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SCHULTE CORPORATION
CINCINNATI, OHIO

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I. SUMMARY

On March 31, 1990, NIOSH received a confidential request for a health hazard evaluation from employees of the Schulte Corporation, Cincinnati, Ohio, 45242. NIOSH was asked to evaluate complaints of tightness in the chest, itching of the skin, metallic taste in the mouth, and concern over the discharge of black dust from the noses of employees working in the machine shop area of the facility.

On June 19, 1990, an initial survey was conducted during which a walk-through of the facility was conducted and workers in the machine shop area were interviewed. Some workers on the second shift were interviewed later by telephone. A follow-up industrial hygiene survey was conducted on August 17, 1990, in which air samples were collected to evaluate worker exposures to total and respirable particulates, metals, oxides of nitrogen, aldehydes, and ozone. Bulk dust samples, collected from surfaces in the machine shop area, were analyzed to determine their epoxy resin content since these resins can cause irritation and immunologic responses.

Total dust samples, taken in the worker's breathing zone, ranged from 0.49 to 4.78 milligrams per cubic meter (mg/m^3). These exposures were well below the OSHA Permissible Exposure Level for nuisance dust (15 mg/m^3); however, since settled dust samples obtained from near the epoxy coating area contained epoxy resin, the nuisance dust exposure criteria is not directly applicable. Respirable dust samples, obtained with direct reading measurement techniques, ranged from 0.05 to 0.43 mg/m^3. Exposures to this dust should be minimized to reduce the potential for adverse health affects. Exposures to nitric oxide and nitrogen dioxide were well below applicable exposure criteria, ranging from 0.09 to 0.31 and 0.12 to 0.14 mg/m^3 respectively for the four workers evaluated. The primary metal in the welding plume was iron; other metals were not found in significant amounts. Aldehydes were not detected in samples evaluating exposures to two resistance welders. Ozone concentrations, measured near welders using a direct-reading instrument, exceeded the NIOSH ceiling level of 0.1 parts per million (ppm), ranging from 0.03 to 1.62 (ppm). Even though these readings were not obtained in the breathing zone of welders, they documented a potential health hazard.

The six workers interviewed reported symptoms temporally related to work. Headaches, sore throat, cough, hoarseness of voice, metallic taste, and chest tightness were the most commonly reported. A black nasal discharge was also reported. A potential ergonomic problem due to repetitive wrist motion was identified.

A potential health hazard from exposure to ozone was identified. Other exposures measured would not individually be expected to cause the reported symptoms at the levels measured. Exposures may have been higher in the past, especially during the winter when doors and windows are closed, or some combination of the exposures may be causing the symptoms. Recommendations aimed at further reducing exposures and for developing a program for the prevention of cumulative trauma are made in Section VIII of this report.

KEYWORDS: SIC 3496 (Miscellaneous Fabricated Wire Products), metal dust, iron oxide, respiratory irritation, itchy skin, metallic taste, nitric oxide, nitrogen dioxide, ozone, aldehydes, welding.

II. INTRODUCTION

On March 31, 1990, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation from employees of the Schulte Corporation, Cincinnati, Ohio. The request stated symptoms and complaints of tightness in the chest, itching of the skin, metallic taste in the mouth, and the discharge of a black dust from the nose experienced by those employees who worked in the machine shop of the facility.

On June 19, 1990, an initial site visit was conducted and randomly selected employees were interviewed at the facility. Randomly selected second shift employees were interviewed by telephone. A follow-up environmental survey was conducted on August 17, 1990.

III. BACKGROUND

The Schulte Corporation's Blue Ash facility is one of three facilities owned and operated by the company. The Blue Ash facility is involved in the manufacturing and shipping of epoxy-coated steel wire shelving. The manufacturing process can be divided into two phases. First, the fabrication of the steel wire shelving in the "machine shop" area starts with various sizes of steel rod and wire received from various suppliers of steel. The second phase entails the cleaning of the fabricated steel shelving and the coating with an epoxy resin electrostatically applied to the steel shelving.

The distinction between steel wire and steel rod is primarily one of size in diameter (1/16 inch compared to 1/2 inch) rather than metal alloy content. Steel wire stock, received from the supplier in coils approximately 36 inches in diameter, is first straightened and then cut to length employing machinery consisting of an initial lubricating bath of kerosene, a series of rollers, and a shearing mechanism. Once cut to length, the wire is placed into metal hoppers and transferred to the resistance welder area for welding to the steel rod.

Steel rod stock is also received from the supplier in coils approximately 60 inches in diameter. Steel rod is fed continuously into machines referred to as "descalers" since they serve to descale the accumulated metal oxide from the surface of the steel rod as it is received from the supplier. The steel rod is then drawn down twice in diameter to approximately 7/16 of an inch using wire drawing machines. The drawing process is lubricated with a wire drawing compound referred to by employees as "soap."

Descaled steel rod, four or five lines at a time, is continuously fed from descaler machines into a resistance welder where it is positioned at right angles with the previously described straightened and cut-to-length pieces of smaller diameter wire. The wire is gravity fed onto the five lines of steel rod through overhead hoppers as they pass into the resistance welder. Once positioned, the steel rod and wire are welded and the fabricated shelving is cut to length as desired. Approximately the first three inches of a leading edge of the shelving is then bent 90 degrees using a hydraulic metal brake, forming a front edge to the shelving.

Following the completion of the metal fabrication process, the shelving is then stacked and taken to the coating area of the facility. Sections of the shelving are hung on an overhead conveyor, passed through a cleaning bath of phosphate detergent and phosphoric acid, and dried with fans. Once dry, the shelving is electrostatically coated with a powdered epoxy resin and passed through a gas-fired radiant heating oven to cure the epoxy coating. The coated shelving is allowed to cool, then packaged, and sent to a warehousing area for storage and/or shipment.

IV. METHODS

A. Environmental Evaluation

Initial Survey

On June 19, 1990, an initial meeting and walk-through survey was conducted at the Schulte Corporation, Blue Ash facility. Attending the initial meeting were representatives of company management, the local unit of the International Association of Aerospace Workers (IAAW) union, and NIOSH. Topics discussed included the nature and description of the manufacturing processes used at the facility, past and present symptoms and complaints expressed by employees, past industrial hygiene evaluations made at the facility, and how NIOSH intended to conduct the health hazard evaluation (HHE).

Following the meeting, a walk-through survey was conducted in the machine shop area of the facility. Notes and sketches of the area were taken to be used in designing a sampling protocol for the HHE. Various employees working in the area were asked questions about their jobs in order to obtain information pertinent to placement of sampling pumps, duration of various assigned tasks, and other related information.

It was noted that the scope of the health hazard evaluation as requested was directed at, and limited to, the machine shop area of the facility. However, since the machine shop and the epoxy coating areas were contiguous and the epoxy resin was present in the form of a fine powder in the presence of fans, air hoses, and push brooms, it was reasonable to anticipate that some of the epoxy resin dust might enter into the machine shop area. Consequently, it was decided that bulk samples should also be taken in the machine shop area (some near the border between the machine shop and the epoxy coating area) to see if epoxy resin dust was found in the total dust sampled in the machine shop area.

Follow-up Survey

The follow-up survey was conducted on August 17, 1990, and included an evaluation of all of the employees working in the machine shop area of the facility on the first and second shifts.

Six personal breathing zone (PBZ) samples, six area samples and one sample from a resistance welder were taken for total dust (NIOSH method 0500).[1] Gilian low-flow sampling pumps, calibrated at

1.5 liters per minute (L/min), fitted with pre-weighed polyvinyl filters were used to collect both PBZ and area samples for total dust. Total dust was determined gravimetrically. Additional analysis of these samples for metals was also done using inductively coupled argon plasma (ICP) analysis (NIOSH method 7300).[1] Respirable dust was measured using an Environmental Instruments respirable aerosol monitor (RAM). A total of 15 measurements were taken across both work shifts.

PBZ samples for nitric oxide and nitrogen dioxide were taken on four employees (two per shift) whose eight-hour work shift included some time as an operator of one of the resistance welders. Samples were collected using pairs of Palmes tubes, one for nitric oxide and the other for nitrogen dioxide (NIOSH method 6700), attached to the shirt collars of the employees.[1] As this sampling method is by passive diffusion, no pumps were required.

Two PBZ and 3 equipment (welder) samples for welding fumes were collected using Gilian low-flow (1.5 L/min) pumps fitted with mixed cellulose ester (MCE) membrane filters (NIOSH method 7200.[1] Samples were analyzed for the presence of one or more of 30 possible elements.

Sampling of the resistance welders for aldehydes and ozone was also done. Sampling for aldehydes was done using a Gilian low-flow (0.5 L/min) pump fitted with an Orbo 23 solid sorbent tube (NIOSH method 2539).[1] Aldehydes were also sampled for at each resistance welder using a Drager pump and tube designed for detecting aldehydes.

Ozone samples were taken for each resistance welder using a Mast Development Company (MDC) ozone monitor, model 727-3, fitted with a length of teflon tubing and a teflon filter in place to prevent intake of dust into the sampling train of the instrument. As this is a real-time instrument, a Rustrak Ranger data logger was used to record data for the duration of an eight-hour shift.

Three bulk samples of dust were taken from the machine shop area for analysis to determine the presence of epoxy resin dust. A bulk sample of the epoxy resin was taken from the bottom of the electrostatic precipitator chamber to aid in the analysis of samples.

B. Medical Evaluation

On June 19, 1990, the NIOSH medical officer conducted confidential interviews with first-shift employees who were selected randomly from a seniority list provided by the company. Second-shift employees were later telephoned, but most were not reachable. A total of 6 out of 21 employees on the seniority list were interviewed and asked about symptoms and environmental conditions in the workplace.

V. EVALUATION CRITERIA

A. Environmental Evaluation

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at levels set by the evaluation criterion. These combined effects are not often considered by the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase with overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are the following: 1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). It must be noted that the OSHA PELs are required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits, by contrast, are based primarily on concerns relating to the prevention of occupational disease.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from short-term exposures.

B. Particulates

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for total nuisance dust (particulates not otherwise regulated) is 15 milligrams of dust per cubic meter of air (mg/m^3).(2) The American Conference of Governmental Industrial Hygienists (ACGIH) threshold level value (TLV) for total nuisance dust is 10 mg/m^3.(3) These evaluation criteria were established to minimize mechanical irritation of the eyes, nose, throat, and lungs.

Airborne dust is generated by the descaling operations of the manufacturing processes used by the Schulte Corporation. This dust remains suspended in air and, as a result, some of it is inhaled by employees working in the machine shop area of the facility in sufficient quantity as to be observed in the nasal discharge of exposed employees. The presence of dust in nasal discharge, as stated by employees, indicates mucous membrane contact and a potential for direct skin contact, as well as inhalation exposure to dust. Although iron oxide, the primary component of the airborne dust collected in this health hazard evaluation, is not known to have irritant properties, irritant effects may be related to the size, shape, and local deposition of particles rather than their chemical properties. In addition, short-term exposures which cause irritation may not be detected by time-weighted samples. As a result, the nuisance dust evaluation criteria used by OSHA and ACGIH may not be appropriate in establishing concentrations of dust that do not cause discomfort.

C. Gases and Fumes

Welding fumes and gases associated with the process of welding, including nitric oxide, nitrogen dioxide, ozone, and aldehydes, are potentially generated by welding operations such as those used by the Schulte Corporation. It was therefore necessary to sample for these agents to confirm the presence and, if present, the levels of these agents in the work environment. All of these agents are known irritants and could irritate the eyes and respiratory tract. As respiratory irritants these agents may also be contributing to the reported symptom of tightness in the chest.

It has been reported that ozone can cause mutagenic effects in humans. Evidence, based on animal studies, has also been reported that ozone can cause effects in reproductive processes and may also be capable of inducing some forms of cancer in the respiratory system.

D. Epoxy Resin Dust

Epoxy compounds such as epoxy resins are known to cause irritation and possible immunologic response in some hypersensitive individuals. An epoxy resin was being used in coating operations at the Schulte Corporation in an area contiguous with the machine shop area. Bulk samples were taken from locations in the machine shop area, and some from areas bordering the coating operations area, to determine if the epoxy resin dust was present and therefore potentially a causative factor in the reported symptom of tightness in the chest.

VI. RESULTS

A. Environmental

Results for exposure monitoring for total dust conducted during the follow-up survey are shown in Table 1. None of the dust levels measured exceeded either the OSHA PEL value of 15 mg/m^3 or the ACGIH TLV of 10 mg/m^3. (2,3) Personal breathing zone samples for total dust ranged from 0.48 to 4.78 mg/m^3. The lowest level was measured for a machinist working on the second shift. The highest level was measured for the lead man working in the descaler area on the first shift.

However, with the presence of epoxy resin in the dust, these guidelines may not be applicable to conditions found in this health hazard evaluation.

Area air samples for total dust ranged from 0.05 to 4.20 mg/m^3. The lowest concentration was measured in the break area located near the offices and conference room of the facility during the first shift. The highest concentration was measured in the descaler area during the second shift.

As shown in Table 2, concentrations of respirable dust measured using the direct reading RAM ranged from 0.05 to 0.43 mg/m^3 with the lowest concentration measured in the break area near the offices and conference room during the first shift, and the conference room itself during the second shift. The highest concentration measured was in the descaler area during the second shift.

The results of personal and area sampling (both filter and direct-reading instrumentation) for dust levels in the machine shop area indicate that the highest levels occurred in the descaler area followed by the resistance welder area. It should also be noted that dust concentrations measured in the conference room during the first shift were twice those measured during the second shift indicating that dust concentrations in non-manufacturing areas of the facility vary with level of work activity in the manufacturing areas. This would also indicate that the ventilation system used in the office and conference room areas is contaminated with dust generated in the machine shop area.

As shown in Table 3, elemental analysis of dust samples shows that the dust consists mainly of iron (probably iron oxide) with traces of barium, chromium, copper, magnesium, manganese, sodium, titanium, and zinc. Similar elemental analysis performed on welding fume samples, both personal and equipment area, show that iron was also the most prevalent metal with traces of copper, manganese, and zinc. As shown in Table 4, none of the concentrations of metals measured in either dust or welding fume samples exceeded relevant PELs, RELs, or TLVs for any of these metals.

Personal breathing zone samples taken for exposure to nitric oxide and nitrogen dioxide for four employees who operated a resistance welder for some period of time during their eight-hour shift ranged from 0.31 mg/m^3 (0.25 ppm) to 0.09 mg/m^3 (0.07 ppm) for nitric oxide and 0.14 mg/m^3 (0.07 ppm) to 0.12 mg/m^3 (0.06 ppm) for nitrogen dioxide. As shown in Table 5, exposure levels of both nitric oxide and nitrogen dioxide were well below the REL, PEL, and TLV values for both chemicals.(1,2,3)

As shown in Table 6, ozone exposures for both the rod and linen resistance welders, using the direct-reading MDC ozone monitor, indicate workers in the area would have been potentially exposed above the OSHA permissible time-weighted average (TWA) exposure limit (PEL) of 0.1 ppm (0.2 mg/m^3). Insufficient data were collected to calculate a time-weighted average for exposure to ozone. Further, since workers are rotated among various work stations in the production line (usually every two hours), they do not typically operate a resistance welder for a full eight-hour shift. Therefore, although the potential exists for worker exposure to ozone above the NIOSH recommended and the OSHA permissible time-weighted average values, it probably does not occur with current work patterns.

However it should be noted that, as shown in Table 6, workers operating resistance welders were definitely exposed above the OSHA permissible short-term (ST) exposure limit of 0.3 ppm (0.6 mg/m^3).[2] These values were also above the NIOSH recommended exposure limit of 0.1 ppm (0.2 mg/m^3) as a ceiling.[1] Values ranged from non-detected to 1.62 ppm. A trace of ozone (<.05 ppm) was detected on one resistance welder and none detected at the other resistance welder using a Drager pump and ozone detector tubes. Aldehydes were not detected in samples taken for both resistance welders.

Bulk samples of dust taken from the machine shop area were qualitatively analyzed for the presence of epoxy resin dust using infrared spectral analysis. Results show that the bulk sample taken from the floor of the welding area nearest the epoxy resin coating area contained a measurable amount of epoxy resin dust. Bulk samples taken from the floor of the welding area away from the epoxy resin coating area and from the descaler area contained only trace amounts of epoxy resin dust indicating that minimal migration of epoxy resin dust into the machine shop area occurs.

B. Medical

The interviewed employees reported that airborne dust had increased since the descalers were put into operation. Scale and dust from steel rod stock were reported to fall off when stock was pulled from the coils. Scrap hoppers on descalers used to collect metal flakes and dust as they are removed from the steel rod reportedly overflowed on occasion if the hoppers were not emptied when full. Filters on the descalers were reported to be cleaned less than once a month. In addition, employees reported that floors were usually dusty because sweeping was done only once or twice a week. The floors were reported to be cleaner than usual on the day of the initial visit. Reportedly, dust was typically blown around the machine shop area. Smoke generated by welding operations was reported to be worse on hot and humid days and could be visible in the general area.

The interviewed employees reported symptoms temporally related to work. Headaches (4), black nasal discharge (3), sore throat (3), cough (4), hoarseness of voice (3), metallic taste (3), and chest tightness (3) were more commonly reported. Most of the symptomatic employees were nonsmokers. Lightheadedness, eye irritation, nose irritation, shortness of breath, chest wheezing, chest pain, fast or skipped heart beat, and itching of the skin were less frequently reported.

One employee reported hand numbness suggestive of carpal tunnel syndrome. The employee reported that basket wires were bent with a wrench up to a thousand times in a day. NIOSH investigators noted that employees used repetitive wrist motions for tasks in the area around the metal brake, where shelves are shaped.

VII. DISCUSSION

Although the symptoms reported by interviewed employees can be found in the general population and may not necessarily be caused by work exposures, the occurrence of these symptoms while at work and their improvement when away from work indicates a possible occupational cause.

The highest dust concentrations measured were from area and personal samples taken in the descaler area, consistent with employee reports that the air became notably dustier after the descalers were put into operation. The results of sampling analysis indicate that, on the day of sampling, metal dust particles and welding fumes were well below the OSHA PELS and ACGIH TLVS and would not have been expected to cause irritant or other acute health effects. Similarly, concentrations of nitric oxide, and nitrogen dioxide measured in samples taken from the resistance welders were below the OSHA PELs and the ACGIH TLVs and also lower than those expected to cause irritant or acute health effects.

Concentrations of ozone measured using direct reading instrumentation were found to potentially be above both NIOSH recommended and OSHA permissible exposure limits expressed as time-weighted averages. Concentrations of ozone measured were above both the NIOSH recommended ceiling exposure and the OSHA permissible short-term exposure levels. Exposure to these levels of ozone may be hazardous and are likely to cause symptoms of irritation. These levels of ozone were measured directly in the exhaust plume of gases and smoke directly above the resistance welders and were not measured as personal breathing zone samples of exposed workers. It is reasonable to assume that the concentrations of ozone would be lower if measured as PBZ samples. However, employees working at the resistance welders are exposed to the levels of ozone reported over a period of several hours during an eight-hour work shift. Therefore, chronic exposure to concentrations of ozone that may be lower than those measured by the direct reading ozone meter, but possibly still above current permissible or recommended levels, cannot be dismissed as not being safe.

Exposure to high concentrations of dusts, fumes, smoke, ozone, nitric oxide, and nitrogen dioxide can, even individually, cause eye and respiratory irritation. Only ozone was detected at elevated concentrations. However, the report of work-related symptoms suggests that higher concentrations of ozone and other air contaminants may be present in the machine shop area at other times, such as in the winter when the doors are closed or that exposures at lower levels in combination may be causing symptoms. Short-term exposures to dust in the machine shop area during such periods of time may be high enough to cause eye and respiratory irritation. Long-term sampling methods used to evaluate dust exposures in conducting this HHE would not detect such instances of high-level, short-term exposures.

Repetitive, forceful wrist motions in the performance of job tasks are known to cause carpal tunnel syndrome and other cumulative trauma disorders. Such wrist movements were observed among employees in the wire-shaping area. These workers and others performing similar tasks may be at increased risk of developing such disorders, which may eventually result in irreversible nerve damage. Preventive measures should be undertaken to decrease the risk of developing cumulative trauma disorders.

VIII. RECOMMENDATIONS

Although airborne dust concentrations measured throughout the machine shop area were found to be below the OSHA regulated concentration of 15 mg/m^3, it is apparent that, based on information gathered from interviews with employees, there is still some discomfort in working in airborne dust concentrations present in the work environment.

Although disposable respirators are currently made available to employees upon request, there appears to be no effective respirator program in place to insure the proper maintenance and use of respirators. Without such a program, it is unlikely that respirators would be effectively used in reducing exposure to airborne dust. Instead, engineering controls should be used to decrease airborne dust concentrations in the machine shop area. A relatively simple solution might be to use local exhaust ventilation on the dust collector compartment of each descaler to remove dust from the air as it is generated. Vacuum lines are already in place and used for vacuuming the floor in the descaler area. Adding a dedicated vacuum line system as recommended is both a feasible and practical solution.

Concentrations of airborne dust may also be reduced with the addition of overhead exhaust ceiling fans placed over each resistance welder. Although these ceiling fans would not be as effective in reducing dust concentrations as other methods such as vacuum lines, they would be of some help in reducing concentrations of airborne dust around the resistance welders which were found to be second to those concentrations found in the descaler area. Management representatives have stated that it is their intention to add overhead ceiling exhaust fans above each of the resistance welders to improve the current ventilation system.

During the initial walk-through survey, it was observed that a vacuum line was used to clean up accumulated metal scale and dust from the floor area around the descalers rather than sweeping with a broom. However, brooms and a compressed airline were observed in the resin coating area, presumably for cleaning operations in that area. Vacuuming is the preferred method for cleaning both the descaler area and the resin coating area.

Implementation of these recommendations should result in an improved work environment in all work areas, as well as the office area, through the reduction in total airborne dust. However, it must be noted that airborne dust is also generated in the epoxy resin coating area of the facility. Unless corrective measures are taken in this area as well, airborne dust concentrations may continue to be uncomfortably high for some employees.

Ventilation in the immediate area of the resistance welders should be improved to reduce potential overexposure of workers to ozone. Local exhaust ventilation would be the most effective method in reducing ozone levels.

A program for the prevention of cumulative trauma disorders should be developed. It should include ergonomic assessments of high risk job titles, engineering and/or administrative controls, and employee education and training. Because of the potential seriousness of cumulative trauma disorders, any program should place primary emphasis on removing causative factors rather than relying on the medical treatment of symptomatic employees.

The work environment should also be monitored during periods of hot weather in order to assess the possibility of heat stress occurring in workers in the machine shop area.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods, 3rd Edition. Cincinnati, OHIO, (DHHS (NIOSH) publication no. 84-100), 1984.

2. Code of Federal Regulations [1989]. Air Contaminants - Permissible Exposure Limits. 29 CFR 1910.1000 (amended). U.S. Government Printing Office, Federal Register.

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1. Schulte Corporation
2. International Association of Metal and Aerospace Workers (IAMAW), District 34
3. Confidential Requestors
4. OSHA, Region

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the affected employees for a period of 30 calendar days.

Table 1
Total Dust Exposure Data
(Sampling Filter)
Schulte Corporation
HETA 90-0232
August 17, 1990

Sample Description (liters)	Shift # (mg)	Sampling Time (mg/m^3)	Sampling Volume	Total Dust	Dust Conc
Personal Breathing Zone Air Samples*					
1st Lead Man	1	444	666.0	3.18	4.78
2nd Lead Man	1	446	669.0	0.54	0.81
Machinist	1	439	658.5	0.58	0.88
1st Lead Man	2	246	369.0	0.27	0.49
1st Machinist	2	249	373.5	0.18	0.72
2nd Machinist	2	238	357.0	0.17	0.48
Area Air Samples*					
Outside Foreman's Office	1	491	736.5	0.49	0.67
Storage Area Near					
Coating Area	1	460	690.0	0.30	0.44
Descaler Area	1	480	720.0	0.61	0.85
Welder Area					
(Linen)	1	472	708.0	0.82	1.16
Break Area	1	444	666.0	0.03	0.05
Welder Area					
(Rod)	2	185	277.5	1.03	3.71
Descaler Area	2	203	304.5	1.28	4.20
NIOSH Recommend Exposure Limit (REL) None					
OSHA Permissible Exposure Limit (PEL) 15 mg/m^3					
ACGIH Threshold Limit Value (TLV) 10 mg/m^3					

* Both personal and area samples were collected and analyzed using NIOSH method 0500. Instrumental precision in weighing n one sitting is approximately 0.01 mg.

Table 2
Respirable Dust Exposure Data
(Direct Reading Instrument)
Schulte Corporation
HETA 90-232
August 17, 1990

	First Shift		**Second Shift**	
Description of Sample	Time of Sample	Respirable Dust (mg/m^3)	Time of Sample	Respirable Dust (mg/m^3)
Inside Foreman's Office	0940	0.19	1735	0.14
Welding Area	0943	0.14	1740	0.31
Descaler Area	0944	0.42	1741	0.43
Storage Area (1)	0945	0.20	1742	0.22
Break Area (near offices)	0948	0.05	1745	0.14
Conference Room (2)	0950	0.10	1747	0.05
Epoxy Coating Area (3)	0953	0.60	1757	0.37
Wire Straightener	----	----	1744	0.17

(1) Storage area near steel column between epoxy coating area and the machine shop area.

(2) Dust levels in the conference room would indicate that dust from the machine shop and/or the epoxy coating areas is entering into the ventilation system responsible for providing ventilation to the conference room and offices. The fifty percent decrease in dust levels measured on the second shift would indicate a turning down or turning off of that portion of the ventilation system.

(3) Area not within the scope of the HHE request but does show the highest dust levels measured; most likely due to epoxy dust rather than machine shop generated dust.

Table 3
Elemental Analysis* of Total Dust
Schulte Corporation
HETA 90-232
August 17, 1990

Sample Description		**Element (in micrograms)**								
Personal Sampling	**Shift #**	**Ba**	**Cr**	**Cu**	**Fe**	**Mg**	**Mn**	**Na**	**Ti**	**Zn**
Lead Man 1-1	1	5	1	7	1,300	6	7	20	1	8
Lead Man 1-2	1	ND	ND	3	296	ND	1	30	ND	5
Laborer 1-1	1	ND	ND	3	339	ND	1	ND	ND	2
Machinist 2-1	2	ND	ND	1	120	ND	ND	ND	ND	3
Lead Man 2-1	2	ND	ND	ND	69	ND	ND	ND	ND	ND
Machinist 2-2	2	ND	ND	ND	49	ND	ND	ND	ND	5
Area Sampling										
Foreman's Office(1)	1	1	1	2	180	ND	ND	ND	ND	1
Storage Area (2)	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Welding Area	1	ND	ND	ND	50	2	ND	20	ND	2
Descaler Area	1	ND	ND	4	370	2	2	ND	ND	3
Break Area (3)	1	ND	ND	ND	4	ND	ND	ND	ND	2
Welder Sampling										
Rod Welder	2	ND	ND	9	260	ND	2	ND	ND	3
Limit of Detection (LOD) ug/filter	1	1	1	1	2	1	1	1	1	1

* Elements analyzed for were aluminum (Al), arsenic (As), barium (Ba), beryllium (Be), calcium (Ca), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), lithium (Li), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), phosphorus (P), platinum (Pt), selenium (Se), silver (Ag), sodium (Na), tin (Sn), tellurium (Te), thallium (Tl), titanium (Ti), tungsten (W), vanadium (V), yttrium (Y), zinc (Zn), and zirconium (Zr) using NIOSH method No. 7300. Elements not listed above were either not detected or analyzed for in the samples.

(1) On window ledge outside of foreman's office.
(2) Storage area near I-beam column closest to the beginning the epoxy coating process.

Table 4
Elemental* Analysis of Welding Fumes
Schulte Corporation
HETA 90-232
August 17, 1990

Sample Description		Element (ug)			
Personal Shift	**Sampling #**	**Copper**	**Iron**	**Manganese**	**Zinc**
Welder 1-1	1	3.0	310.0	1.0	1.0
Welder 2-1	2(1)	ND	26.0	ND	ND
Equipment Sampling					
Linen Welder	1	6.0	4440.0	3.0	ND
Rod Welder	1	8.0	300.0	3.0	2.0
Rod Welder	2	8.0	240.0	2.0	2.0
Limit of Detection (LOD)	1.0	1.0	1.0	1.0	ND

* Elements analyzed for were aluminum, arsenic, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lithium, magnesium, manganese, molybdenum, nickel, lead, phosphorus, platinum, selenium, silver, sodium, tin, tellurium, thallium, titanium, tungsten, vanadium, yttrium, zinc, zirconium using NIOSH method No. 7300. Elements not listed above were either not detected or analyzed for in the samples.

(1) Employee wore sampling train only 70 minutes (sample volume of 105 liters) of 8-hour shift due to severe sunburn.

Table 5
Nitric Oxide and Nitrogen Dioxide Data*
Schulte Corporation
HETA 90-232
August 17, 1990

				Nitric Oxide (NO)		Nitrogen Dioxide (NO_2)	
Sample Description	Shift #	Sample Time (hrs)	Sample Volume* (L)	mg/m^3	ppm	mg/m^3	ppm
1st Welder	1	6.2	0.34	0.28	0.23	0.12	0.06
2nd Welder	1	6.3	0.34	0.09	0.07	0.14	0.07
1st Welder	2	4.2	0.23	0.31	0.25	0.14	0.07
2nd Welder	2	4.1	0.23	0.09	0.07	0.14	0.07
Limit of Detection (LOD) 0.01 0.03							

	NO	NO_2
NIOSH Recommend Exposure Limit (REL)	25 ppm 10-hr TWA ($30 mg/m^3$)	1 ppm 15 min ceil ($1.8 mg/m^3$)
OSHA Permissible Exposure Limit (PEL)	25 ppm ($30 mg/m^3$)	5 ppm ($9 mg/m^3$)
ACGIH Threshold Limit Value (TLV)	25 ppm ($31 mg/m^3$)	3 ppm ($5.6 mg/m^3$)

* Samples were collected and analyzed using NIOSH method 6700. The LOD and Limit of Quantification (LOQ) for both NO and NO^2 are 0.01 and 0.031 ug respectively.

Table 6
Ozone Concentration Data
(Direct Reading Instrument)
Schulte Corporation
HETA 90-232
August 17, 1990

Sample Description	Instrument Reading (In Volts)*	Ozone Concentrations (mg/m^3)	Ozone Concentrations (ppm)
Linen Welder	0.0039	0.78	0.39
	0.0022	0.44	0.22
	0.0016	0.32	0.16
	0.0025	0.50	0.25
	0.0003	0.06	0.03
	0.0003	0.06	0.03
	0.0005	0.10	0.05
	0.0014	0.28	0.14
	0.0021	0.42	0.21
	0.0028	0.56	0.28
	0.0033	0.66	0.33
	0.0031	0.62	0.31
	0.0029	0.58	0.29
	0.0049	0.98	0.49
	0.0063	1.26	0.63
	0.0072	1.44	0.72
Rod Welder	0.0162	3.24	1.62
	0.0070	1.40	0.70
	0.0055	1.10	0.55
	0.0043	0.86	0.43
	0.0134	2.68	1.34
	0.0123	2.46	1.23
	0.0126	2.52	1.26
	0.0073	1.46	0.73
	0.0032	0.64	0.32

	0.0047	0.94	0.47
NIOSH Recommend Exposure Limit (REL) 0.2 mg^3 (Ceiling)			
OSHA Permissible Exposure Limit (PEL) 0.2 mg^3 0.6 mg^3 (Short Term Exposure Limit)			
ACGIH Threshold Limit Value (TLV) 0.2 mg^3			

* Signal output from ozone meter is in volts; 1 volt = 10 ppm, therefore 100mv = 1 ppm.

On June 19, 1990, NIOSH investigators conducted an initial walk-through survey and privately interviewed randomly selected employees of the first shift who were working in the machine shop area. Telephone interviews with randomly selected employees of the second shift who worked in the machine shop area were conducted later.

A follow-up industrial hygiene survey was made on August 17, 1990. Personal breathing zone (BZ) air sampling was conducted for total dust, welding fumes, nitric oxide, and nitrogen dioxide. Area air sampling was also conducted for total dust. Bulk samples of dust from three areas of the machine shop were also collected.

Results of personal BZ sampling for total dust in six breathing zone samples ranged from 0.49 mg/m^3 to 4.78 mg/m^3,and 0.44 mg/m^3 to 4.20 mg/m^3 in seven area samples obtained throughout the machine shop area of the facility. A seventh area sample was taken in a break area some distance from the machine shop area and measured 0.05 mg/m^3.

The bulk dust sample taken from the floor of the welding area nearest the epoxy coating area contained a measurable amount of epoxy dust. Bulk dust samples taken from the welding area away from the epoxy resin coating area and the descaler area showed only trace amounts of epoxy resin dust indicating little migration of epoxy dust from the epoxy coating area into the machine shop area.

During the first and second shifts, thirteen instrument readings for respirable dust were taken throughout the machine shop area and one in the facility conference room using direct reading instrumentation. Respirable dust measurements ranged from 0.05 mg/m^3 (conference room, second shift) to 0.43 mg/m^3 (descaler area, second shift).

Welding fume samples were taken from the exhaust stream of resistance welders for the analysis of the presence of aldehydes and ozone. Area sampling using direct reading instrumentation was conducted for respirable dust. Personal BZ samples collected for nitric oxide and nitrogen dioxide on four employees (two per shift) who operated resistance welders for some period of time during their eight-hour shift, indicated exposure to nitric oxide ranging from 0.09 mg/m^3 to