The author is grateful for the contributions to this project made by the following individuals:

Mr. Michael Connor, CIH; Acumen Industrial Hygiene
Ms. Christine M. Miller, PhD; California State University, Sacramento
Mr. Tom Sharkey, MS
Mr. Wes Straub, CIH; Straub Industrial Hygiene
Mr. John Pesce; Star Environmental

Appendix A – Raw Data

DESCO TOOLS EVALUATION
RAWDATA

AIRBORNE EXPOSURE DATA MICROGRAMS PER CUBIC METER

TOOL	LABEL	OUTSIDE CNTL	TRIAL 1 CNTL	TRIAL 1 LEFT	TRIAL 1 RIGHT	TRIAL 2 CNTL	TRIAL 2 LEFT	TRIAL 2 RIGHT	MEAN	STD. ERROR
Rotopeen, Small Vac	RP	0.081	0.309	0.476	0.651	0.734	0.466	0.313	0.477	0.069
Rotohammer, Small Vac	RH	0.081	0.522	0.257	0.365	0.400	0.511	0.266	0.350	0.059
Needle Gun, Small Vac	NG	0.081	0.638	0.544	0.356	0.894	1.830	0.297	0.757	0.362
Corner Needle Gun, Small Vac	CNG	0.057	0.495	0.856	0.750	NA	NA	NA	0.804	0.054
Right Angle Sander, Big Vac	RBV	0.057	2.030	0.261	0.253	0.294	0.289	0.241	0.261	0.010
Right Angle Sander, Small Vac	RSV	0.057	0.506	0.253	0.241	0.294	0.274	0.313	0.270	0.016
Mini Die Grinder, Big Vac	MDG	0.057	0.294	0.497	0.254	0.302	0.452	0.256	0.365	0.182

NA: NOT AVAILABLE DUE TO LACK OF SUBSTRATE

SURFACE CONTAMINATION
UG/SQ FOOT

TOOL	LABEL	RESULT
Control	CNTL	46.75
Mini Flush Plate-Rotopeen	RP	120.78
Mini Flush Plate-Rotohammer	RH	26.75
Needle Gun	NG	12.50
Right Angle Sander, Big Vac	RBV	28.75
Right Angle Sander, Small Vac	RSV	55.50
Mini Die Grinder	MDG	144.75
MEAN		62.25
STD. ERROR		19.13

PAINT DENSITY SAMPLES, MG/CM2

SAMPLE	PLATE 1	PLATE 2
A	1.02	1.43
B	1.64	1.39
C	1.53	1.53
D	1.55	1.60
E	1.38	1.63
MEAN		1.53
STD. ERROR		0.03

PAINT CONCENTRATION SAMPLES, PPM

SAMPLE	PLATE 1	PLATE 2
A	71433.2	70301.1
B	73785.7	76720.4
C	78749.4	72385.8
D	75024.0	71518.8
E	73872.1	72479.0
MEAN		13406.95
STD. ERROR		699.13

TOOL DESIGNATIONS

	PART #	VACCUM UNIT	ABRASIVE
Mini Flush Plate, Rotpeen	100.212	305.006	HEAVY DUTY TUNGSTEN CARBIDE ROTOPEEN
Mini Flush Plate, Rotohammer	100.214	305.006	ROTATING IMPACT DESCALER
Needle Gun	130.224	305.006	0.7" BY 3MM FLAT TIP
Corner Needle Gun (attachment)	130.2243	305.006	0.7" BY 3MM FLAT TIP
Right Angle Sander, Big Vac	151.210	DE017915	METAL CONDITIONING DISK, 810.714
Right Angle Sander, Small Vac	151.210	305.006	METAL CONDITIONING DISK, 810.714
Mini Die Grinder	140.219	DE017915	METAL CONDITIONING DISK, 810.714, NC FLOATING SHROUD USED