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AMERICAN BUILDINGS COMPANY
EL PASO, ILLINOIS

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I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a confidential request from a group of employees to conduct a health hazard evaluation (HHE) at the American Buildings Company located in El Paso, Illinois. The request stated that several spray paint workers and welders in the Ridge Frame department reported respiratory problems believed to be related to paint vapors and welding fumes generated in the workplace. In response to the request, on June 15-17, 1993, NIOSH conducted environmental and medical evaluations. The environmental evaluation included full-shift personal breathing-zone (PBZ) air sampling to assess worker exposures to paint vapors and welding fumes. The medical evaluation consisted of employee interviews and review of plant personnel records to assess the workers health complaints.

Air sampling results revealed PBZ exposures to total hydrocarbons (naphthas) as high as 663 milligrams per cubic meter (mg/m^3), which exceeded the NIOSH recommended exposure limit (REL) of 350 mg/m^3 for an 8-hour time-weighed average (TWA) exposure. Air sampling results also revealed elevated levels of welding fume components that included inorganic arsenic, iron oxide, copper, manganese, and ozone. Inorganic arsenic concentrations were as high as 0.16 mg/m^3, exceeding the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of 0.10 mg/m^3. Iron oxide concentrations were as high as 4.31 mg/m^3, approaching the NIOSH REL of 5 mg/m^3. Copper concentrations were as high as 0.056 mg/m^3, approaching both the NIOSH REL and the OSHA PEL of 0.10 mg/m^3. Exposures to manganese peaked at 0.38 mg/m^3, below the NIOSH REL, the OSHA PEL, and the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of 1.0 mg/m^3 for manganese. Ozone measurements revealed PBZ exposures that peaked at 0.35 parts per million (ppm), which exceeded the NIOSH ceiling limit of 0.10 ppm.

Based on the environmental and medical data obtained during the HHE, NIOSH investigators determined that a health hazard existed at the American Buildings Company. The investigators concluded that elevated exposures to paint vapors and welding fumes, particularly inorganic arsenic, could cause serious health effects to workers if actions are not taken by the employer to reduce exposures.

Keywords: SIC 3441 (Fabricated Structural Metal), welding fumes, inorganic arsenic, metals, paint vapors, naphthas, hydrocarbons, ozone.

II. INTRODUCTION

On October 29, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request to conduct a health hazard evaluation (HHE) at the American Buildings Company located in El Paso, Illinois. Workers were concerned about potential exposure to welding fumes and paint vapors in the Rigid Frame department. Employees reported symptoms such as vomiting, nausea, headaches, and nose bleeds. On June 15-17, 1993, a NIOSH site visit was made that included environmental and medical evaluations.

III. BACKGROUND

Since 1971, the American Buildings Company has manufactured pre-engineered steel building structures. During the time of the NIOSH site visit, the American Buildings Company employed approximately 225 employees over three shifts at the El Paso plant. Of those employed in the Ridge Frame area, 33 were welders and 13 were painters. Production is seasonal, and the workforce at the El Paso plant typically decreases to 180-200 employees after December of each year. Eighty-percent of the laid off employees are rehired in the month of May. Less than 10% of the employees leave the company each year.

Gas metal arc welding (GMAW) was performed on mild steel structures using wire fed fluxes. Although no local exhaust ventilation was provided during welding, ceiling fans exhausted welding fumes through the roof to the outdoors. After welding was performed on steel structures, they were then transferred from the welding area by an overhead crane to a large paint booth. As steel structures entered the booth, one or two workers spray painted them using compressed air spray paint guns. The painting operation used a red oxide primer paint containing about 40% aliphatic hydrocarbons. As the painted steel structures exited the booth, they were spot painted by three to four other workers. Some painters were observed wearing NIOSH approved half-mask organic vapor, air-purifying respirators. The paint booth was equipped with a dry filter ventilation system that was exhausted through the roof to the outdoors. The exhaust system was reportedly in operation during every shift, and the air-filters were changed once each day. The ventilation design specifications for the exhaust system were not available at the time of the HHE.

IV. ENVIRONMENTAL EVALUATION AND METHODS

A. Environmental Evaluation and Methods

On June 15, 1993, NIOSH investigators conducted a walk-through survey of the plant to obtain preliminary information about the plant's processes. During the

entire second shift (2:30 p.m. to 11:00 p.m.) on June 16, 1993, NIOSH industrial hygienists conducted air sampling in the painting and the welding areas to assess worker exposures to hydrocarbons, welding fumes, and ozone. Since management reported that more painting occurred during the second shift than on the other two shifts, NIOSH industrial hygienists conducted air sampling during the second shift. Observations were also made to identify general safety concerns.

Five full-shift, time-weighed average (TWA) personal breathing-zone (PBZ) air samples for hydrocarbons were collected on painters, and two area samples were collected in the general vicinity of the painting area. Each air sample was collected on 150 milligram (mg) charcoal tubes, using battery-powered air sampling pumps calibrated at a flowrate of 200 cubic centimeters (cc) per minute, in accordance with NIOSH method 1500.[1] Charcoal tube area air samples were submitted and analyzed for qualitative screening. PBZ samples were analyzed quantitatively, based on the area air sample screening results.

Five full-shift TWA PBZ air samples for 30 different metals and minerals were collected under welders helmets while they welded on steel structures. Two general area air samples were also collected in the welding area. These air samples were collected on cellulose ester membrane (CEM) filters, using battery-powered air sampling pumps calibrated at a flowrate of 1 liter per minute. Air samples were analyzed according to NIOSH method 7300, using an inductively coupled plasma (ICP) emission spectrometer.[1]

Using Dräger® colorimetric detector tubes, seven ozone measurements were made at the breathing-zone of welders while they performed welding duties. The Dräger® tubes have an accuracy of ±10 to 15% and a limit of detection (LOD) of 0.05 parts per million (ppm).

B. Medical Evaluation

To evaluate reported health problems and potential occupational hazards, fifteen employees (10 welders and 5 painters) in the Rigid Frame area on the second shift were interviewed. Information was gathered about workplace conditions, work practices, and frequency of medical symptoms possibly related to paint vapors and welding fumes. Additional interviews were conducted with management personnel to gather information about employee policies and frequency of medical absenteeism to determine incidence of health problems and lost work days in various areas of the workplace over time. Plant records were also reviewed; these included employee attendance records and the Occupational Safety and Health Administration (OSHA) Injury and Illness logs (Form 200) for 1991 through 1993.

V. EVALUATION CRITERIA

A. General

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 ten 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 even though 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 the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the 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: (1) NIOSH Recommended Exposure Limits (RELs),[(2)] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[(3)] and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).[(4)] The OSHA PELs may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in the report, industry is legally required to meet those levels specified by the OSHA standard.

A TWA exposure refers to the average airborne concentration of a chemical substance during a normal 8- to 10-hour workday. A short-term exposure limit (STEL) is defined as a 15-minute TWA which should not be exceeded at any time during the workday even if the 8-hour TWA is within the applicable exposure criteria. Ceiling limit is defined as the concentration of a substance that should not be exceeded at any time during the workday even if the 8-hour TWA is within applicable exposure criteria. Action levels are exposure concentrations established by OSHA for particular substances at which employers must initiate certain provisions of the OSHA standard such as periodic monitoring, medical surveillance,

and employee training. An action level of a substance is generally one-half the concentration of the PEL.

B. Specific Substance Evaluation Criteria and Health Effects Summary

1. Total Hydrocarbons (Naphthas)

Petroleum naphtha is comprised mainly of aliphatic hydrocarbons.[5] Effects from exposure to these solvents are primarily acute, unless significant amounts of substances that have chronic toxicity are present, such as benzene or glycol ethers. Epidemiologic studies have shown that exposure to similarly refined petroleum solvents (i.e., mineral spirits, Stoddard solvent) can cause dry throat, burning or tearing of the eyes, mild headaches, dizziness, respiratory irritation, and dermatitis.[6] The petroleum naphtha used in the paint at the American Buildings Company contains *n*-hexane and heptane.

Since naphthas are mixtures of aliphatic hydrocarbons, the evaluation criteria are based upon the most commonly available varieties (petroleum ether, rubber solvent, varnish makers' and painters' naphtha, mineral spirits, and Stoddard solvents). The NIOSH REL for petroleum distillates (naphtha) is 350 milligrams per cubic meter (mg/m^3) of air as a TWA exposure. In addition, a ceiling concentration limit (15 minutes duration) of 1800 mg/m^3 is stipulated. The OSHA PEL for petroleum distillates (naphtha) is 2000 mg/m^3 TWA, while the PEL for Stoddard solvents is 525 mg/m^3. The ACGIH has also established a TLV of 525 mg/m^3 for Stoddard solvents.

Prolonged and repeated exposure to *n*-hexane may damage peripheral nerve tissue and result in muscular weakness and loss of sensation in the extremities. Inhalation of *n*-heptane can cause loss of appetite, nausea, vertigo, incoordination, giddiness, and other symptoms of central nervous system (CNS) depression.[6] Dermal contact is capable of producing immediate irritation leading to erythema and hyperemia.[7] The symptoms associated with *n*-heptane-induced CNS depression appear to be reversible acute effects as opposed to chronic neurotoxic effects. An 8-hour workshift for *n*-hexane the NIOSH REL and ACGIH TLV are both 176 mg/m^3, and the OSHA PEL is 1800 mg/m^3.[2-4] There are no STELs established for this substance. The OSHA PEL for n-heptane is 2000 mg/m^3 TWA over an 8-hour workshift. The ACGIH TLV for heptane is 1640 mg/m^3, with a corresponding STEL of 2050 mg/m^3 averaged over 15 minutes.[3,4] The NIOSH REL for n-heptane, however, is 350 mg/m^3 TWA over 8 hours, with a 15-minute ceiling limit of 1800 mg/m^3.[4]

2. Welding and Brazing Fumes

The composition of welding fume will vary considerably depending on the alloy being welded, the process, and the electrodes used.[8] Many welding processes can also produce other hazards, including toxic gases such as ozone or nitrogen oxides, and physical hazards such as intense ultraviolet radiation. Of particular concern are welding processes involving stainless steel, cadmium or lead coated steel, and metals such as nickel, chromium, zinc, and copper. Fumes from these metals are considerably more toxic than those encountered when welding iron or mild steel. Arsenic, which NIOSH considers to be a potential occupational carcinogen, is a minute constituent in some metal alloys. Epidemiological studies and case reports of workers exposed to welding emissions have shown an increased incidence of acute and chronic respiratory diseases.[8] These illnesses include metal fume fever, pneumonitis, and pulmonary edema. The major concern, however, is the excessive incidence of lung cancer among welders. Epidemiological evidence indicates that welders generally have a 40% increase in relative risk of developing lung cancer.[8] Because of the variable composition of welding emissions, and epidemiological evidence showing an increased risk of lung cancer, NIOSH recommends that exposures to all chemical and physical agents associated with welding or brazing be controlled to the lowest feasible concentration. Exposure limits for each chemical or physical agent should be considered upper boundaries of exposure. The ACGIH TLV and OSHA PEL for total welding fume, which applies only to manual metal-arc or oxy-acetylene welding of iron, mild steel or aluminum, is 5 mg/m^3 as an 8-hour TWA.[3,4]

Based on the significant levels of airborne arsenic, iron oxide, and ozone measured during this investigation, listed below is a summary of health effects and exposure criteria for each of these substances. Additional information concerning the hazards associated with other components of welding fumes can be found in the NIOSH document, "Criteria for Recommended Standard: Occupational Exposure Welding, Brazing, and Thermal Cutting."[8]

a. Inorganic Arsenic

Exposure to inorganic arsenic can produce dermatitis (skin inflammation), keratoses (horny growths on the skin), peripheral neuropathies (diseases of the nerves of the extremities), peripheral vascular diseases (diseases of the arteries and veins of the extremities), and cancer of the skin, liver, and lungs.[9] Arsenic is absorbed primarily via inhalation and ingestion. Oral ingestion from contaminated hands may result in absorption of toxicologically significant amounts of arsenic.[10]

ACGIH has adopted a TLV-TWA of 0.01 mg/m^3 for inorganic arsenic, with the designation of confirmed human carcinogen.[3] Both NIOSH and

OSHA [29 CFR 1910.1018] consider inorganic arsenic to be a potential occupational carcinogen.[2,4] The NIOSH REL (ceiling limit) is 0.002 mg/m^3, and the OSHA PEL-TWA is 0.01 mg/m^3. OSHA also has an action limit of 0.005 mg/m^3.

b. Iron Oxide Fume

Exposure to iron oxide fume or dust may cause siderosis, a "benign" pneumoconiosis manifested by opacities on chest x-ray but no symptoms present or functional impairment.[11] Iron oxide alone does not cause fibrosis in the lungs of animals. The OSHA PEL for iron oxide is 10 mg/m^3. The NIOSH REL and the ACGIH TLV for iron oxide fume are both 5 mg/m^3.

c. Ozone

Ozone (O_3) is a highly reactive and unstable gas composed of three oxygen atoms rather than the usual two. During welding it is formed from the interaction of ultraviolet light and oxygen. O_3 has a pungent odor at 0.01 to 0.02 ppm in air. At 0.25 ppm, O_3 can cause irritation to the eyes and upper respiratory tract.[11] Symptoms of chronic exposure include headache, weakness, shortness of breath, drowsiness, reduced ability to concentrate, slowing of heart and respiration rate, and confusion.[12] NIOSH recommends that O_3 exposures should not exceed 0.10 ppm for a STEL.[2] The OSHA PEL for O_3 is 0.10 ppm as an 8-hour TWA, and 0.30 ppm as a STEL.[3,4] The ACGIH TLV for O_3 is a ceiling limit of 0.10 ppm.

VI. ENVIRONMENTAL OBSERVATIONS AND RESULTS

A. Industrial Hygiene Evaluation

1. Air Sampling Results

Hydrocarbon air sampling results for painters are shown in Table I. Based on the area air samples collected and analyzed qualitatively, the most predominant individual hydrocarbons measured were hexane and heptane. Full-shift PBZ concentration for hexane ranged from 0.046 mg/m^3 to 3.05 mg/m^3, and heptane ranged from 0.067 mg/m^3 to 4.14 mg/m^3. Hexane and heptane exposures were well below their most stringent exposure criteria of 176 mg/m^3 and 350 mg/m^3, respectively. PBZ air samples also revealed full-shift total hydrocarbon (naphthas) concentrations that ranged from 124 mg/m^3 to 663 mg/m^3, below the OSHA PEL 2000 mg/m^3. However, two of the five PBZ samples exceeded the NIOSH REL of 350 mg/m^3.

Air sampling results on welders for 30 different metals and minerals are presented in Table II. The most predominant individual metals were arsenic, iron oxide, copper, and manganese. Four of five PBZ measurements revealed full-shift TWA exposures to arsenic (range: 0.003 to 0.016 mg/m^3) that exceeded both the OSHA PEL and ACGIH TLV of 0.01 mg/m^3. These measured arsenic exposures also exceeded the NIOSH (15-minute) REL-Ceiling of 0.002 mg/m^3.

PBZ exposures for iron oxide were measured as high as 4.30 mg/m^3. While below the OSHA PEL of 10 mg/m^3, this concentration approaches the NIOSH and ACGIH iron oxide exposure criteria of 5.0 mg/m^3. PBZ exposures to copper fumes were as high as 0.06 mg/m^3, approaching the OSHA PEL and NIOSH REL of 0.10 mg/m^3, and the ACGIH TLV of 0.20 mg/m^3. PBZ exposures to manganese peaked at 0.36 mg/m^3, below the OSHA and ACGIH exposure criteria of 1.0 mg/m^3. The highest exposure for 15 other metals and minerals was less than 20% of the most stringent exposure criteria.

Dräger® tube measurements on welders revealed ozone concentrations that ranged from 0.025 ppm to 0.35 ppm. Three measurements exceeded the both the NIOSH REL and ACGIH TLV Ceiling limits of 0.10 ppm.

2. Other Observations

a. NIOSH industrial hygienists observed unsafe work practices and discovered safety deficiencies in the Ridge Frame department. While most workers exercised good work practices during the NIOSH evaluation, some employees were observed welding without the use of welding helmets and proper respiratory protection. Failure to use a welding helmet while welding may explain worker reports of welder's flash and burns of the upper arm and neck. A painter was observed wearing a (NIOSH/MSHA approved) dust\mist respirator, a respirator which is not effective against paint vapors. Another painter was observed using a respirator equipped with organic vapor cartridges that appeared to be beyond their service life. This worker reported that the respirator was given to him by management on the day of the NIOSH evaluation, and that he had not been properly fit-tested for use of the respirator.

b. According to the material safety data sheets (MSDS), the spray paint used is classified as a flammable liquid. Although NIOSH investigators did not observe workers smoking tobacco products in the plant, an ashtray that contained used cigarettes was observed near the painting area. Due to the flammability of the paint, allowing workers to smoke near the painting area poses a fire hazard. NIOSH investigators determined a distance of 55 feet

between the welding area and the paint area. (This distance meets the minimum distance of 35 feet that an OSHA General Industry regulation permits between an ignition source and a combustible source [29 Code of Federal Regulation (CFR) Part 1910.252 (d)(2)(vii)].)[4]

c. An emergency eye wash station was not present in the paint area for workers who might experience accidental sprays or splashes to the face and eyes.

B. Medical Evaluation

The NIOSH medical investigator interviewed 15 employees working in the Rigid Frame area during the second shift (10 welders and 5 painters). The interviewed welders had been employed at this facility an average of three years (range: one month to ten years). All welders were provided and required to wear personal protective equipment that included welding helmets, hearing protection, safety glasses, and safety shoes. Symptoms occurred in about 50% of the workers; the most common symptoms were cough, welders' flash, and skin burns of the upper arm and neck. The complaints of coughing included the appearance of black phlegm during or shortly after the work shifts. One-half of the interviewed welders were current cigarette smokers. Fewer than 50% of the interviewed workers reported of eye irritation, vision changes, nausea, abdominal pains, headaches, muscle weakness, shortness of breath, or chronic bronchitis.

The painters had been employed at this facility for an average of three years (range: three weeks to 11 years.) Some painters used half-mask respirators equipped with cartridges effective against organic vapors, ear-plugs for hearing protection, safety glasses, and safety shoes. Respiratory protection was not furnished by the employer. Workers purchased their own half-mask organic vapor respirators to reduce irritation of the nose and throat that they experienced. Workers also reported inadequate ventilation in the welding and paint areas.

Review of OSHA 200 logs revealed five injuries (cuts, bruises, and broken bones) among workers in the Rigid Frame area during the period of 1991 and 1993. During this same period, 28 reported incidents occurred among all employees. Medical absenteeism was less than 2% of the working days and not higher in the welding or painters areas, compared to the other employees in the building.

VII. DISCUSSION

NIOSH environmental results revealed worker exposures to arsenic that exceeded the OSHA PEL of 0.01 mg/m^3. The OSHA regulation states that if the initial monitoring for arsenic reveals employee exposure to be above the action limit, the employer is required to repeat monitoring at least quarterly, and medical examinations are to be provided for all employees exposed to levels of arsenic that are above the OSHA action level of 0.005 mg/m^3 for at least 30 days per year [29 CFR Part 1910.252].[(4)]

Whenever there is a potential for a hazardous exposure to toxic substances, traditional industrial hygiene practice dictates that the following hierarchy of controls, in decreasing order of desirability and effectiveness, be implemented to protect worker health:

1. Elimination of the toxic substance from the workplace.

2. Substitution of the toxic substance with a less toxic substance.

3. Installation of engineering controls designed to reduce exposure.

4. Use of administrative controls to reduce exposure.

5. Use of personal protective equipment to reduce exposure.

In some instances, it is not possible to eliminate or substitute a potentially hazardous substance from a production process without altering the integrity of the desired product. Thus, strategies for reducing hazardous exposure may depend on the use of engineering controls and personal protective equipment. Local exhaust ventilation and/or process isolation are commonly used controls for reducing welding fume and paint vapors. In some situations where fixed local exhaust ventilation is not feasible, a movable hood with a flexible duct may be used. Cooling fans can also be considered, but only when local exhaust is not feasible (i.e., remote work areas or outdoor settings). Cooling fans can remove welding fumes from the breathing-zone when properly placed at the side of the worker, but their use is limited and they may cause dispersion of the air contaminants to other work areas. Any use of cooling fans at an indoor worksite requires supplemental general ventilation. Personal protective equipment should only be used when engineering controls are not feasible, in the interim when engineering controls are being installed or repaired, or when engineering controls have not sufficiently reduced exposures.

Air sampling results revealed elevated exposures to total hydrocarbons among paint workers, and their complaints of respiratory symptoms were consistent with those related to hydrocarbon exposures. Some paint workers took the initiative of purchasing their own respirators to protect themselves from paint vapors. This action by workers provides belief that their health complaints were valid, and suggests that they were concerned about protecting their health. In accordance with the Occupational Safety and Health Act, *employers are responsible for providing personal protective equipment at no cost to the employee.*[(2)]

An OSHA General Industry regulation [29 CFR Part 1910.252 (d)(2)(vii)], requires (unless separated by a partition) a minimum distance of 35 feet between a spray paint booth (combustible source) and welding equipment that produces flames and sparks. The distance between the spray paint booth and the welding process was estimated at 55 feet. Although there was a safe distance between the two processes during the time of the evaluation, if new processes are added or current processes are relocated, this distance requirement should be considered.

VIII. CONCLUSIONS AND RECOMMENDATIONS

In summary, based on the environmental and medical data obtained during the evaluation, NIOSH investigators concluded that a health hazard existed at the American Building Company. Paint workers were exposed to elevated levels of total hydrocarbons that may be associated with paint workers' health complaints. Welders were exposed to elevated levels of welding fume components, particularly inorganic arsenic and ozone. Other welding fume components measured at significant concentrations included iron oxide, copper, and manganese. Several safety deficiencies and unsafe work practices were observed that may contribute to the adverse health effects reported by workers. The following recommendations are offered to improve occupational health and safety at the American Building Company.

1. Engineering control measures (i.e., movable direct exhaust ventilation hoods [see Appendix A]) should be implemented in the welding area to reduce worker exposure to welding fumes. Management should consult a qualified person who is knowledgeable about industrial ventilation.

2. To reduce worker exposure to paint solvents, the exhaust ventilation system in the spray paint booth should be evaluated to ensure that the system operates according to the manufacturers specifications, or as recommended by the ACGIH.[13] Management should consult a qualified person who is knowledgeable about industrial ventilation.

3. Until engineering controls are in place to reduce worker exposure to welding fumes and paint vapors, management should provide workers with respiratory protection. For example, half-face welding fume respirators that can be worn under welding helmets are commercially available.

4. Until improved exhaust ventilation can be provided to reduce exposures to paint solvents, a written respiratory protection program should be implemented for workers in the paint area that is consistent with OSHA requirements and NIOSH recommendations.[4,14] A respiratory protection program should include the following:

    a. Medical evaluation to determine individual worker's ability to use a respirator and to perform the work required when wearing a respirator.

    b. Regular training of personnel.

    c. Respirator fit testing.

d. Use of NIOSH/MSHA approved respirators.

e. Periodic environmental monitoring.

f. Proper maintenance, inspection, cleaning, and storage of respirators.

The appropriate type of respirator for paint workers is a half-face, air purifying respirator equipped with cartridges designed to protect against organic vapors and paint spray. *It is important to reiterate that respiratory protection should not be used as the primary means of reducing exposures.*

5. To reduce a potential fire hazard, smoking should be prohibited near the painting operation. The use of tobacco products, as well as eating and drinking while working, can increase worker exposure to paint constituents by way of ingestion. Workers who work with paints, solvents, or other hazardous substances should be encouraged to wash hands and face prior to these activities. Because environmental tobacco smoke is classified as a carcinogen, NIOSH recommends that smoking should be prohibited at the worksite. Until that can be achieved, smoking should be restricted to smoking lounges that are separately ventilated. In addition, a "No Smoking" sign should be posted in the spray paint area.

6. The MSDSs for some paints used in the painting area specify the need to use safety goggles when applying the paint. Safety glasses (with side shields) that were worn by painters should be replaced with safety goggles for better eye protection against accidental spills or splashes.

7. An eye wash station should be located in the painting area for accidental cases of paint splashes in the eyes and face. Training should be provided to inform workers about the presence of an eye wash station and the procedures for using the station.

8. Management should improve hazard communication by providing a worker education program intended to inform workers about the health risks from exposure to substances in the workplace, the proper use of personal protective equipment, and proper work practices. Occupational health personnel or others knowledgeable about these issues should discuss each of these topics with the employees. In addition, a copy of MSDSs should be posted in the spray paint area.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report have been sent to:

1. American Buildings Company
2. Confidential Requesters
3. OSHA, Region V

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

Table I
FULL-SHIFT PERSONAL BREATHING-ZONE AIR SAMPLING RESULTS FOR HYDROCARBONS
HETA 93-0035
AMERICAN BUILDING COMPANY
June 16, 1993

Sample Location	Sampling Time (minutes)	Sample Flow Rate (liters per minute)	Sample Volume (liters)	Concentration, milligrams per cubic meter (mg/m^3)		
				n-Hexane	n-Heptane	Total Hydrocarbons (Naphthas)
Painter	458	0.20	96.6	3.05	4.14	663
Painter	446	0.20	89.2	0.19	0.26	124
Painter	443	0.20	88.6	0.06	0.25	367
Painter	432	0.20	86.4	0.07	0.07	130
Painter	432	0.20	86.4	0.05	0.08	140
Minimum Detectable Concentration (MDC)			96	0.005	0.005	0.005
Minimum Quantifiable Concentration (MQC)			96	0.017	0.017	0.017
Exposure Criteria (expressed in mg/m^3)						
NIOSH Recommended Exposure Limit (REL)				176	350	350
OSHA Permissible Exposure Limit (PEL)				1800	2000	2000
ACGIH Threshold Limit Value (TLV)				176	1640	525

Abbreviations:
ND = Not detected
Trace = Value is between the MDC and the MQC
Ceiling = Level which should not be exceeded
TWA = Time Weighted Average (8-hours)
STEL = Short-term Exposure Limit (15 minutes)

Table II
FULL-SHIFT PERSONAL BREATHING-ZONE AIR SAMPLING RESULTS FOR METALS
HETA 93-0035
AMERICAN BUILDING COMPANY
June 16, 1993

Sample Location	Sample Type	Sampling Time (minutes)	Sample Flow Rate (liters per minute)	Sample Volume (liters)	Concentration, milligrams per cubic meter (mg/m^3)			
					Arsenic	Copper	Iron Oxide	Manganese
Welder #3	PBZ	394	1	394	0.005	0.056	4.31	0.380
Welder #4	PBZ	420	1	420	0.003	0.050	3.60	0.360
Welder #5	PBZ	422	1	422	ND	0.031	2.00	0.18
Welder #6	PBZ	443	1	443	0.016	0.004	1.50	0.02
Welder #8	PBZ	458	1	458	0.005	0.041	3.35	0.287
Welder #7	PBZ	417	1	417	ND	0.039	1.90	0.039
Welding Area	Area	418	1	418	ND	0.015	ND	0.074
Outdoors	Area	378	1	378	ND	ND	Trace	ND
Minimum Detectable Concentration (MDC)				458	0.001	0.0002	0.002	0.0006
Minimum Quantifiable Concentration (MQC)				458	0.003	0.0007	0.006	0.002
Exposure Criteria (expressed in milligrams per cubic meter)								
NIOSH Recommended Exposure Limit (REL)					0.002 mg/m^3 STEL	0.10 TWA	5.0 TWA	1 mg/m^3 TWA 3 mg/m^3 STEL
OSHA Permissible Exposure Limit (PEL)					0.01 mg/m^3 TWA 0.005 mg/m^3 (AL)	0.10 TWA	10.0 TWA	1.0 TWA
ACGIH Threshold Limit Value (TLV)					0.10 mg/m^3 TWA	0.20 TWA (for fume)	5.0 TWA	1.0 mg/m^3 TWA 3 mg/m^3 STEL (proposed)

Abbreviations:

ND	=	Not Detected	NA	=	Exposure criteria not available
PBZ	=	Personal Breathing-Zone	TWA	=	Time Weighed-Average (8-hours)
STEL	=	Short-term Exposure Limit (15-minutes)	AL	=	Action Level

Comments:

The following elements were either not detected or were present at concentrations less than 20% of the most stringent occupational exposure criteria.

Aluminum	Beryllium	Cadmium	Selenium	Thallium	Barium	Chromium	Silver	Molybdenum
Titanium	Cobalt	Phosphorus	Platinum	Tellurium	Vanadium	Nickel	Lithium	

Appendix A
Selected Local Exhaust Ventilation Designs

Source:
Industrial Ventilation Manual, 20th Edition
American Conference of Governmental Industrial Hygienists[15]