

International Union of Operating Engineers National Hazmat Program

Human Factors Assessment Report

DeWalt Reciprocating Saw OENHP #: 2001-01, Version A



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International Union of Operating Engineers National Hazmat Program
International Environmental Technology and Training Center

Human Factors Assessment Report



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**DeWalt Reciprocating Saw
(OENHP #: 2001-01, Version A)**

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1.0 EXECUTIVE SUMMARY

Florida International University's (FIU) Hemispheric Center for Environmental Technology (HCET) evaluated five saws for their effectiveness in cutting specially prepared fiberglass-reinforced plywood crates. These crates were built as surrogates for crates that presently hold radioactively contaminated glove boxes at the Department of Energy's (DOE) Los Alamos facility. The DeWalt reciprocating saw was assessed on August 13, 2001. During the FIU test of efficacy, a team from the Operating Engineers National Hazmat Program (OENHP) evaluated the occupational safety and health issues associated with this technology.

The DeWalt reciprocating saw is a hand-held industrial tool used for cutting numerous materials, including wood and various types of metals depending upon the chosen blade. Its design allows for cutting close to floors, corners, and other difficult areas. An adjustable shoe sets the cut at three separate depths.

During the demonstration for the dismantling of the fiberglass-reinforced plywood crate, the saw was used for extended continuous cutting, over a period of approximately two hours. The dismantling operation involved vertical and horizontal cuts, saw blade changes, and material handling. During this process, operators experienced vibration to the hand and arm in addition to a temperature rise on the handgrip. The blade of the saw is partially exposed during handling and fully exposed during blade changes. Administrative controls, such as duty time of the operators and the machine, operator training, and personal protective equipment (PPE), such as gloves, should be considered when using the saw in this application.

Personal noise sampling indicated that both workers were exposed to noise levels exceeding the Occupational Safety and Health Administration's (OSHA) Action Level of 85 decibels (dBA) with time-weighted averages (TWA's) of 88.3 and 90.6 dBA. Normally, a worker would be placed in a hearing conservation program if his TWA was greater than the Action Level. In this case, however, monitoring was conducted during a simulation, not during the actual work conducted at the worksite. Additional sampling should be conducted at the worksite to determine the actual noise levels for the workers. Until it is determined that the actual TWA's are less than the Action Level, the workers should use PPE. A training program on the proper use and wearing of the selected PPE should be provided to each worker.

Nuisance dust monitoring yielded a concentration of 10.69 milligrams per cubic meter (mg/m^3). Although this is less than the OSHA Permissible Exposure Limit (PEL) of 15 mg/m^3 , it is above the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Value (TLV) of 10 mg/m^3 . Fiberglass dust monitoring yielded a fiber count of 1.7 fibers per cubic centimeter (f/cc). This is above the PEL and the TLV of 1.0 f/cc. Therefore, controls should be implemented (engineering or PPE) to reduce the workers' exposure to the dust. Respirators should be used if engineering controls do not sufficiently control the dust or fiberglass generated. Respirators should be equipped with an organic vapor and acid gas cartridge with a High Efficiency Particulate Air (HEPA) filter, since during the demonstration, the workers complained of an odd smell, which may have been from the breakdown of the fiberglass.

2.0 INTRODUCTION

2.1 OENHP Safety and Health Assessment

On August 13, 2001, three safety professionals from OENHP performed the human factors assessment in a containment called a PermaCon, which is located in the high bay building at FIU located at 10555 West Flagler Street, Miami, Florida, 33174. The team consisted of John Kovach, Jeana Harrison, and Aaron Ondo.

The PermaCon is equipped with dual-hinged panels for access, two standard doors with stainless steel covering on the inside face, two type A transfer panels, two make-up air inlets, five windows on the side panels, and ten portals on the roof to allow for external lighting. The PermaCon dimensions are 20 x 16 x 12 feet. A portable HEPA filtration unit is connected to rear air outlets to generate negative pressure in the PermaCon during evaluations. The HEPA filtration unit draws 1,720 cubic feet of air each minute (cfm) at 1-inch static pressure (sp) water gauge (wg) and 1,060 cfm at 9 inches sp wg. HEPA unit efficiency is 99.97 percent for 0.3-micrometer particles.

2.2 Technology Description and Operation

The DeWalt reciprocating saw was tested on a specially prepared, 4 x 4 x 8 foot fiberglass-reinforced plywood crate at FIU in August 2001. In conjunction with FIU's evaluation of efficiency and cost, this report covers the hazard analysis and safety evaluation that OENHP conducted during the test.

The DeWalt reciprocating saw is a hand-held industrial tool for cutting wood, as well as various types of metals. A variable speed selector wheel is provided to control the speed of the tool. The saw has a variable speed trigger switch for added versatility. The further the trigger is depressed, the greater the speed of the saw. An adjustable shoe, used to limit the depth of cut, can be selected using a push button control on the handgrip, permitting the selection of three separate cutting depths. Blade change is accomplished with the release of a blade clamp lever located on the handgrip. The design of the saw motor housing permits cutting close to floors, corners, and other difficult areas. There are blades available for cutting wood and various types of metals.

3.0 METHODOLOGY

3.1 Methodology for Assessment of Safety Issues

The team completed a Job Hazard Analysis (JHA) after the evaluation. This is a well-established tool. The JHA systematically identifies all of the steps required to operate a piece of equipment or complete a task. The potential hazards of each step are listed and the methods to control these hazards are identified. The information from the JHA was then used to create a Technology Safety Data Sheet (TSDS). This innovative tool is required by the DOE for all of the technologies funded by the Office of Science and Technology. See Section 6.0 for the completed safety analyses.

3.2 Methodology for Assessment of Health Issues

Noise levels, total nuisance dust, and fiberglass dust were evaluated during the cutting of the 4 x 4 x 8 foot fiberglass-reinforced plywood crate. All samples were measured during the approximate two-hour operation of the DeWalt reciprocating saw.

3.2.1 Noise Sampling

Personal noise levels were evaluated using Quest Q-300 data-logging noise dosimeters. These instruments were pre- and post-calibrated to 114.0 dBA with a Quest Q-10 acoustical calibration unit.

3.2.2 Air Sampling

3.2.3 Nuisance Dust

Dust monitoring was conducted by drawing air with a MSA Escort Elf air-sampling pump through a pre-weighed PVC 37-millimeter (mm) filter in a closed-face cassette. Sampling and analysis followed the National Institute for Occupational Safety and Health (NIOSH) Manual of Analytical Methods (NMAM) 0500 gravimetric method for total dust. The cassettes were pre-weighed and analyzed by Galson Laboratories, an AIHA-Accredited lab. Pre- and post-sampling calibration was accomplished using a BIOS International DryCal DC-1 primary calibration system. The level of quantification reported by the lab was 0.05 mg.

3.2.4 Fiberglass Dust

Fiberglass dust monitoring was conducted by drawing air with a MSA Escort Elf air-sampling pump through a MCE 25-mm filter in an open-faced cowl. Analysis was conducted with phase contrast microscopy using NMAM 7400, Revision #3, which is a fiber counting method. The cowls were prepared and analyzed by Galson Laboratories. Pre- and post-sampling calibration was performed in the same manner as the nuisance dust samples.

4.0 RESULTS AND DISCUSSION

4.1 Safety Issues

The DeWalt reciprocating saw is a straightforward and versatile machine for cutting wood and metals. The design of the motor housing permits cutting in difficult areas. The blade, mounted on the front of the saw, can be used to cut various depths. The length of the blade, which is exposed at all times, varies with the type of blade and the position of the adjustable shoe for depth of cut. To reduce operator contact with the blade during handling and use, care should be exercised to use the appropriate blade, proper depth selection for the application, and PPE. Table 6.3.1 contains a summary of the safety and health issues for the five saws used in the demonstration.

4.2 Health Issues

During the dismantling of the fiberglass-reinforced plywood crate, the reciprocating saw was used for extended continuous cutting, over a period of approximately two hours. The dismantling operation involved vertical and horizontal cuts. During the dismantling process, operators experienced vibration of the hands/arms and increased heat from the handgrip. As the dismantling of the crate progressed, the working surfaces flexed as the integrity of the crate decreased. This required manual support of the working piece, and the use of wedges between the pieces to eliminate blade pinch. The heat build-up on the handgrip during the operation was managed with the use of leather gloves and control of duty time of the saw in the dismantling operation. To manage the impact of vibration, the work piece should be adequately supported, manually or mechanically, and the adjustable shoe of the saw should be firmly in contact with the work surface during cutting.

The OSHA Action Level for noise exposure under 29 CFR 1910.95 is 85 dBA, averaged over an 8-hour time period. From OSHA's Hearing Conservation Amendment of 1983, exceeding this level means the employer must administer a continuing, effective hearing conservation program. OSHA also requires that workers exposed above 90 dBA, as an 8-hour TWA must be protected – preferably through engineering or administrative controls. If neither is feasible, the employer must provide PPE.

Personal noise sampling indicated that both workers were over the Action Level with TWA's of 88.3 and 90.6 dBA. These data are not entirely representative as they were gathered during a simulation and not at the actual worksite. Additional sampling should be conducted on-site, but the workers should wear hearing protection until it is determined that it is no longer necessary. Noise data for all of the saws used in the demonstration are listed in Table 6.3.2.

Air sampling was performed while the workers dismantled the fiberglass-reinforced crates. Results from the total nuisance dust (i.e., particulate not otherwise regulated) and fiberglass dust samples for all saws in the demonstration are listed in Table 6.3.2. The total nuisance dust sample for the DeWalt reciprocating saw was 10.69 mg/m^3 , which is lower than the OSHA PEL of 15 mg/m^3 , but slightly higher than the ACGIH TLV of 10 mg/m^3 . The fiber analysis yielded 1.7 f/cc, which is above the PEL and TLV of 1 f/cc.

5.0 RECOMMENDATIONS

The lack of blade guarding, the heat and vibration in the handgrip, and the nuisance and fibrous dust levels are the main concerns with this saw in this application. Engineering controls should be used to eliminate these problems whenever possible. Where this is not possible, administrative controls, training, and proper PPE should be used.

Examples of engineering controls include two specialized ventilation systems: a downdraft hood and a capturing hood with a flexible duct (see Section 6.4 for figures). With a downdraft hood, a crate would sit on the top of the hood so the dust would be pulled down into the hood. A ventilation system such as this requires specialized knowledge and should be designed by a ventilation engineer.

6.0 APPENDIX

6.1 Job Hazard Analysis

Job Hazard Analysis DeWalt Reciprocating Saw (OENHP #: 2001-01, Version A)		
Sequence of Job Steps	Potential Accident or Hazard	New Procedure or Protection
Phase 1: Construction/Start-up		
Pre-operation inspection	<ul style="list-style-type: none"> Saw or cord damage may cause shock 	<ul style="list-style-type: none"> Inspect saw for obvious damage and frayed/cut cord. Use qualified personnel and manufacturer-authorized parts.
Powering Saw	<ul style="list-style-type: none"> Blade improperly locked leading to blade ejection when saw is turned on. Wrong amperage extension cord causing an electrical hazard. Ungrounded outlet causing an electrical hazard. 	<ul style="list-style-type: none"> Check blade clamp lever to ensure that it is flush with handgrip after blade is inserted. Inspect extension cord to verify adequacy to handle saw amperage. Inspect outlet to verify proper grounding and polarity by checking the outlet with a receptacle circuit tester. Use an outlet with a ground fault circuit interrupter (GFCI).
Phase 2: Operation		
Operation of saw in horizontal and vertical motions	<ul style="list-style-type: none"> Hand slipping on handgrip near cutting blade, which may lead to cuts or abrasions. Blade partially exposed at all times, may lead to cuts or abrasions. Vibration to hands during use may lead to vibration-induced nerve damage known as Raynaud's Syndrome. Excessive exposure to noise could lead to temporary or permanent hearing loss. 	<ul style="list-style-type: none"> Position hand properly on handgrip. Use leather-work gloves with rubber grips on the palms and fingers to reduce slip on the handgrip. Use leather-work gloves. Pick up and store saw properly. Train users on proper positioning of saw. Secure working piece. Ensure that adjustable shoe is firmly against working surface – helps reduce vibration. Wear leather-work gloves. Control personnel duty-time (administrative control). Wear ear protection (ear plugs or muffs) properly while saw is in use.

Job Hazard Analysis
DeWalt Reciprocating Saw (OENHP #: 2001-01, Version A)

Sequence of Job Steps	Potential Accident or Hazard	New Procedure or Protection
(. . . Continued) Operation of saw in horizontal and vertical motions	<ul style="list-style-type: none"> • Temperature rise on handgrip leading to exposure to a hot surface. • Worn or degraded blades may lead to fatigue from force of operator to maintain cutting rate. • Broken blade may lead to flying projectiles, strains, or sprains. • No end of cut protection may lead to cuts or abrasions. • Static loading of saw may cause worker fatigue. • Changing blades may cause cuts and abrasions. • Blade pinch may result in broken blade or twists/strains. • Saw could overheat due to exertion. • Excessive sparking may lead to equipment damage and electrical hazard. 	<ul style="list-style-type: none"> • Inspect condition of blade periodically and replace worn blades. • Control machinery duty time (rest machine when it's hot). • Change out worn or degraded blades. • Avoid pinching blade. • Use proper ergonomic position. • Do not force the cutting process. • Maintain ergonomic position. • Wear hand and eye protection. • Maintain ergonomic position. • Maintain proper work position. • Control personnel duty time. • Follow manufacturer's procedures. • Wear leather-work gloves. • Support work surface manually or mechanically with wedges. • Maintain proper work position. • Use eye and hand protection. • Do not force the cutting process. • Control machinery duty time. • Maintain ergonomic position. • Remove power to saw. • Inspect saw periodically. • Use qualified personnel and manufacturer-authorized replacement parts.
Phase 3: Maintenance (Emergency and Routine)		
Cleaning	<ul style="list-style-type: none"> • Exposure to energized parts. 	<ul style="list-style-type: none"> • Remove power source before beginning maintenance (use a lockout/tagout procedure). • Use qualified personnel and manufacturer-authorized replacement parts.

Job Hazard Analysis
DeWalt Reciprocating Saw (OENHP #: 2001-01, Version A)

Sequence of Job Steps	Potential Accident or Hazard	New Procedure or Protection
(. . . Continued) Cleaning	<ul style="list-style-type: none"> Exposure to contamination. 	<ul style="list-style-type: none"> Use safety and health information such as Material Safety Data Sheets (MSDS) for proper procedures and necessary PPE.
Blade replacement	<ul style="list-style-type: none"> May lead to cuts and abrasions. 	<ul style="list-style-type: none"> Use eye and hand protection. Follow manufacturer's procedures.
Phase 4: Shutdown (Emergency and Routine)		
Release trigger mechanism to stop saw.	<ul style="list-style-type: none"> Possible cut or abrasion 	<ul style="list-style-type: none"> Keep blade away from body. Maintain proper ergonomic position.
Remove power	<ul style="list-style-type: none"> Shock 	<ul style="list-style-type: none"> Use proper method to unplug tool i.e., grip plug and remove from socket (outlet).
Phase 5: Decontamination/Decommissioning		
Wipe the saw to remove decontamination	<ul style="list-style-type: none"> Exposure of operator or maintenance personnel to site-specific contaminants. 	<ul style="list-style-type: none"> Use safety and health guidance such as MSDS's to determine proper procedures and necessary personal protective equipment. Dispose of contaminated wastes using approved procedures.

6.2 Technology Safety Data Sheet

Technology Safety Data Sheet DeWalt Reciprocating Saw (OENHP #: 2001-01, Version A)

Section 1: Technology Identity

Technology Name(s):		Emergency Contact:
DeWalt Reciprocating Saw		
Manufacturer's Name and Address:		Information Contact:
DeWalt Industrial Tool Company 701 East Joppa Road Baltimore, Maryland 21286		Telephone: 1-800-433-9258
Date Prepared:	TSDS Version Number:	Prepared By:
8/20/01	2001-01, Version A	John Kovach, MS; Jeana Harrison; Aaron Ondo, MS; Bruce Lippy, CIH, CSP

Section 2: Technology Description

The DeWalt reciprocating saw is an industrial tool for cutting wood, as well as steel, aluminum, copper, and other metals. A variable speed selector wheel, operated from the trigger, is provided to control the speed of the tool for added versatility. The further the trigger is depressed, the higher the speed of the saw. Three cutting depths can be achieved through the use of an adjustable shoe, which is operated by a push-button on the handgrip. Blade change is accomplished with the release of a blade clamp lever located on the handgrip. The design of the saw's motor housing permits close cutting to floors, corners, and other difficult areas. A broad choice in blades allows the cutting of wood and various types of metals.

Section 3: Technology Pictures



Figure 1. An operator beginning a cut in the vertical direction with the DeWalt Reciprocating Saw.



Figure 2. An operator using the DeWalt Reciprocating Saw to make a cut in the horizontal direction.

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Section 4: Safety Hazards

Hazard Category:

- 4 – Could result in death or permanent total disability
- 3 – Could result in permanent partial disability or injuries or occupational illness that may result in hospitalization of at least three persons
- 2 – Could result in injury or occupational illness resulting in one or more lost work days
- 1 – Could result in injury or illness not resulting in a lost work day

A. Buried Utilities, Drums, and Tanks	Hazard Rating: N/A
• Buried utilities, drums, and tanks are not associated with this technology.	
B. Chemical (Reactive, Corrosive, Pyrophoric, etc)	Hazard Rating: N/A
• Chemical use is not associated with this technology.	
C. Confined Space	Hazard Rating: N/A
• Confined space is not a hazard associated with this technology.	
D. Electrical	Hazard Rating: 1
<ul style="list-style-type: none"> • Shock due to insufficient amperage in cord and/or ungrounded outlets may occur. • Performing maintenance or blade changes while machinery is energized may lead to shock. Following lockout/tagout procedures will reduce this risk. • Exposure to a damaged extension cord may lead to shock. 	
E. Explosives	Hazard Rating: N/A
• Explosives are not associated with this technology.	
F. Fire Protection	Hazard Rating: N/A
• The facility fire protection plan should cover this tool, as it does not present an additional fire hazard.	
G. Gas Cylinders	Hazard Rating: N/A
• Gas cylinders are not used with this technology.	
H. Ladders/Platforms	Hazard Rating: N/A
• Electrical shock is possible when used with metal ladders or platforms.	
I. Lockout/Tagout	Hazard Rating: 1
• The facility's lockout/tagout procedures and manufacturer's recommended procedures should cover this tool.	
J. Mechanical Hazards	Hazard Rating: 2
• Cuts or abrasions may occur from contact with saw blade during use and blade changes.	
K. Moving Vehicles	Hazard Rating: N/A
• This saw does not utilize any moving vehicles, although one will be used to move the fiberglass-reinforced crates to the decommissioning area. The workers should be aware of the normal hazards associated with moving vehicles.	
L. Overhead Hazards	Hazard Rating: 1
• During dismantlement of the fiberglass-reinforced crates, pieces of crate could fall upon completion of a cut or when the top of the crate is removed. Workers should wear hard hats when working on crates.	

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M. Pressure Hazards	Hazard Rating: N/A
<ul style="list-style-type: none"> There are no pressure hazards associated with this technology. 	
N. Slips/Trips/Falls	Hazard Rating: 1
<ul style="list-style-type: none"> Electrical cords should be properly managed during cutting operations. Work area should be kept clean and organized to eliminate possible tripping hazards. 	
O. Suspended Loads	Hazard Rating: N/A
<ul style="list-style-type: none"> Suspended loads are a site-specific hazard and are not part of this technology. 	
P. Trenching/Excavation	Hazard Rating: N/A
<ul style="list-style-type: none"> Trenching and excavation are not used for this technology. 	
Section 5: Health Hazards	
A. Inhalation	Hazard Rating: 2
<p>Inhalation hazards are highly dependent upon the type of material being cut.</p> <ul style="list-style-type: none"> General inhalation hazards associated with woodworking: <ul style="list-style-type: none"> Wood dust Plywood resins Inhalation hazards associated with the disassembly of fiberglass-reinforced plywood crates: <ul style="list-style-type: none"> Fiberglass dust (possible human carcinogen) Fiberglass resins Vapors and formaldehyde 	
B. Skin Absorption	Hazard Rating: 2
<p>Skin absorption is largely based upon the material being cut.</p> <ul style="list-style-type: none"> Fiberglass dust causes skin irritation (associated with the disassembly of fiberglass-reinforced plywood crates). 	
C. Noise	Hazard Rating: 2
<p>A noise assessment should be conducted on-site during actual use of the technology to determine the type of hearing protection required.</p> <ul style="list-style-type: none"> Excessive noise from tool and cutting operations may cause hearing damage. Excessive noise from ventilation and filtration system, as well as any noise from nearby operations, may cause hearing damage. 	
D. Heat Stress/Cold Stress	Hazard Rating: 2
<p>Heat stress is generally site-specific, although there are heat stress issues associated with this tool.</p> <ul style="list-style-type: none"> Heat stress can be generated by personal protective equipment such as: Tyvek suits, full-face respirators, and gloves. Heat from hand tool during extended tool duty time may cause heat stress. Extended worker duty time could cause heat stress, especially if the worker is working in hot conditions or wearing personal protective equipment. 	
E. Ergonomics	Hazard Rating: 2
<ul style="list-style-type: none"> Hand/arm vibration from the tool may cause nerve damage known as Raynaud's Syndrome. Static and awkward operating postures may cause pain in the hands and/or arms. Awkward lifting of tool may cause pain in the hands and/or arms. 	
F. Ionizing Radiation	Hazard Rating: N/A
<ul style="list-style-type: none"> Ionizing radiation is site-specific. 	
G. Non-ionizing Radiation	Hazard Rating: N/A
<ul style="list-style-type: none"> Non-ionizing radiation is site-specific. 	

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H. Biological Hazards	Hazard Rating: N/A
<ul style="list-style-type: none"> There are no biological hazards associated with this technology. 	
I. Other	Hazard Rating: N/A
<ul style="list-style-type: none"> None 	
Section 6: Phase Analysis	
A. Construction/Start-up	
<ul style="list-style-type: none"> Identify hazards through a pre-job analysis to determine personal protective equipment required. Inspect saw for obvious damage that may cause excessive vibration and potential for electrical shock. Select proper blade for each job so that worker fatigue and kickback is minimized and to reduce potential for sprains. Check power cords for proper amperage, frays, and cuts to protect against electrical shock. Ensure blades are straight and the teeth are sharp to reduce amount of force needed and to minimize vibration. Ensure blades are properly mounted to start work to avoid kickback or sprain. 	
B. Operation	
<ul style="list-style-type: none"> Maintain proper work position, don't overextend arms. Wear proper safety protection for hands (leather-work gloves with rubber grips), eyes (safety glasses or goggles), and ears (ear plugs or ear muffs), and respiratory protection (depends upon the operation). Do not bind the blade between work pieces; do not force tool. Change blade only while the tool is not energized and use approved lockout/tagout procedures. Use proper amperage power cord and a grounded outlet. 	
C. Maintenance (Emergency and Routine)	
<ul style="list-style-type: none"> Check for damage to the saw and frayed cord. Perform all maintenance with the power off (unplug saw) and use approved lockout/tagout procedures. Conduct maintenance with qualified personnel and use manufacturer's authorized parts. 	
D. Shutdown (Emergency and Routine)	
<ul style="list-style-type: none"> Keep blade away from body while shutting down the tool. Grip plug and remove from socket (outlet). Maintain proper ergonomic position to avoid cuts and abrasions by the blade. 	
E. Decontamination/Decommissioning	
<ul style="list-style-type: none"> Use approved decontamination procedures. Discard unit using approved procedures. 	
Section 7: Worker Protection Measures	
A. Exposure Monitoring	
<ul style="list-style-type: none"> Noise sampling should be conducted during the actual use of the tool to determine the actual noise levels and the proper personal protective equipment necessary. Air sampling should be conducted during the actual use of the tool to determine levels of site-specific contaminants in the air. Nuisance dust is associated with woodcutting and fibers are associated with the cutting of fiberglass-reinforced crates. 	

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B. Worker Training

Worker training should include the following elements:

- Pre-job walk through
- Manufacturer's operating procedures
- Respirator training
- Personal protective equipment to be used
- Hearing conservation program, including the proper use of ear plugs
- Lockout/tagout procedures
- Recognition of heat stress symptoms
- Electrical training
- Recognition of ergonomic issues and symptoms

C. Medical Surveillance

- Audiograms must be administered if the noise levels are above 85 decibels. Workers whose personal noise sample yields results greater than 85 decibels must be placed in a hearing conservation program, which includes audiograms.

D. Engineering Controls

- No additional engineering controls are recommended.

E. Administrative Controls

- Worker training
- Controlled duty time of personnel and the equipment

F. Personal Protective Equipment

- Gloves
- Safety glasses or goggles
- Hearing protection

Section 8: Emergency Preparedness
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- Emergency response procedure should identify how the hazards identified in this TSDS are being addressed. Each worker should be trained and understand how to respond.

Section 9: Comments, Lessons Learned, and Special Considerations

- May want to cover blade to reduce employee's exposure.
- The dismantling process for the fiberglass-reinforced plywood crates is lengthy, involving cutting, saw blade changes, and material handling during the process. The cutting process involves extended continuous duty time for the saw. As a result, a temperature rise for the tool was experienced and was transmitted to the handgrip. A consideration may be the use of a thermal overload in the saw that would add further protection to the equipment and the worker. This would further limit saw use and reduce the heat on the handgrip.
- In order to minimize contact with the partially exposed blade during the beginning and end of a job, consider operating procedures that include blade insertion as the last step in preparation for a job and blade removal as the first step at the end of a job. Since the blade is exposed at all times by design, removal of the blade during downtime would minimize this potential hazard.

6.3 Summary of All Saws

During the week of August 13-16, 2001, five saws were tested on specially prepared 4 x 4 x 8 foot plywood and fiberglass reinforced plywood crates at FIU. The following tables summarize the results of the OENHP evaluation. Table 6.3.1 summarizes the safety features for the saws tested, and table 6.3.2 summarizes the results of noise and dust measurements obtained during these operations.

Table 6.3.1. Comparison of Safety and Health Features for Saws During the Simulation.

Saw (OENHP #)	Blade Guarding	Power Switch	Thermal Overload	Electrical Cord/Plug	Dust Control
DeWalt Reciprocating (2001-01-A)	Blade partially exposed at all times	On/off switch	No overload or thermal shutoff	Double insulated cord	No control of dust at point of cut
Milwaukee Worm Drive Circular (2001-02-A)	Upper and retractable lower guard	On/off switch	No overload or thermal shutoff	Grounded plug	No control of dust at point of cut
Porter-Cable Circular (2001-04-A)	Upper and retractable lower guard	On/off switch	No overload or thermal shutoff	Double insulated cord	Directional discharge away from worker; vacuum attachment for dust collection
Evolution 180 Circular (2001-03-A)	Upper guard, chip collector, retractable lower guard	On/off switch	Overload shutoff	Double insulated cord	Metal chip collector
Adamant Circular (2001-05-A)	Blade partially exposed at all times	Interlocking on/off switch	Stall overload, and shutoff	Grounded plug	No control of dust at point of cut

Table 6.3.2. Comparison of Industrial Hygiene Sampling Data from the Simulation.

Saw	Nuisance Dust (mg/m ³)	Fiberglass Dust (f/cc)	Noise TWA - Dosimeter 1 (dBA)	Noise TWA - Dosimeter 2 (dBA)
DeWalt Reciprocating	10.69	1.70	88.3	90.6
Milwaukee Worm Drive Circular	36.07	Void ¹	82.7	84.6
Porter-Cable Circular #1	3.53	12.9	77.1	78.3
Porter-Cable Circular #2	22.05	Void ¹	89.7	90.0
Evolution 180 Circular	3.5 ²	1.74 ²	69.1	68.8 ² / 69.8 ³
Average ± Standard Deviation	15.2 ± 13.9	5.5 ± 6.5	81.4 ± 8.5	80.4 ± 9.7
Coefficient of variation	91.8	118.5	10.4	12.0

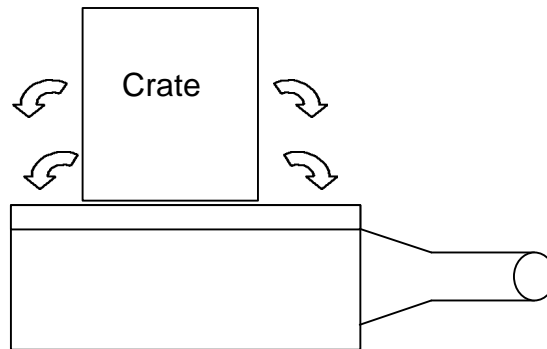
¹ Void: Filter was overloaded – sample could not be analyzed.

² Evolution 180 with fiberglass-reinforced plywood crate

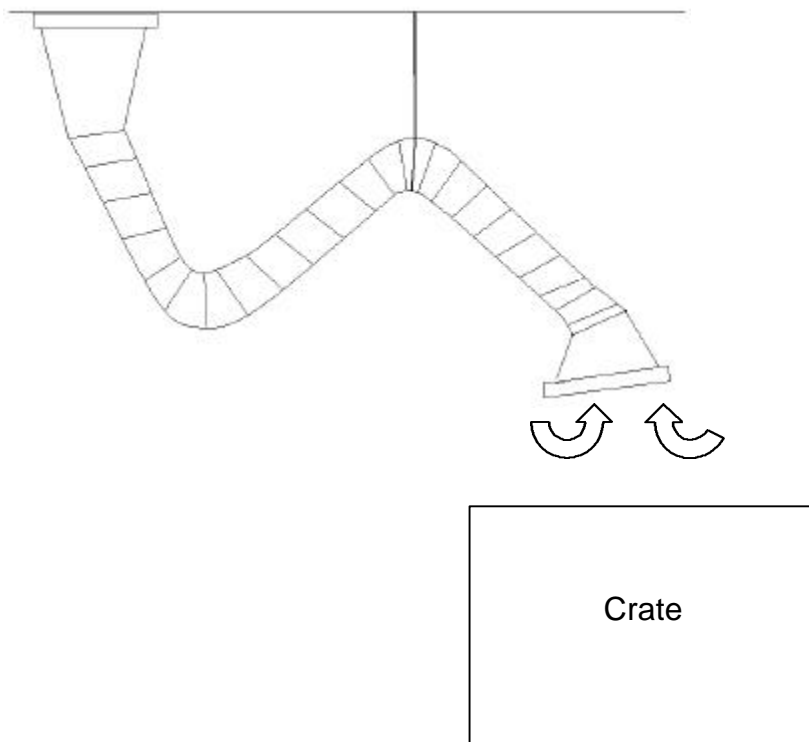
³ Evolution with ¼ inch stainless steel only

6.4 Figures and Drawings

6.4.1 Drawing of a Downdraft Hood



6.4.2 Drawing of a Capture Hood



6.5 Industrial Hygiene Data

Certificates of Analysis for laboratory data are available upon request via the contact information in the front of this document.

6.5.1 Noise Sampling Data



INTERNATIONAL UNION OF OPERATING ENGINEERS
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1293 Airport Road Beaver, WV 25813
(304) 253-8674 Fax: (304) 253-1384

Industrial Hygiene Noise Sampling Data: Noise

Project: FIU - Saws					Calibrator						
Address: Hemispheric Center for Environmental Technology					Mfr.: Quest Technologies						
Florida International University					Model: QC-10						
10555 West Flagler St, CEAS 2100					Serial No.: QE7030012						
C/S/Z: Miami, FL 33174					Cal. Date: 6/6/2001						
Phone: 305-348-2590 Fax: 305-348-6308					Instrument						
Sampling Data					No. 1						
Name:					Mfr.: Quest Technologies						
Job title/description:					Model: 300						
					Serial No.: QC 7010089						
					Cal. Date: 6/6/2001						
PPE Used: full face-piece respirator with G/V cartridges, Tyvek suits, ear plugs, Tyvek suits, gloves					Exchange Rate (3 to 6 dB):						
					Dose Criterion (80 to 90 dB):						
					Filter Weighting (A, B, or C):						
					Response (Slow or Fast):						
Calibration											
Pre					Post						
Date (M/D/Y)	Time (24H:M)	Target (dB)	Actual (dB)	Diff. (%)	Date (M/D/Y)	Time (24H:M)	Target (dB)	Actual (dB)	Diff. (%)		
8/13/01	11:35	114.0	113.1	0.79	8/13/01	16:00	114.0	113.1	0.79		
8/14/01	8:10	114.0	113.1	0.79	8/15/01	8:10	114.0	113.5	0.44		
8/15/01	8:10	114.0	113.5	0.44	8/16/01	8:05	114.0	113.1	0.79		
8/16/01	8:05	114.0	113.1	0.79	8/16/01	10:45	114.0	113.1	0.79		
Noise Data and Information											
Location	Type (P or A)	Date (M/D/Y)	Start (24H:M)	Stop (24H:M)	Time (min)	Lav (dB)	TWA (dB)	Lmax (dB)	Lpk (dB)	8hr % Dose	8 hr Proj. % Dose
A	P	8/13/01	13:40	15:33	113	98.0	88.3	112.1	118.6	78.83	302.20
B	P	8/14/01	9:20	9:45	25	89.4	69.1	110.9	118.4	5.55	92.60
C	P	8/14/01	10:50	11:42	52	97.9	82.7	113.7	118.5	36.66	299.20
D	P	8/15/01	13:30	13:57	27	97.7	77.1	111.0	118.4	16.73	290.00
E	P	8/16/01	8:25	9:30	65	100.3	89.7	114.7	118.6	96.02	417.00
Location	Description										
A	DeWalt Reciprocating Saw										
B	Evolution 180 Saw - used with pump #2										
C	Milwaukee Saw - used with pump #2										
D	Porter Cable Saw #1 - Used with pump #3										
E	Porter Cable Saw #2 - Used with pump #3										
Calibration by:	Jeana M. Harrison					Signature: _____		Date: _____			
Sampling by:	Jeana M. Harrison					Signature: _____		Date: _____			



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Industrial Hygiene Noise Sampling Data: Noise

Project: <u>FIU - Saws</u>					Calibrator						
Address: <u>Hemispheric Center for Environmental Technology</u>					Mfr.: <u>Quest Technologies</u>						
<u>Florida International University</u>					Model: <u>QC-10</u>						
<u>10555 West Flagler St, CEAS 2100</u>					Serial No.: <u>QE7030012</u>						
C/S/Z: <u>Miami, FL 33174</u>					Cal. Date: <u>37048</u>						
Phone: <u>305-348-2590</u> Fax: <u>305-348-6308</u>					Instrument						
Sampling Data					No. <u>2</u>						
Name:					Mfr.: <u>Quest</u>						
Job title/description:					Model: <u>300</u>						
					Serial No.: <u>QC 7010093</u>						
					Cal. Date: <u>6/6/2001</u>						
PPE Used: <u>full face-piece respirator with G/V cartridges, Tyvek suits, ear plugs, Tyvek suits, gloves</u>					Exchange Rate (3 to 6 dB): _____						
					Dose Criterion (80 to 90 dB): _____						
					Filter Weighting (A, B, or C): _____						
					Response (Slow or Fast): _____						
Calibration											
Pre					Post						
Date (M/D/Y)	Time (24H:M)	Target (dB)	Actual (dB)	Diff. (%)	Date (M/D/Y)	Time (24H:M)	Target (dB)	Actual (dB)	Diff. (%)		
8/13/01	11:40	114.0	114.1	0.09	8/13/01	16:00	114.0	113.4	0.53		
8/14/01	8:10	114.0	113.9	0.09	8/15/01	8:10	114.0	113.4	0.53		
8/15/01	8:10	114.0	113.4	0.53	8/16/01	8:10	114.0	113.9	0.09		
8/16/01	8:10	114.0	113.9	0.09	8/16/01	10:55	114.0	113.9	0.09		
2											
Noise Data and Information											
Location	Type (P or A)	Date (M/D/Y)	Start (24H:M)	Stop (24H:M)	Time (min)	Lav (dB)	TWA (dB)	Lmax (dB)	Lpk (dB)	8hr % Dose	8 hr Proj. % Dose
F	P	8/13/01	13:40	15:33	113	100.3	90.6	113.4	119.4	109.50	420.50
G	P	8/14/01	9:20	9:45	25	89.1	68.8	110.9	119.2	53.00	88.74
H	P	8/14/01	10:50	11:42	52	100.1	84.6	115.3	119.3	47.48	403.60
I	P	8/15/01	13:30	13:57	27	99.0	78.3	111.6	119.2	19.81	350.80
J	P	8/16/01	8:25	10:15	110	100.7	90.0	115.1	119.3	100.40	442.80
K	P	8/16/01			15	94.8	69.8	112.5	118.9	6.12	196.70
Location	Description										
F	Dewalt Reciprocating Saw										
G	Evolution 180 with crates - used with pump #3										
H	Milwaukee - used with pump #3										
I	Porter Cable #1 - used with pump #2										
J	Porter Cable #2 - used with pump #4										
K	Evolution 180 with 1/4" stainless steel										
Calibration by: <u>Jeana M. Harrison</u> Signature: _____ Date: _____											
Sampling by: <u>Jeana M. Harrison</u> Signature: _____ Date: _____											

6.5.2 Air Sampling Data



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Industrial Hygiene Air Sampling Data: Information

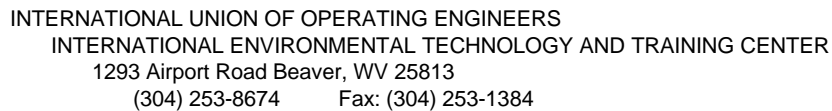
Project: FIU - Saws					Contaminant(s) Sampled				Media				
Address: Hemispheric Center for Environmental Technology					Dust: Total Dust (nuisance)				Mfr.: SKC				
Florida International University					Fume:				Lot No.: 762				
10555 West Flagler St, CEAS 2100					Gas:				Cassette: 37 mm				
C/S/Z: Miami, FL 33174					Mist:				Filter: PVC				
Phone: 305-348-2590 Fax: 305-348-6308					Vapor:				Pore size: 5.0 µm				
Personal Sampling Data					Other:				Face: (O/C) Closed				
Name:					Analytical Method: 500				Tube: NA				
Job title/description:					Min: Max: (L/Min)				Treat.: NA				
PPE used: full-facepiece respirator with G/V cartridges, ear plugs, Tyvek suits, gloves					Date (m/d/y)	Time (H:M)	Temp (°F)	Pres. ("Hg)	RH (%)				
Ventilation: HEPA vacuum for containment													
Sample No.	Type	Date	Instrument	Pump	Use 24 hour Military Time (24HH:MM)								Total
	P, A, B	(M/D/Y)	Serial No.	No.	Start	Stop	Start	Stop	Start	Stop	Start	Stop	(min)
111	P	8/13/01	8575	3	13:41	15:35							114
112	B	8/13/01			14:40	15:51							71
113	P	8/14/01	8575	3	9:20	9:50							30
114	A	8/13/01	8682	2	14:40	15:51							71
Sample No.	Location: Inside Permacon with DeWalt												
111													
Blank No.	Task: Cutting fiberglass reinforced plywood boxes												
112													
Comments:													
Sample No.	Location: BLANK												
112													
Blank No.	Task:												
Comments:													
Sample No.	Location: Inside Permacon with Evolution 180												
113													
Blank No.	Task: Cutting fiberglass reinforced plywood boxes												
Comments:													
Sample No.	Location: Area outside Permacon; near inlet												
114													
Blank No.	Task: Cutting fiberglass reinforced plywood boxes												
Comments:													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													



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Industrial Hygiene Air Sampling Data: Information

Project: FIU - Saws					Contaminant(s) Sampled				Media				
Address: Hemispheric Center for Environmental Technology					Dust: Total Dust (nuisance)				Mfr.: SKC				
Florida International University					Fume: 0				Lot No.: 762				
10555 West Flagler St, CEAS 2100					Gas: 0				Cassette: 37 mm				
C/S/Z: Miami, FL 33174					Mist: 0				Filter: PVC				
Phone: 305-348-2590 Fax: 305-348-6308					Vapor: 0				Pore size: 5.0 µm				
Personal Sampling Data					Other: 0				Face: (O/C) Closed				
Name:					Analytical Method: 500				Tube: NA				
Job title/description:					Min: 0 Max: 0 (L/Min)				Treat.: NA				
PPE used: full-facepiece respirator with G/V cartridges, ear plugs, Tyvek suits, gloves					Date (m/d/y)	Time (H:M)	Temp (°F)	Pres. (°Hg)	RH (%)				
Ventilation: HEPA vacuum for containment													
Sample No.	Type P,A,B	Date (M/D/Y)	Instrument Serial No.	Pump No.	Use 24 hour Military Time (24HH:MM)								Total (min)
					Start	Stop	Start	Stop	Start	Stop	Start	Stop	
115	A	8/14/01	8572	4	9:20	11:47							147
116	B	8/14/01			9:25	11:47							142
117	P	8/14/01	8575	3	10:50	11:48							58
118	P	8/15/01	8682	2	13:30	13:57							27
Sample No. 115	Location: Outside Permacon; near inlet												
Blank No.	Task: Cutting fiberglass reinforced plywood boxes												
Comments:													
Sample No. 116	Location: BLANK												
Blank No.	Task:												
Comments:													
Sample No. 117	Location: Inside Permacon with Milwaukee												
Blank No. 116	Task: Cutting fiberglass reinforced plywood boxes												
Comments: Lost filtration in Permacon for 5 minutes													
Sample No. 118	Location: Inside Permacon with Porter Cable #1												
Blank No. 119	Task: Cutting fiberglass reinforced plywood boxes												
Comments:													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													



Industrial Hygiene Air Sampling Data: Information

[illegible]



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Industrial Hygiene Air Sampling Data: Information

Project: FIU - Saws					Contaminant(s) Sampled				Media				
Address: Hemispheric Center for Environmental Technology					Dust: Total Dust (nuisance)				Mfr.: SKC				
Florida International University					Fume: 0				Lot No.: 762				
10555 West Flagler St, CEAS 2100					Gas: 0				Cassette: 37 mm				
C/S/Z: Miami, FL 33174					Mist: 0				Filter: PVC				
Phone: 305-348-2590 Fax: 305-348-6308					Vapor: 0				Pore size: 5.0 µm				
Personal Sampling Data					Other: 0				Face: (O/C) Closed				
Name:					Analytical Method: 500				Tube: NA				
Job title/description:					Min: 0 Max: 0 (L/Min)				Treat.: NA				
PPE used: full-facepiece respirator with G/V cartridges, ear plugs, Tyvek suits, gloves					Date (m/d/y)	Time (H:M)	Temp (°F)	Pres. (°Hg)	RH (%)				
Ventilation: HEPA vacuum for containment													
Sample No.	Type P,A,B	Date (M/D/Y)	Instrument Serial No.	Pump No.	Use 24 hour Military Time (24HH:MM)								Total (min)
123	B	8/16/01			Start	Stop	Start	Stop	Start	Stop	Start	Stop	
					8:30	10:25							115
													0
													0
													0
Sample No. 123	Location: BLANK												
Blank No.	Task:												
Comments:													
Sample No. 0	Location:												
Blank No.	Task:												
Comments:													
Sample No. 0	Location:												
Blank No.	Task:												
Comments:													
Sample No. 0	Location:												
Blank No.	Task:												
Comments:													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													



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 3775 Morgantown Industrial Park Bldg 400, Morgantown, WV 26501
 (304) 284-9129 Fax: (304) 284-9130

Industrial Hygiene Air Sampling Data: Information

Project: FIU - Saws					Contaminant(s) Sampled				Media				
Address: Hemispheric Center for Environmental Technology					Dust:				Mfr.: Zefon				
Florida International University					Fume:				Lot No.: 2522				
10555 West Flagler St, CEAS 2100					Gas:				Cassette: 25 mm				
C/S/Z: Miami, FL 33174					Mist:				Filter: MCE				
Phone: 305-348-2590 Fax: 305-348-6308					Vapor:				Pore size: 0.8 µm				
Personal Sampling Data					Other: Fiberglass (fiber count)				Face: (O/C) open				
Name:					Analytical Method: 7400				Tube: na				
Job title/description:					Min: 0.5 Max: 16 (L/Min)				Treat.: na				
PPE used: full face-piece respirator with G/V cartridges, ear plugs, Tyvek suits, gloves					Date (m/d/y)	Time (H:M)	Temp (°F)	Pres. (°Hg)	RH (%)				
Ventilation: HEPA vacuum for containment													
Sample No.	Type	Date	Instrument	Pump	Use 24 hour Military Time (24HH:MM)								Total
	P, A, B	(M/D/Y)	Serial No.	No.	Start	Stop	Start	Stop	Start	Stop	Start	Stop	(min)
B176962	P	8/13/01	8572	4	13:40	15:33							113
B176969	B	8/13/01			14:40	15:50							70
B177013	P	8/14/01	8682	2	9:20	9:47							27
B176956	P	8/14/01	8682	2	10:50	11:47							57
Sample No.	Location: Inside Permacon with DeWalt Reciprocating Saw												
B176962													
Blank No.	Task:												
B176969													
Comments:													
Sample No.	Location: BLANK												
B176969													
Blank No.	Task:												
Comments:													
Sample No.	Location: Inside Permacon with Evolution 180												
B177013													
Blank No.	Task:												
177106													
Comments: Evolution saw began to smoke, therefore use was discontinued													
Sample No.	Location: Inside Permacon with Milwaukee												
B176956													
Blank No.	Task:												
177106													
Comments:													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													



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 (304) 253-8674 Fax: (304) 253-1384

Industrial Hygiene Air Sampling Data: Information

Project: FIU - Saws					Contaminant(s) Sampled				Media				
Address: Hemispheric Center for Environmental Technology					Dust: 0				Mfr.: Zefon				
Florida International University					Fume: 0				Lot No.: 2522				
10555 West Flagler St, CEAS 2100					Gas: 0				Cassette: 25 mm				
C/S/Z: Miami, FL 33174					Mist: 0				Filter: MCE				
Phone: 305-348-2590 Fax: 305-348-6308					Vapor: 0				Pore size: 0.8 µm				
Personal Sampling Data					Other: Fiberglass (fiber count)				Face: (O/C) open				
Name:					Analytical Method: 7400				Tube: na				
Job title/description:					Min: 0.5 Max: 16 (L/Min)				Treat.: na				
PPE used: full face-piece respirator with G/V cartridges, ear plugs, Tyvek suits, gloves					Date (m/d/y)	Time (H:M)	Temp (°F)	Pres. (°Hg)	RH (%)				
Ventilation: HEPA vacuum for containment													
Sample No.	Type	Date	Instrument	Pump	Use 24 hour Military Time (24HH:MM)								Total
	P,A,B	(M/D/Y)	Serial No.	No.	Start	Stop	Start	Stop	Start	Stop	Start	Stop	(min)
B177106	B	8/14/01			9:25	11:47							142
B176951	P	8/15/01	8575	3	13:30	13:57							27
B177168	B	8/15/01			13:30	14:00							30
B176997	P	8/16/01	8575	3	8:25	9:30	9:50	10:15					90
Sample No.	Location: BLANK												
B177106													
Blank No.	Task:												
Comments:													
Sample No.	Location: Inside Permacon with Porter Cable #1												
B176951													
Blank No.	Task:												
B177168													
Comments:													
Sample No.	Location: BLANK												
B177168													
Blank No.	Task:												
Comments:													
Sample No.	Location: Inside Permacon with Porter Cable #2												
B176997													
Blank No.	Task:												
B176957													
Comments:													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													
Sampling by: Jeana M. Harrison Signature: _____ Date: _____													



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Industrial Hygiene Air Sampling Data: Information

Project: FIU - Saws					Contaminant(s) Sampled					Media				
Address: Hemispheric Center for Environmental Technology					Dust: 0					Mfr.: Zefon				
Florida International University					Fume: 0					Lot No.: 2522				
10555 West Flagler St, CEAS 2100					Gas: 0					Cassette: 25 mm				
C/S/Z: Miami, FL 33174					Mist: 0					Filter: MCE				
Phone: 305-348-2590 Fax: 305-348-6308					Vapor: 0					Pore size: 0.8 µm				
Personal Sampling Data					Other: Fiberglass (fiber count)					Face: (O/C) open				
Name:					Analytical Method: 7400					Tube: na				
Job title/description:					Min: 0.5 Max: 16 (L/Min)					Treat.: na				
PPE used:					Date (m/d/y)	Time (H:M)	Temp (°F)	Pres. (°Hg)	RH (%)					
Ventilation:														
Sample No.	Type P,A,B	Date (M/D/Y)	Instrument Serial No.	Pump No.	Use 24 hour Military Time (24HH:MM)								Total (min)	
B176957	B	8/16/01			Start	Stop	Start	Stop	Start	Stop	Start	Stop	115	
													0	
													0	
													0	
Sample No. B176957 Location: BLANK														
Blank No. Task:														
Comments:														
Sample No. 0 Location:														
Blank No. Task:														
Comments:														
Sample No. 0 Location:														
Blank No. Task:														
Comments:														
Sample No. 0 Location:														
Blank No. Task:														
Comments:														
Sampling by: Jeana M. Harrison Signature: Date:														
Sampling by: Jeana M. Harrison Signature: Date:														

6.6 Acronym List

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
cfm	Cubic feet per minute
dBA	Decibels in A-weighted scale
DOE	Department of Energy
f/cc	Fibers per cubic centimeter
FIU	Florida International University
HCET	Hemispheric Center for Environmental Technology
HEPA	High Efficiency Particulate Air
IUOE	International Union of Operating Engineers
JHA	Job Hazard Analysis
mg/m ³	Milligrams per cubic meter
MSDS	Material Safety Data Sheet
NETL	National Energy Technology Laboratory
NIOSH	National Institute for Occupational Safety and Health
NMAM	NIOSH Manual of Analytical Methods
OENHP	Operating Engineers National Hazmat Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PPE	Personal protective equipment
REL	Recommended Exposure Limit
sp. wg.	Static pressure water gauge
TLV	Threshold Limit Value
TSDS	Technology Safety Data Sheet
TWA	Time-weighted average