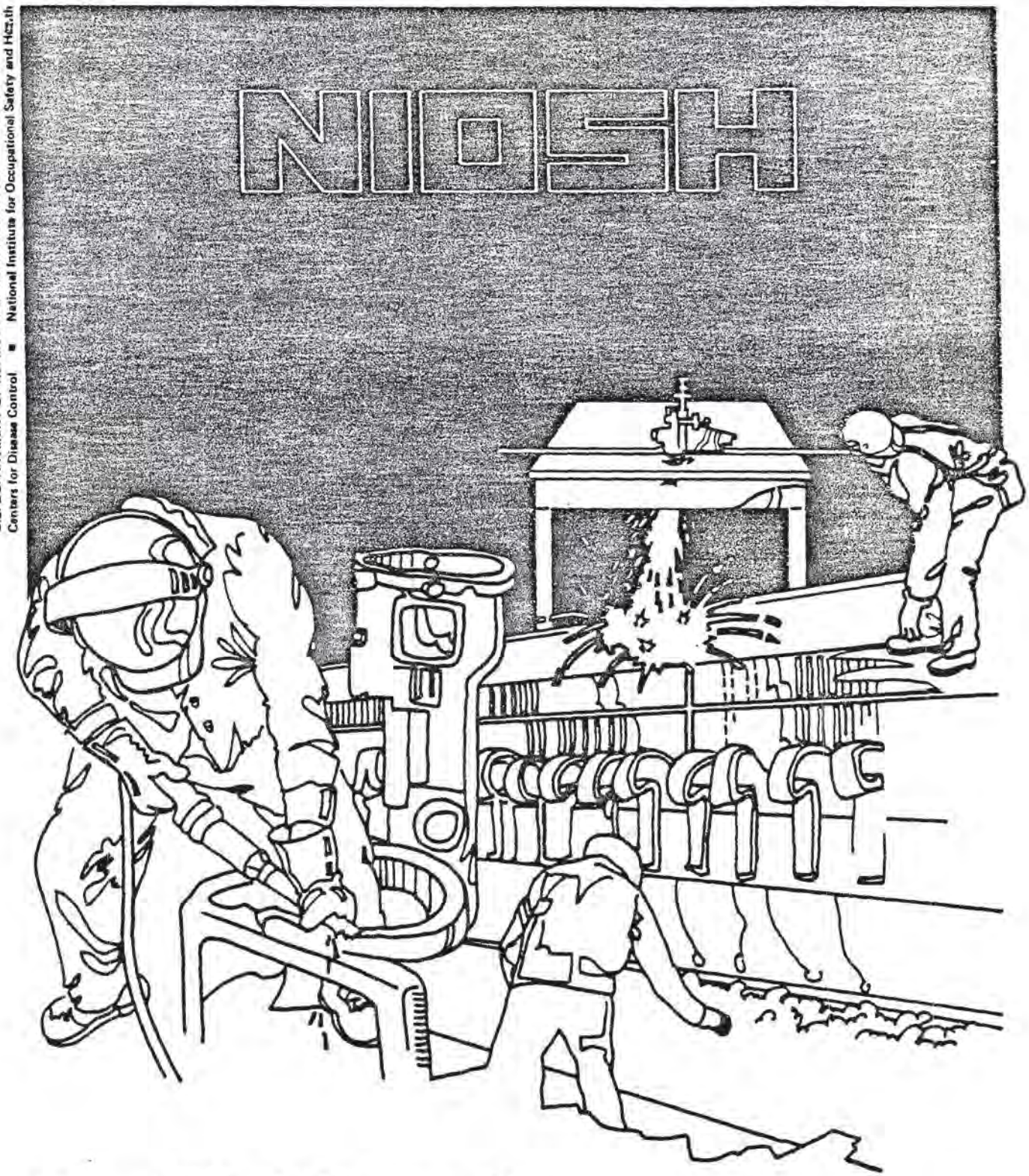
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HHE 80-153-881
PALMER INDUSTRIAL COATINGS INCORP.
WILLIAMSPORT, PENNSYLVANIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HHE 80-153-881
May 1981
Palmer Industrial Coatings Incorporated
Williamsport, Pennsylvania

NIOSH INVESTIGATORS:
Walter J. Chrostek, IH
Marshal S. Levine, MD

I. SUMMARY

On May 27, 1980, NIOSH received a request from the President of Palmer Industrial Coatings, Incorporated, Williamsport, Pennsylvania, expressing concern about what the possible adverse health effects may be from exposure to abrasive blasting materials, solvents and fumes. No adverse health effects were reported at the time.

An initial walk-through survey was conducted by the NIOSH investigator on June 24, 1980, during which the operations and controls were observed and an inventory of paints and thinners was made. Four bulk samples of the most commonly used solvents were collected for laboratory analysis. Chemical substances found were acetone, isopropanol, methyl ethyl ketone (MEK), toluene, xylene, cellosolve acetate, trichloroethylene, epichlorohydrin, methyl isobutyl ketone (MIBK), butanol and petroleum distillate. The abrasive blasting operations were also evaluated.

On September 9 and 10, 1980, environmental air evaluations were conducted for the above-mentioned air contaminants. Six employee breathing zone and two operator's exposure samples were collected for the above-mentioned organic solvents. Analysis of the samples showed that there is a potential for over-exposure of paint sprayers to organic solvents as calculated by the formula for mixtures. NIOSH approved respirators for organic vapors were used by the paint sprayers. Two samples (1.31-1.36) exceeded NIOSH criteria (1.0). None exceeded the OSHA standard.

Epichlorohydrin was not considered in the calculation formula for mixtures. Although NIOSH recommended an occupational exposure of 2 milligrams per cubic (mg/M^3) meter of air, NIOSH subsequently recommended that epichlorohydrin be handled in the workplace as if it were a human carcinogen. All of the samples collected (2.2-138.9 mg/M^3) exceed the NIOSH recommended standard for epichlorohydrin of 2.0 mg/M^3. Seven of the eight samples exceeded the OSHA standard of 19 mg/M^3.

Four personal breathing zone respirable air samples were collected for free crystalline silica containing dust on September 8-9, 1980. The samples were collected under the hood and represent actual exposure. Analysis of the dust showed the silica content to be 87 percent. The NIOSH recommended standard for crystalline silica is 0.05 mg/M^3 and the OSHA standard for 87 percent silica is 0.11 mg/M^3. Gravimetric analysis of the samples shows that there is an overexposure to respirable crystalline silica containing dust (0.25-0.69 mg/M^3).

On September 12, 1980, medical investigators from the Center for Occupational and Environmental Health of the Johns Hopkins University and the U.S. Public Health Service Hospital in Baltimore, Maryland interviewed nine employees. Complaints of health effects are primarily related to acute reversible central nervous system symptoms, and to eye irritation.

On the basis of the data obtained in this investigation, NIOSH determined that there is a health hazard from overexposure to organic solvent vapors, especially epichlorohydrin, at the paint spraying operations. A hazard from overexposure to silica-containing dust exists in abrasive blasting operations. Recommendations have been incorporated into this report as a guide in controlling exposure to the organic solvents and silica-containing dust.

KEYWORDS: SIC 1799: (Special trade contractor, abrasive blasting, epoxy painting), acetone, isopropanol, MEK, toluene, xylene, cellosolve acetate, trichloroethylene, epichlorohydrin, glycidal ethers of bisphenol A, MIBK, butanol, petroleum distillate, crystalline silica, steel dust, eye irritation, acute central nervous system symptoms

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, NIOSH investigates the toxic effects of substances found in the workplace. On May 27, 1980, a request was submitted by the President of Palmer Industrial Coatings, Onc., expressing concern about the possible adverse health effects from exposure to paint thinners and abrasive blasting.

III. BACKGROUND

Palmer Industrial Coatings, Inc., is engaged in finishing structural steel members and other fabricated steel products. The products are abrasive-blasted (steel shot or sand) and spray painted. Paints used are either two component epoxies or oil based depending on the customer's specification. About 90 percent of the paints used are epoxies.

Sand blasting is done outdoors by one to three operators. Steel shot blasting is done on a machine where the fabricated steel product is put on an automatic conveyer. Local exhaust is applied in key dust producing areas.

Following the blasting, the steel products are put on mounts and spray painted with two-part epoxy paints and zinc primers which may contain lead as an impurity. The two parts of the epoxy paint system are the epoxy resin mixture, which contains the epoxy polymers, and the curing agent mixture which catalyzes the cross-linking of the polymers and thereby "hardens" the coating.

The zinc oxide primer is prepared from the zinc-free paint mixture to which is added powdered zinc.

On April 29 and 30, 1980, the NIOSH Regional Industrial Hygienist met with representatives of the company and the employees for the opening and closing conferences and walk-through survey. An interim report on this visit was sent to plant management and the representative of the employees in August 1980. It included recommendations for respirator use and maintenance of only NIOSH-approved respirators.

Environmental air sampling for organic vapors, silica and steel dust was conducted on September 9-10, 1980.

On September 12, 1980, NIOSH contract personnel from the Center for Occupational and Environmental Health of the Johns Hopkins University and the U.S. Public Health Service Hospital, Baltimore, Maryland, conducted a walk-through evaluation. During this visit, operations were observed. Informal interviews were conducted with nine of the twenty-five painters and sandblasters concerning their health and possible work-related effects. The medical program for painters and sandblasters was discussed with the plant physician who has recently begun regular medical examinations of the employees.

IV. EVALUATION DESIGN AND METHOD

A. Environmental

1) Organic Solvents

During the visit of June 24, 1980, four bulk samples of the most frequently used solvents were collected. Analysis of these samples showed the major peaks were cellosolve acetate, toluene and methyl ethyl ketone. The lesser peaks were MIBK, xylene, trichloroethylene, acetone, and isopropanol. Epichlorohydrin was not detected in the solvents.

Environmental air sampling was conducted on September 9-10, 1980. Four bulk air samples were collected near the five-gallon paint buckets on charcoal tubes utilizing personal pumps operating at 100 cubic centimeters per minute. Air samples in the employee breathing zone were taken in a similar manner.

The samples were analyzed quantitatively by NIOSH Method P&CAM 127[1] with modifications.

The limits of detection using these methods were 0.01 mg for isopropanol, MEK, toluene, xylene, cellosolve acetate, and MIBK; 0.03 mg for acetone and trichloroethylene and 0.05 mg for epichlorohydrin.

Bulk air and personal air samples obtained on the paint sprayer using a primer were collected. The samples were analyzed using gas chromatography/mass spectrometry in accordance with NIOSH Method P&CAM 127[1] (modified).

The limits of detection using this method were 0.01 mg/sample for n-butanol and xylene and 0.03 mg/sample for petroleum distillate.

2) Bisphenol A and Diglycidyl Ether of Bisphenol A

Eleven personal air samples were collected. These samples were analyzed for bisphenol A and the diglycidyl ether of bisphenyl A by NIOSH Method P&CAM 333. The limit of detection for this analysis was 0.6 microgram per sample for both analytes.

3) Silica-containing dust

A bulk air sample and personal respirable dust samples were collected for silica-containing dust. The sandblaster's air samples were collected under the employees sand blasting hood so that a realistic exposure both with the employees sand blasting hood on and off could be evaluated while the operator was in the sandblasting area. The samples were collected utilizing pre-weighed mixed cellulose ester membrane filters preceded by a cyclone with a personal sampling pump at a rate of 1.7 liters per minute.

The sample was analyzed for quartz and cristobalite using x-ray diffraction.

A preliminary scan of the sample indicated that no interfering substances were present and no cristobalite was detected, however, the dust contained 87 percent silica.

The lower limit of quantitation was estimated to be 0.03 milligram or 1.5% for a two-milligram sample for both polymorphs of silica.

The instrumental precision of weighings done at one sitting was 0.01 mg per sample.

4) Steel dust

Personal total dust exposures were evaluated at the shot blasting operations. The samples were collected on pre-weighed mixed cellulose membrane filters and analyzed gravimetrically.

B. Medical

Nine employees were interviewed by the personnel from the Johns Hopkins Center for Occupational and Environmental Health of the U.S. Public Health Service Hospital, Baltimore, Maryland during the walk-through of September 12, 1980.

V. EVALUATION CRITERIA

Substance*	NIOSH (TWA)	OSHA (TWA)
Acetone[3]	590	2400
Isopropanol[4]	980	980
Methyl Ethyl Ketone (MEK)[3]	590	590
Toluene[5]	375 (Skin)**	750
Xylene[6]	435	435
Cellosolve Acetate[11]		540**
Trichloroethylene[10]	535**	535
Epichlorohydrin[7][16]	2**	19**
Methyl Isobutyl Ketone (MIBK)[3]	200	410
Butanol[10]	450	450
Petroleum Distillates[9]	350	2000

There are no established standards or criteria for bisphenol A or diglycidyl ether of bisphenol A. At present there is insufficient data available to suggest a standard for these compounds.

* Denotes milligrams of contaminant per cubic meter of air sampled.
**Potential contribution to the overall exposure by the cutaneous route including the mucous membrane and eye.

Aromatic epoxy resins have been shown to be mutagenic in bacteria and may represent a cancer risk in humans. They contain additives (catalysts, curing agents, etc.) other than bisphenol A (BA) and DGEBA which were not covered in this evaluation due to inadequate information and/or lack of necessary or sufficiently sensitive analytical procedures for their detection. Although such additives represent a very small percentage of the overall formulation, they may contribute significantly to the overall toxicological considerations of the total resin system. The glycidyl ethers are highly reactive both chemically and biologically. Cytotoxic effects and mutagenicity in bacteria and other test systems has been demonstrated. It is recommended((NIOSH) criteria document, Occupational Exposure to Glycidyl Ethers.[12]) that because of the evidence that some "glycidyl ethers have the potential to produce tumorigenic, mutagenic, or reproductive effects, and because few have been adequately tested for such effects, occupational exposure to glycidyl ethers is defined (in this document) as work in any area where these substances are manufactured, stored, used, or handled". (p.11) It is further recommended that "work practices appropriate for handling glycidyl ethers should be adhered to in processes involving an uncured epoxy resin system". (p. 27)

The diluents in the paints are mixtures of organic solvents. Atmospheric samples that were collected were analyzed for the individual components of the air contaminant

In order to determine if there were overexposures to mixtures of organic solvents, the following formula was used:[2]

$$E_m = (\frac{C_1}{L_1} + \frac{C_2}{L_2}) + \ldots (\frac{C_n}{Ln})$$

where E_m is the equivalent exposure for the mixture C_1 is the observed atmospheric concentration and L_1 is the corresponding threshold limit value. If the sum of the fractions exceeds unity (1), then the threshold limit of the mixture should be considered as being exceeded. The formula is only used when the chief effects are in fact additive, which they were in this case.

Silica-containing Dust[8]

1. Occupational Health Standard promulgated by U.S. Department of Labor - Federal Register, July 1, 1975, Volume 39, Title 29, Part 1910, sub-part 7, Section 1000, the silica standard for quartz in respirable dust is calculated by dividing 10 mg/M^3 by the % quartz + 2 for dust with more than 5 percent Si O_2 or 5 mg/M^3 meter for respirable dust with 1 percent or less Si O_2.

2. The NIOSH Criteria Document[8] recommends respirable free silica exposure should not exceed 0.05 mg/M^3, for a ten hour time weighted average (TWA).

VI. TOXICITY

A. Acetone, Methyl Ethyl Ketone (MEK), Methyl Isobutyl Ketone (MIBK)[10]

These solvents may produce a dry, scaly, and fissured dermatitis after repeated exposure. High vapor concentrations may irritate the conjunctiva and mucous membranes of the nose and throat, producing eye and throat symptoms.

In high concentrations, narcosis is produced, with symptoms of headache, nausea, light-headedness, vomiting, dizziness, incoordination, and unconsciousness.

Recent reports indicate that exposure of workers to methyl n-butyl ketone has been associated with the development of peripheral neuropathy.

B. Isopropyl Alcohol[10]

The vapors are mildly irritating to the conjunctiva and mucous membranes of the upper respiratory tract and is potentially narcotic in high concentrations.

C. Toluene[10]

Toluene may cause irritation of the eyes, respiratory tract, and skin. Repeated or prolonged contact with liquid may cause removal of natural lipids from the skin, resulting in dry, fissured dermatitis. The liquid splashed in the eyes may cause irritation and reversible damage.

Acute exposure to toluene predominantly results in central nervous system depression. Symptoms and signs include headache, dizziness, fatigue, muscular weakness, drowsiness, incorrdination with staggering gait, skin paresthesias, collapse and coma.

D. Xylene[10]

Xylene vapor may cause irritation of the eyes, nose, and throat. Repeated or prolonged skin contact with xylene may cause drying and defatting of the skin which may lead to dermatitis. Liquid xylene is irritating to the eyes and mucous membranes, and aspiration of few milliliters may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Repeated exposure of the eyes to high concentrations of xylene vapor may cause reversible eye damage.

Acute exposure to xylene vapor may cause central nervous system depression and minor reversible effects upon liver and kidneys. At high concentrations xylene vapor may cause dizziness, staggering, drowsiness, and unconsciousness. Also at very high concentrations, breathing xylene vapors may cause pulmonary edema, anorexia, nausea, vomiting, and abdominal pain.

E. Cellosolve Acetate[11]

The vapors are irritating to the eyes, nose and throat; at very high concentrations it has caused central nervous system depression in animals, and it is expected that severe exposure will cause the same effects in humans.

No effects have been reported in humans, probably because the vapor becomes objectionable before concentrations necessary to cause adverse systemic effects are reached. Cellosolve acetate is a defatting agent, and prolonged or repeated contact may lead to dermatitis.

F. Trichloroethylene[10]

Exposure to trichloroethylene vapor may cause irritation of the eyes, nose, and throat. The liquid, if splashed in the eyes, may cause burning irritation and damage. Repeated or prolonged skin contact with the liquid may cause dermatitis.

Acute exposure to trichloroethylene depresses the central nervous system exhibiting such symptoms as headache, dizziness, vertigo, tremors, nausea and vomiting, irregular heart beat, sleepiness, fatigue, blurred vision, and intoxication similar to that of alcohol. Unconsciousness and death have been reported. Alcohol may make the symptoms of trichloroethylene overexposure worse. If alcohol has been consumed, the overexposed worker may become flushed. Trichloroethylene addiction and peripheral neuropathy have been reported. Recent reports indicate that exposure to trichloroethylene may induce liver tumors in mice.

G. Epichlorohydrin[7][16]

Epichlorohydrin is highly irritating to eyes, skin, and respiratory tract. Skin contact may result in delayed blistering and deep-seated pain. Allergic eczematous contact dermatitis occurs occasionally.

The earliest symptoms of intoxication may be referable to the gastrointestinal tract (nausea, vomiting, abdominal discomfort) or pain in the region of the liver. Labored breathing, cough, and cyanoses may be evident and the onset of chemical pneumonititis may occur several hours after exposure.

NIOSH recommends that as a prudent measure, epichlorohydrin be handled in the workplace as if it were a human carcinogen. This recommendation is based primarily on two recent studies: a long term epidemiologic study showing a significant increase in respiratory cancer deaths of exposed workers, and an inhalation study showing an increase in nasal carcinomas in rats. In addition, cytogenetic studies of human peripheral lymphocytes have shown a highly significant increase in chromosome abnormalities in exposed workers. Pending further evaluation of its carcinogenic potential, NIOSH believes it would be prudent to minimize occupational exposure to epichlorohydrin.

H. Glycidyl Ethers[12][17]

Glycidyl ethers are synthetic compounds and find their major use as components of epoxy resin systems. The "diglycidyl ether of bisphenol A" has been a traditional basic active ingredient of epoxy resins; other glycidyl ethers are frequently incorporated into epoxy resin systems as reactive diluents. The epoxy group of the glycidyl ethers reacts during the curing process and glycidyl ethers are therefore generally no longer present in completely cured products. Epoxy resins containing glycidyl ethers are used in a variety of applications including protective coatings, reinforced plastics, as well as bonding materials and adhesives.

Much occupational exposure to glycidyl ethers results from the use of proprietary or trade name products which do not disclose the presence of toxic agents in their formulations. This complicates efforts to take appropriate precautionary measures for the prevention of occupational disease. For example, unrecognized hazardous situations can occur where protective coatings containing epoxy resins are sprayed, thereby facilitating the inhalation of even non-volatile materials, and where there is skin contact with epoxy resins containing glycidyl ethers.

Reports from different laboratories present a pattern of findings indicating that some of the glycidyl ethers may be capable of producing testicular atrophy and hemopoietic abnormalities in various species of laboratory animals. While none of the individual research reports are conclusive, some of the changes observed may act as predisposing factors to systemic problems. NIOSH is not aware of any studies investigating the possible occurrence of testicular atrophy or hemopoietic abnormalities in humans exposed to glycidyl ethers. The possibility of these effects occurring in humans is reason for concern. Therefore, the occupational health community is advised of the possibility of these effects appearing in workers exposed to glycidyl ethers.

I. Butanol[10]

Butanol is a primary skin irritant. The vapor is an irritant to the conjunctiva and mucous membranes of the nose and throat. A mild keratitis characterized by corneal vacuoles has been noted at vapor concentrations over 200 ppm.

Inhalation of high concentrations, in addition to the local effects, have produced transitory and persistent dizziness with Meniere's syndrome. Slight headache and drowsiness may also occur.

J. Petroleum Distillates[10][11]

Petroleum distillates are irritating to the skin, conjunctiva and mucous membranes of the upper respiratory tract. Skin "chapping" may develop after repeated contact with the liquid. The vapor is a central nervous system depressant.

K. Silica Dust

The compound responsible for the development of silicosis is crystalline silica (silicon dioxide). The three most common crystalline forms of free silica encountered in industry are quartz, cristobalite, and tridymite. Inhalation of microscopic silica particles into the lung leads to a fibrogenic response. This results in the production of whorls of connective tissue encasing the silica particle(s). The various stages of progression of silicosis are related to the degree of exposure to free silica, duration of exposure, duration of time retained dust reacts with lung tissue, and certain host factors.[8]

Silicosis is usually a chronic disease with symptoms developing late. It is not common for the chest x-ray to show signs of silicosis before 15-20 years of exposure. A more rapid onset of disease would indicate heavier exposure because of unusual circumstances of employment (lack of protection, or work in enclosed areas), of an infectious or immulogic complication.[14]

L. Nuisance Dust[15]

In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, the so-called "nuisance" dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance aerosols have been called biologically "inert", but the latter term is inappropriate to the extent that there is no particulate which does not evoke some cellular response in the lung, inhaled in sufficient amounts. However, the lung-tissue reaction caused by inhalation of nuisance aerosols has the following characteristics:

1. The architecture of the air spaces remains intact.
2. Collagen (scar tissue) is not formed to a significant extent.
3. The tissue reaction is potentially reversible.

Excessive concentrations of nuisance aerosols in the workroom air may seriously reduce visibility (iron oxide), may cause unpleasant deposits in the eyes, ears and nasal passages (Portland Cement dust), or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by rigorous skin cleansing procedures necessary for their removal.

VII. RESULTS AND DISCUSSION

The breathing zone samples of the epoxy paint sprayers were collected to determine their potential exposures to organic solvents. Analysis of these samples showed that they exceeded NIOSH and OSHA standards. The atmospheric air samples were analyzed for acetone, isopropanol, MEK, toluene, xylene, cellosolve acetate, trichloroethylene, and MIBK. The formula $\frac{C^1}{L^1} + \frac{C^2}{L^2} \cdots \frac{Cn}{L^n}$ was used to determine if the additive effects exceeded unity.

Using the formula, two of the eight operations exceeded unity by using NIOSH recommended criteria (1.31-1.36). None exceeded unity using OSHA standards.

The environmental air concentrations found for epichlorohydrin and diglycidyl ether of bisphenol A were not used in the formula as the health symptoms are different from the above solvents.

NIOSH standard for epichlorohydrin is 2 mg/M^3, while OSHA standard is 19 mg/M^3. All samples (2.4-138.9 mg/M^3) exceed the NIOSH recommended standard and seven of the eight samples exceeded the OSHA standard.

All painters wore NIOSH-approved respirators while spraying. These were removed after the spraying was completed. The foreman, who was in the area, did not wear a respirator. The results of the environmental air sampling as presented in Table II for the foreman would also represent the general air in the plant as most of his time is spent in the area. (See sample Nos. 1, 12 and 14.)

Sandblasting is performed outdoors by one to three employees wearing air supplied hoods. Portable sand blast units are brought into the area where the operation is to be performed. The primer paint, if specified by the customer, is also applied in the same area.

An automatic steel shot machine reduces potential exposure to silica. Shot blasting is performed on an automated local exhaust machine.

The environmental air samples for silica-containing dust were taken under the hood of the sand blaster and are listed as exposures. The analysis of the samples for silica shows that the exposure of the sandblaster performing this operation throughout the day exceeded both NIOSH and OSHA criteria for dust containing 87 percent free silica, viz. 0.05 and 0.11 mg/M^3. The exposures for the permanent sand blaster ranged from 0.25 to 0.69 mg/M^3 of silica. (See Table VII). The chief causative agent for overexposure was fugitive dust from adjacent sand blasting operations or ambient dust in the area when the hood is removed.

VIII. CONTROL MEASURES IN PLACE

A. Ventilation

Ventilation at Palmer Industrial Coatings consists primarily of natural ventilation through open doorways during summer months and mild weather. During the winter, the doorways are kept shut as much as possible and ventilation is reduced. Heating is provided by kerosene burners. Small rotary fans in the high ceilings are used to maintain circulation and to return warm air back toward the ground.

B. Medical

At the present time, Palmer Industrial Coatings has no formal medical testing program. A local physician was interviewed at his office. He has been approached by Palmer Industrial Coatings to perform yearly physicals for all the painters and sandblasters on a regular basis and is interested in developing specific screening examinations for painting and sandblasting exposures.

C. Work Practices

The dirt floor of the working area is skimmed approximately twice per year as a cleaning measure to remove overspray of paint and other materials. Water spray is used to keep dust down.

D. Personal Protective Equipment

Personal protective equipment used by the workers at Palmer includes air-supplied hoods used during the sandblasting operation and single cartridge respirators used during the mixing and spraying of coatings. The respirator currently in use is NIOSH approved. The spray painters also use a paper helmet and goggles when they are mixing paints or applying coatings.

Workers are supplied at the plant with clean work uniforms and also clean overalls, and showers are available at the work site.

E. Results of Worker Interviews

Nine employees were interviewed by personnel from the Center for Occupational and Environmental Health of the U.S. Public Health Service Hospital, Baltimore, Maryland, during the walk-through. They ranged in age from 23 to 46, with most in their late twenties and early thirties; the mean age of the workers was 30.7 years. The men had worked at Palmer Industries for as little as six months to as long as 13 years; the mean number of years worked at Palmer was 5.3 years. A summary of the findings from these interviews is given in Table 5.

Reports of adverse health effects appeared to be centered around the use of the Con-Lux "Tank-O-Lon" coating (Con-Lux Coatings, Inc., Edison, NJ), a two-part epoxy paint system, which had been used for one particular job through the past year; this job was just being completed at the time of the walk-through. One worker reported that the "Tank-O-Lon" vapors made him feel weak and tired; some said the vapors made them feel "high" or lightheaded, irritable, depressed, or nauseated.

The workers also complained of eye irritation, sinus problems and shortness of breath when using the "Tank-O-Lon" coating system. One worker noticed a recurrence of childhood asthma when exposed to vapors from the "Tank-O-Lon" coating; these asthma attacks occurred approximately six hours after exposure. He also developed a rash manifested by red, blistered and weeping skin on his face and in his nostrils after using the "Tank-O-Lon" coating and was told by his local physician that he had a contact dermatitis. The dermatitis was not noticeably aggravated by exposure to the sun; treatment with cortisone was followed by complete resolution of symptoms. One worker, who has been working with the "Tank-O-Lon" paint through the past year, complained of numbness and tingling in his hands and feet for the past several months. This worker has also had a loss of appetite with the resultant loss of eight pounds.

Several workers complained of health effects related to the use of a "Carbo Zinc 11" primer coating (Carboline, St. Louis, MO). Symptoms included a persistent taste in the mouth which lasts for hours after exposure; loss of appetite; sore, dry throat and occasional sinus problems. The "Carbo-Zinc" coating as well as other fast-drying coatings were reported by one worker to be more frequently related to nausea, feeling high, "sickness" and late onset of irritability and headache than the slower-drying coatings.

Chronic skin problems were reported by only one of the nine workers interviewed. This worker is a sandblaster who has chronically dry, itchy and irritated skin; his skin discomfort is somewhat relieved by applying baby oil. He feels that the uniforms do not protect him well, and that the symptoms are worse in the summer and are unrelieved by bathing.

Respiratory symptoms, apart from asthma (described above), included shortness of breath on exertion; two of the four painters with this symptom reported that their shortness of breath was worse when using the "Tank-O-Lon" coating. No cough or increased sputum were reported. Several of the workers are smokers who occasionally smoke during working hours.

The workers also complained of frequent eye irritation and occasional nasal stuffiness and sinus congestion which were not related to specific paints, and of occasional ringing in the ears which was related to sandblasting. One worker reported a blood-zinc level of 280 taken by his private physician; he was told that his reading was twice the normal limit. He has no awareness of symptoms or illness related to this zinc level. His blood lead was reportedly within normal limits. One worker reported that chest densities had been found on an x-ray of his chest, but that a tomogram had failed to confirm this diagnosis. Occasional chest pains were mentioned by one worker, but these were not reported to be noticeably related to exposures at work.

The symptoms of feeling high, tired and irritable were reported by one worker to have an exaggerated effect with the use of alcohol. These symptoms were also reported to be worse in the winter when there is less adequate ventilation.

Complaints of health effects are primarily related to acute reversible central nervous system symptoms, and to eye irritation. Although it is not possible from this walk-through investigation to determine cause and effect, it appears that those workers using the Con-Lux "Tank-O-Lon" coating had the most numerous complaints of health effects, including central nervous system symptoms, recurrence of childhood asthma and dermatological effects. Presumably these complaints will subside with the termination of the current exposure. One worker also complained of some numbness and tingling; such symptoms have been noted in cases of exposure to the solvent methyl isobutyl ketone.

IX. RECOMMENDATIONS

A. Medical Monitoring Program

A medical monitoring program should be designed and implemented which will allow for the early diagnosis and treatment of any untoward health effects experienced by the workers. The specific examinations included in the medical monitoring program would be determined according to the possible presence of potentially hazardous or toxic exposures, as determined by industrial hygiene measurements. Workers would be seen by a health provider (physician or nurse practitioner) at yearly intervals for regular health care and medical surveillance.

1) Medical monitoring for workers who are exposed to sandblasting would include a base-line chest x-ray and periodic chest x-rays for evidence of silicosis, to be read by a "B" reader according to the ILO 1970 International Classification of Radiographs of the Pneumoconioses. Medical monitoring of these workers would also include base-line and annual respiratory histories and pulmonary function tests with measures of FEV_1 and FVC to determine whether there is any impairment of pulmonary function. In addition, a base-line PPD test (for past exposure to tuberculosis) and an annual PPD test for those workers whose base-line test was negative is advised due to the possibility of increased incidence of tuberculosis among workers exposed to silica.

2) Workers exposed to high levels of noise from sandblasting or from steel shot operations should have a base-line and annual hearing test (audiometry) for early evidence of hearing loss due to noise exposures.

3) For workers who are exposed to the solvents commonly found in paint, the medical program should include a history and physical exam with special attention to the possibility of central and/or peripheral neurologic effects which might be related to acute or chronic exposures and to the possibility of acute skin problems which might be related to solvent spills.

4) For workers exposed to epoxy paints, the medical monitoring program should include a dermatological history and a work history, with special emphasis on past exposure to epoxy resin systems and past sensitivities, allergies and reproductive events. The physical examination would address the possibility of sensitization to glycidyl ethers and/or amine curing agents, with the possible development of allergic contact dermatitis and eye or mucous membrane irritation. Monitoring of these workers should also include a respiratory history and pulmonary function test as described above, with attention to the possible development of occupational asthma due to exposure to amine curing agents or other potentially sensitizing substances found in epoxy paints.

Because of reports from animal studies that glycidyl ethers may be capable of causing adverse effects in the testes and the hemopoietic (blood forming) system, NIOSH has recommended that medical surveillance for workers exposed to glycidyl ethers include an examination of the testicles for possible signs of atrophy, and blood tests for evidence of either decreased or increased leukocyte counts. Also, NIOSH has recommended that workers be notified of the reported adverse effects of glycidyl ethers in studies of laboratory animals; these adverse effects include mutagenic activity (butyl glycidyl ether was mutagenic in mice and bacteria) and tumorigenic activity (diglycidyl ether caused skin papillomas in mice), as well as testicular and hemopoietic abnormalities. Epichlorohydrin, a precursor of glycidyl ethers, has also been found to have an antifertility effect in studies of laboratory rats.

If the health provider becomes aware of any adverse effects on the reproductive system or the hemopoietic system in workers exposed to glycidyl ethers or epichlorohydrin, NIOSH has requested that all pertinent information be reported to the Director, National Institute for Occupational Safety and Health, as promptly as possible.

5) For workers exposed to potentially lead-containing paints, blood lead determinations should also be made at 6-month intervals, or more frequently if indicated by a professional industrial hygiene survey. The OSHA standard for lead in air is 50 mg/M^3 on an eight hour time weighted average for daily exposure. If a blood lead level of 0.050 mg lead per 100 g of whole blood or greater is found, NIOSH[13] has recommended that a second sample be taken within two weeks and, if the high level is confirmed, appropriate steps should be taken to reduce the worker's exposure. The standard also dictates that in four years workers with blood lead levels greater than 50ug/100 ml must be immediately removed from further lead exposure and in some circumstances workers with lead levels less than 50 ug/100 ml must also be removed. At present, medical removal of workers is necessary at blood lead levels of 70 or greater. Removed workers have protection for wage, benefits, and seniority for up to eighteen months until their blood levels adequately decline and they can return to lead exposure areas. Recommendations for medical monitoring for workers exposed to lead are given in detail in the 1978 revised Criteria Document for Lead.

6) For all workers, the choice of other specific laboratory tests, such as for zinc and cadmium, would be correlated with potential exposures as determined by industrial hygiene measurements.

Pertinent medical records should be maintained for at least 30 years after the termination of employment.

Any positive findings in an individual worker's medical exam which might reasonably be associated with workplace exposures should be an indication not only for appropriate therapy but also for industrial hygiene measurements of exposure and appropriate action if elevated levels of potential hazards are found, whether by improved engineering controls of ambient levels, improved use of personal protective equipment, or changes in type of work performed.

Summary of Medical Monitoring Program for Painters

Type of Exposure	Health Effect	Diagnostic Tool
Sandblasting	silicosis	x-ray
	impaired pulmonary function	pulmonary function tests
	tuberculosis	PPD skin test
Noise	impaired hearing	audiometry
Solvents	neurologic effects	physical exam
	skin problems	physical exam
Epoxy paints (epichlorohydrin, glycidyl ethers and amine curing agents)	contact dermatitis	history, physical exam
	occupational asthma	history, PFT
	possible testicular atrophy (based on findings from animal studies)	physical exam, history

Type of Exposure	Health Effect	Diagnostic Tool
Epoxy paints (epichlorohydrin, glycidyl ethers and amine curing agents)	possible hemopoietic abnormalities (based on findings from animal studies)	leukocyte count
Lead-containing paints	elevated blood lead	blood test

B. Environmental

1) Consider where possible to automate the painting process. There are machines available where the fabricated structure is inserted into the machine, abrasive blasted and painted, coming out as the finished product.

2) The paint manufacturer should be requested to use an epoxy resin with a minimal amount of free epichlorohydrin.

3) Establish a program that sandblasters wear a NIOSH-approved respirator under the blasting hood while sand blasting and when in the area.

4) Consider other less hazardous abrasives as replacements for silica sand, such as primary copper and coal slags.

5) Roof top ventilation fans of such capacity to promptly dissipate organic vapors should be installed. This may require additional air heaters in the winter.

6) If exposure to organic vapors emanating from epoxy resins cannot be controlled by exhaust ventilation, consideration should be given to supply spray painters with supplied air or full face respiratory protective equipment. All employees in the immediate vicinity who may also be exposed should be required to wear NIOSH-approved respirators.

7) Establish a quantitative faceseal fit test program for all employees who must wear respirators.

8) Establish a program of periodic environmental air monitoring to ascertain that the employees are not overexposed to air contaminants.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report prepared by:

Walter J. Chrostek
Regional Industrial Hygienist
Project Leader, HETAB, NIOSH

Marshal S. Levine, M.D.
Physician
Center for Occupational and
Environmental Health
Johns Hopkins University

Originating Office: Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
Cincinnati, OH

Report Typed By: Elaine M. Turner
Secretary
NIOSH, Region III
Philadelphia, PA

Acknowledgements

Laboratory Analysis: Utah Biomedical Test Laboratory
Salt Lake City, UT

Medical Assistance: Edward A. Emmett, M.D.

Joanne Ferrara, R.N., C., M.P.H

Susan Gelletly
Center for Occupational and Environmental Health
Johns Hopkins University and U.S. Public Health Service Hospital
Baltimore, Maryland

Industrial Hygiene: William Shick
Industrial Hygienist

XI. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Service, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, OH 45226. After 90 days, this report will be available through the National Technical Information Service (NTIS), Springfield, VA. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Palmer Industrial Coatings, Inc.
2. Employee Representative
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing the 20 employees of the results of the Palmer Industrial Coatings, Inc. survey, the employer shall promptly "post" for a period of 30 calendar days, the Determination Report in a prominant place(s) near where employees work.

XII. REFERENCES

1. NIOSH Manual of Analytical Methods, Volumes 1 & 2, (NIOSH) Publication #77-157 A & B, 1977, Volume 5, NIOSH Publication #79-141, 1979.

2. U.S. Department of Labor, Occupational Safety and Health Administration, Federal Register, Volume 39, No. 125, June 27, 1974, (Revised No. 7, 1978).

3. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Ketones, Publication #78-173, June 1978 (NIOSH).

4. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Isopropyl Alcohol, Publication #76-142, March 1976 (NIOSH).

5. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Toluene, Publication #73-11023, 1973 (NIOSH).

6. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Xylene, Publication #75-168, 1975 (NIOSH).

7. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Epichlorohydrin, Publication #76-206, 1976 (NIOSH).

8. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Crystalline Silica, Publication #75-120, 1974 (NIOSH).

9. NIOSH Criteria Document, Occupational Exposure to Refined Petroleum Solvents, Publication #77-192, July 1977 (NIOSH).

10. Occupational Diseases: A Guide to Their Recognition, USPHA, CDC, NIOSH, Publication #77-181, Revised June 1977.

11. Nick H. Proctor, Ph.D., James P. Hughes, M.D., Chemical Hazards of the Workplace, J. B. Lippincott Co., Philadelphia, PA 1978

12. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Glycidyl Ethers, Publication #78-166, 1978 (NIOSH)

13. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Inorganic Lead, Revised Criteria - 1978, Publication #78-158, 1978 (NIOSH).

14. Stanley L. Robbins, M.D., Pathology, W. B. Saunders Company, Philadelphia, PA, 1967.

15. Morton M. Ziskind, M.D., CIBA, Occupational Pulmonary Disease, Vol. 30, #4, 1978.

16. NIOSH Current Intelligence Bulletin #30, Epichlorohydrin, October 12, 1978.

17. NIOSH Current Intelligence Bulletin, #29, Glycidal Ethers, October 12, 1978.

TABLE I

PALMER INDUSTRIAL COATINGS
Williamsport, Pennsylvania

HHE 80-153

SUMMARY OF SYMPTOMS REPORTED
BY PAINTERS AND SANDBLASTERS
(9 Interviews)

SYMPTOMS	NUMBER OF WORKER COMPLAINTS
Acute Reversible Central Nervous System Symptoms	4 workers
Eye Irritation	5 workers
Shortness of Breath on Exertion	4 workers
Skin Problems	2 workers
Persistent Taste in Mouth	3 workers
Nasal Congestion	3 workers
Headaches	2 workers
Throat Irritation	2 workers
Ringing in Ears	1 worker
Numbness and Tingling in Hands and Feet	1 worker

TABLE II

PALMER INDUSTRIAL COATINGS
Williamsport, Pennsylvania
HHE 80-153

September 9-10, 1980

Results of Sampling for Organic Vapors (Breathing Zone)

Date	Sample #	Job Description	Sample Period	Airborne Concentrations* Acetone	Isopropanol	MEK	Toluene	Xylene	Cellosolve Acetate	Trichloro-ethylene	MIBK	Levels** for Mixtures NIOSH	OSHA
Sept 9	1	Foreman	08:35-15:00	10.7	16.6	13.1	42.8	32.1	12.3	1.1	15.0	0.34	0.25
	2	Sprayer	07:15-10:05	45.3	18.2	58.8	82.4	76.5	50.6	7.1	2.9		
	6	Sprayer	10:05-15:18	21.7	26.5	153.4	198.1	99.0	38.3	5.4	115.0		
		TWA		30.0	24.6	120.1	157.4	91.1	42.6	6.0	75.5	1.36	0.97
	3	Sprayer	07:20-15:30	5.1	111.1	24.2	121.2	36.4	7.1	2.0	10.1	0.62	0.43
	4	Sprayer	07:29-15:25	47.5	65.8	21.9	89.6	104.2	12.4	3.3	15.5	0.78	0.62
Sept 10	8	Sprayer	07:10-12:10	23.7	36.7	19.7	90.0	93.3	3.7	2.3	26.0		
	17	Sprayer	12:10-15:25	29.7	5.1	3.1	50.3	66.7	1.5	2.6	8.2		
		TWA		26.1	24.3	13.2	74.4	82.8	2.8	2.4	19.0	0.58	0.43
	9	Sprayer	07:10-12:00	59.9	21.3	110.8	173.7	77.8	11.7	6.3	9.9		
	13	Sprayer	13:25-15:00	111.1	27.8	69.5	291.7	104.2	5.6	10.4	173.6		
		TWA		72.0	22.8	101.0	201.6	84.1	10.3	7.3	48.7	1.31	0.92
	10	Sprayer	07:10-12:00	18.2	40.8	23.5	81.5	34.5	4.4	3.5	30.1		
	16	Sprayer	13:25-15:30	13.0	18.8	10.9	61.6	26.8	2.2	2.2	23.9		
		TWA		16.6	34.2	19.7	75.5	32.2	3.7	3.1	28.2	0.51	0.34
	12	Foreman	07:25-12:00	11.2	8.6	11.2	45.1	21.9	3.6	1.3	20.1		
	14	Foreman	13:30-14:55	6.4	4.3	4.3	35.1	17.0	2.1	---	13.8		
		TWA		10.1	7.6	9.6	42.7	20.7	3.2	1.0	18.6	0.33	0.22

* Denotes milligrams of contaminant per cubic meter of air sampled

**Denotes that if the sum of the following fractions: $\frac{C1}{T1}+\frac{C2}{T2}\cdots\frac{Cn}{Tn}$ exceeds unity, then the acceptable level of the mixture should be considered as being exceeded.

C1=observed atmospheric concentration

T1=threshold limit

TABLE III

PALMER INDUSTRIAL COATINGS
Williamsport, Pennsylvania
HHE 80-153

September 9-10, 1980

RESULTS OF SAMPLING FOR EPICHLOROHYDRIN VAPOR

Date	Sample #	Job Description	Sample Period	Airborne Concentrations*	Remarks
Sept. 9	1	Foreman	08:35-15:00	45.5	Operator's Exposure
	2	Sprayer	07:15-10:05	88.2	Operator's Breathing Zone
	6	Sprayer	10:05-15:18	76.7	Operator's Breathing Zone
		TWA		80.7	
	3	Sprayer	07:20-15:30	2.4	Operator's Breathing Zone
	4	Sprayer	07:29-15:25	138.9	Operator's Breathing Zone
Sept. 10	8	Sprayer	07:10-12:10	83.3	Operator's Breathing Zone
	17	Sprayer	12:10-15:25	82.1	Operator's Breathing Zone
		TWA		82.8	
	9	Sprayer	07:10-12:00	56.9	Operator's Breathing Zone
	13	Sprayer	13:25-15:00	104.7	Operator's Breathing Zone
		TWA		68.2	
	10	Sprayer	07:10-12:00	43.9	Operator's Breathing Zone
	16	Sprayer	13:25-15:30	42.0	Operator's Breathing Zone
		TWA		43.3	
	12	Foreman	07:25-12:00	36.3	Operator's Exposure
	14	Foreman	13:30-14:55	42.6	Operator's Exposure
		TWA		37.8	

*Denotes milligrams of contaminant per cubic meter of air sampled

TABLE IV

PALMER INDUSTRIAL COATINGS
WILLIAMSPORT, PENNSYLVANIA

HHE 80-153

September 9-10, 1980

RESULTS OF SAMPLING FOR BISPHENOL A AND GLYCIDYL ETHERS OF BISPHENOL A

Date	Operation	Sample #	Time Period	Bisphenol A*	Glycidyl Ethers* of Bisphenol A	Remarks
9/9	Painter	E 1	07:15-10:05	<0.6**	<0.6	OBZ***
	Painter	E 6	10:05-15:18	<0.6	24.18	
	Painter	E 2	07:29-15:25	<0.6	4.86	OBZ
	Painter	E 3	07:20-15:30	<0.6	2.27	OBZ
	Foreman	E 5	08:30-15:00	<0.6	2.72	OE****
9/10	Painter	E 8	07:10-15:30	<0.6	28.61	OBZ
	Painter	E 9	07:10-15:25	<0.6	8.19	OBZ
	Painter	E 10	07:10-15:30	<0.6	11.85	OBZ
	Foreman	E 12	07:25-14:25	<0.6	5.38	OE

* Denotes micrograms of contaminant per cubic meter of air sampled.
** Denotes lower limit of detection, 6 micrograms per sample.
*** Denotes operator's breathing zone.
**** Denotes operator's exposure.

TABLE V

PALMER INDUSTRIAL COATINGS
Williamsport, Pennsylvania

HHE 80-153

September 9-10, 1980

EVALUATION CRITERIA

Substance*	NIOSH (TWA)	OSHA (TWA)
Acetone	590	2400
Isopropanol	980	980
Methyl Ethyl Ketone (MEK)	590	590
Toluene	375 (Skin)**	750
Xylene	435	435
Cellosolve Acetate		540**
Trichloroethylene	535**	535
Epichlorohydrin	2**	19**
Methyl Isobutyl Ketone (MIBK)	200	410
Butanol	450	450
Petroleum Distillates	350	2000

*Denotes milligrams of contaminant per cubic meter of air sampled.
**Potential contribution to the overall exposure by the cutaneous route including the mucous membrane and eye.

TWA - 8-10 hour time-weighted average concentration.

TABLE VI

Palmer Industrial Coatings, Incorporated
Williamsport, Pennsylvania

80-153
Results of Personal Air Samples for Steel Dust

Date	Operation	Sample No.	Total Steel Dust*
9/9/80	Shot Blasting	M5-1004	3.4
9/10/80	Shot Blasting	M5-983	3.6

*Denotes - milligrams of steel dust per-cubic-meter of air samples.

	Applicable Criteria
	OSHA
Nuisance Dust*	15

TABLE VII

Palmer Industrial Coatings, Incorporated
Williamsport, Pennsylvania

HHE 80-153

Results of Personal Air Samples for Respirable Dust

Date	Operation	Sample No.	Time	Total Respirable Dust *	Total Respirable Silica **
9/9/80	Sandblaster	M5-986	07:10-11:45	0.56	0.49
		M5-991	07:35-14:45	0.80	0.69
9/10/80	Sandblaster	M5-995	13:25-15:00	0.40	0.35
		M5-1003	07:15-15:30	0.29	0.25

* Denotes - milligran of respirable air contaminant per-cubic-meter of air sampled.
** Denotes- milligram of respirable silica per-cubic-meter of air sampled based on 87 percent quartz content.

Applicable Criteria

Quartz Containing Dust

1. Occupational Health Standard promulgated by U.S. Department of Labor - Federal Register July 1, 1975, Volume 39, Title 29, Part 1910, sub-part 7. Section 1000, the silica standard for quartz in respirable dust is calculated by dividing 10 mg/M^3 by the % quartz + 2 for dust with more than 5 % Si O_2 or 5 mg/M^3 meter for respirable dust with 1% or less Si O_2.

2. The NIOSH 1974 Criteria Document recommends respirable free silica exposure should not exceed 0.05 mg/M^3.

TABLE VIII

PALMER INDUSTRIAL COATINGS
Williamsport, Pennsylvania

HHE 80-153

September 9-10, 1980

Results of Sampling for Organic Vapors (Breathing Zone)

Date	Sample #	Operation	Time Period	Xylene	(TWA)***	Butanol	(TWA)	Petroleum Distillate	(TWA)	Levels** for Mixtures NIOSH	OSHA
Sept. 9	C-7	Spraying Undercoat	12:50-14:47	20.5	5	4.3	1.0	102.6	25.0	.08	.02
Sept. 10	C-11	Spraying Undercoat	07:15-12:00	12.9	7.7	3.0	1.8	61.0	36.2	.12	.04

* Denotes milligrams of contaminant per cubic meter of air samples.
** Denotes that if the sum of the following fractions: $\frac{C^1}{T^1}+\frac{C^2}{T^2}+\ldots\frac{Cn}{Tn}$ exceeds unity, then the acceptable level of the mixture should be considered as being exceeded.
C^1= observed atmospheric concentration
T^1= threshold limit
*** Denotes Time Weighted Average

EVALUATION CRITERIA

Substance	NIOSH	OSHA
Xylene	435	435
Butanol	450	450
Petroleum Distillates	350	2000