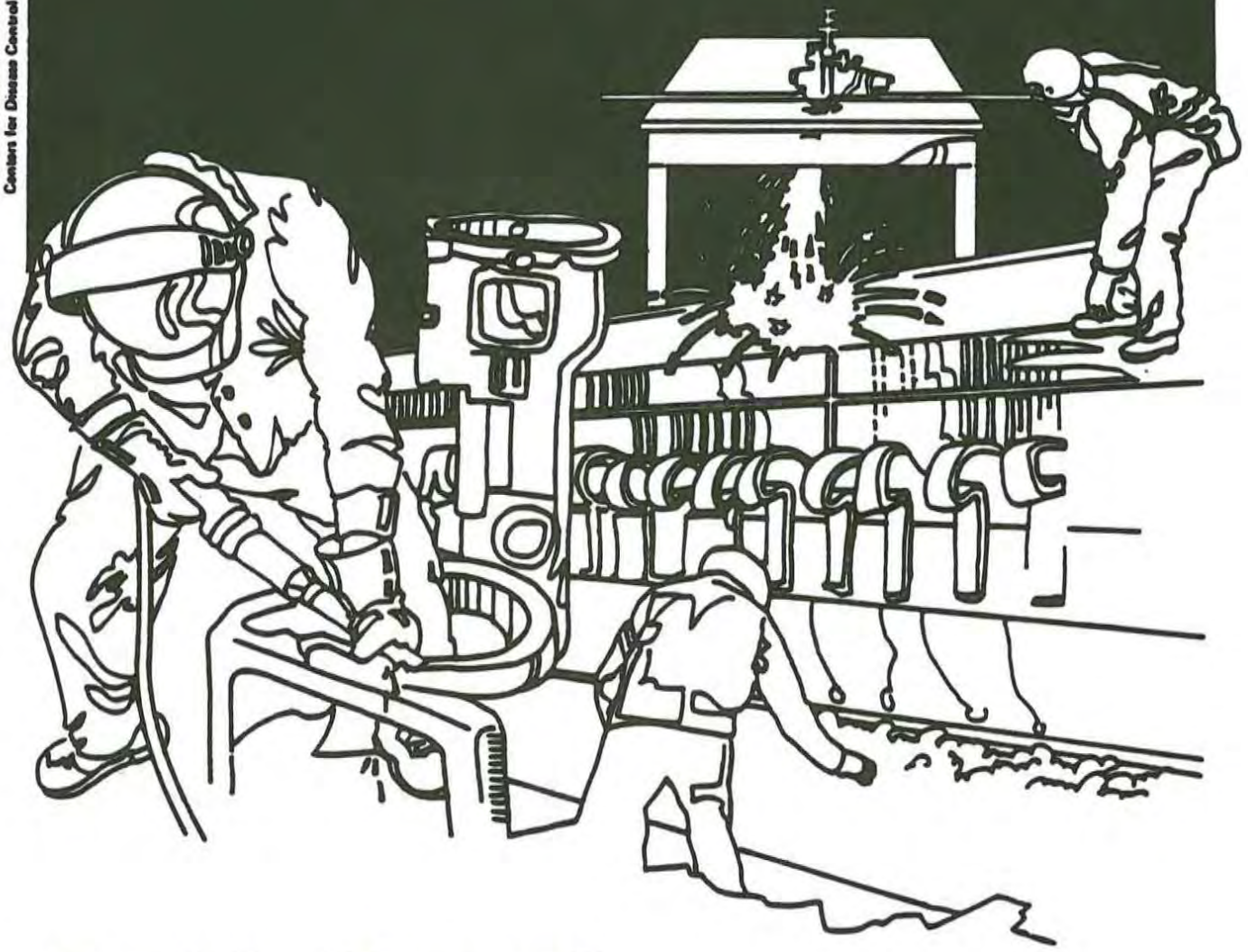
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service
Centers for Disease Control • National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 85-048, 049-1658
LAUSEN ENGINE DIVISION
NEW HOLSTEIN, WISCONSIN

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.

HETA 85-048, 049-1658
JANUARY 1986
LAUSEN ENGINE DIVISION
NEW HOLSTEIN, WISCONSIN

NIOSH INVESTIGATORS:
Daniel Almaguer, I.H.

I. SUMMARY

On November 1, 1985, the National Institute for Occupational Safety and Health (NIOSH) received requests to conduct two separate health hazard evaluations at Tecumseh Products, Lausen Engine Division, New Holstein, Wisconsin. One request concerned employee exposures to vapors during the assembly of brake pads in the Sub-assembly Department and the second request concerned exposures to dusts during the grinding, cutting and drilling of engine parts at the Cam Line.

In February 1985, NIOSH investigators conducted an initial survey of the facility. An opening conference was held with representatives of management and the employees (union), a walk-through evaluation of the facility was conducted, and employees were interviewed.

On May 9, 1985, an environmental survey was conducted to assess potential employee exposures to formaldehyde and phenol in the Sub-assembly Brake Pad area. Personal samples collected for formaldehyde near the breathing zone of employees were below the analytical limit of detection (2 micrograms per sample). General area air samples collected on top of the curing oven showed trace levels of phenol (0.025 parts of phenol per million parts of air (ppm) and 0.042 ppm). General area samples collected at the sub-assembly machine were below the analytical limit of detection for phenol (0.01 milligrams per sample). The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for phenol is 5 ppm as an 8-hour time weighted average (TWA). NIOSH and the American Conference of Governmental Industrial Hygienists (ACGIH) both recommend 5 ppm.

Personal samples collected at the Cam Line showed TWA concentrations for total and respirable particulates (as iron oxide) ranging from 0.78 milligrams per cubic meter (mg/M^3) to 1.89 mg/M^3 and from 0.15 mg/M^3 to 0.43 mg/M^3, repectively. The current OSHA-PEL for total particulate is 15.0 mg/M^3 while the ACGIH recommends a TLV of 10.0 mg/M^3, both the OSHA-PEL and the ACGIH-TLV for respirable particulate is 5 mg/M^3.

Based on the environmental data obtained during this evaluation, it has been determined that no health hazard existed at the time of this survey from exposure to formaldehyde and phenol in the Sub-assembly Brake Pad area, or from exposure to total and respirable nuisance particulates at the Cam Line. Recommendations are contained in section VIII of this report.

Key Words: SIC Code (Internal Combustion Engines), formaldehyde, phenol, total and respirable nuisance particulates.

II. INTRODUCTION

On November 1, 1985, the National Institute for Occupational Safety and Health (NIOSH) received two requests to conduct health hazard evaluations at Tecumseh Products, Lausen Engine Division, New Holstein, Wisconsin. The requestors were concerned about employee exposures to vapors during the assembly of brake pads and exposures to dusts during grinding, cutting and drilling of engine parts.

On February 14, 1985, NIOSH investigators conducted an initial survey of the facility, including an opening conference with representatives of management and the employees (union), a walk-through evaluation of the facility, and employee interviews.

In May 1985, an environmental survey was conducted to assess employee exposures to formaldehyde and phenol in the Sub-assembly Brake Pad Area and total and respirable particulates at the Cam Line. On September 10, 1985, sample results were transmitted via letter to the management and the employees (union).

III. BACKGROUND

A. Plant Production and Workforce

The Lausen Engine Division of Tecumseh Products has been in operation for 30 years and employs approximately 200 administrative, 1200 production, and 50 maintenance personnel. The plant was operating two shifts a day at the time of these surveys. The company produces four cycle internal combustion engines for garden tractors, lawn movers, and snow blowers. Employees are involved in numerous machining and assembling processes along with injection molding of plastics, painting, and engine testing. These requests concerned the assembly of brake pads in the Sub-assembly area and the grinding of cam gears at the Cam Line.

B. Process Description and Employee Duties

Brake pads are assembled in the Sub-assembly department and sent to the engine assembly line. This operation is conducted on an as needed basis and requires two employees working two full days per week on the average. One employee aligns one-hundred fifty-six brake pads on a sheet of cardboard. Brake pads contain a phenolic bonding resin but do not contain asbestos. An adhesive containing a phenolic resin and the solvent methyl ethyl ketone (MEK) is applied to the brake pads under a local exhaust ventilation hood. The cardboard sheets (brake pads) are placed on racks inside the hood and when the racks are full they are placed in a curing oven (400° F) for a twenty minute period. The brake pads are sent to the sub-assembly machine where a second employee places the individual brake pads on a metal bracket with the adhesive side positioned between the lever and the pad. The pads and brackets are sent thru a heated oven (about 450° F) and the individual parts are bonded together.

The cam gear of the engine is produced at the Cam Line. Employee duties at the Cam Line include milling, lathing, grinding, cutting, and drilling of the cam. The base metal used in the cam was iron therefore, iron oxide dust would be generated during these types of operations.

C. Engineering, Administrative, and Personal Protective Controls

Local exhaust ventilation was provided at the Sub-assembly Brake Pad area. The adhesive was applied to the brake pads within a local exhaust ventilation hood and was cured in a sealed oven which was local exhaust ventilated. Assembly of the brake pad and bracket was conducted at the sub-assembly machine (a carousel type oven) which was equipped with local exhaust ventilation. General ventilation was provided at the Cam Line.

IV. EVALUATION DESIGN AND METHOD

Following the initial survey, records of previous inspections conducted by the Occupational Safety and Health Administration (OSHA) were obtained. A review of the OSHA inspection records showed that samples collected at the Sub-assembly Brake Pad area detected airborne concentrations of methyl ethyl ketone below the OSHA, NIOSH, and ACGIH environmental criteria. OSHA sampling at the Cam Line showed detectable airborne concentrations of nuisance particulates (as iron oxide) and oil mists below the applicable environmental criteria. Based on these results sampling for methyl ethyl ketone and oil mists was not conducted by NIOSH investigators.

Sampling in the Sub-assembly Brake Pad area consisted of personal sampling for formaldehyde and general area sampling for phenol to determine if thermal decomposition products were liberated during the heat curing of the brake pads and heating of the brake pads and brackets. Phenolic resins show an appreciable rate of decompostion at temperatures above 572' F, the primary products being phenol and methyl phenols, plus carbon dioxide and/or carbon monoxide. Formaldehyde can be formed as a minor decomposition product under oxidative conditions at 752' F or its yield may be "negligible".[1]

Since iron was the base metal used in the cam gear, sampling was conducted for total and respirable nuisance particulates as iron oxide. During cam gear production processes (grinding, etc.), airborne contaminants may arise from the abrasive, its bonding material, the base metal being ground, or its surface coating if present.[2] Since the metal being ground was not coated, this was not considered a source of contaminants. From the industrial hygiene standpoint, the abrasive material is considered to constitute a relatively small portion of the total grinding emissions, and the hazard from the bonding agent is usually considered to be minor.[2,3] Studies have clearly shown that the majority of the particulate evolved during grinding is released from the workpiece.[3]

Personal samples for formaldehyde were collected on solid sorbent tubes connected via tygon® tubing to battery powered pumps operating at 50 cubic centimeters per minute (cc/m) for a period of 3 to 4 hours. Formaldehyde samples were analyzed via gas chromatography according to NIOSH Method P&CAM 354.[4]

General area samples for phenol were collected in impingers containing 15 milliliters (ml) of 0.1 N sodium hydroxide solution connected via tygon® tubing to battery powered pumps operating at 1 liter per minute (lpm) for 3 to 4 hours in the morning and the afternoon. Phenol samples were analyzed via gas chromatography according to NIOSH Method 3502.[5] A complete listing of the sample location, duration and other pertinent sampling information is presented in Tables 1 and 2.

Personal samples for total and respirable dusts were collected on pre-weighed polyvinyl chloride (PVC) filters connected via tygon tubing to battery powered pumps. Total dust samples were collected at a flow rate of 1.5 lpm and respirable dust samples were collected at a flow rate of 1.7 lpm using a 10 mm cyclone. These samples were analyzed gravimetrically. A complete listing of the sample location, duration and other pertinent sampling information is presented in Table 3.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for 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 the level set by the evaluation 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 Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, 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 this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 (29 USC 651, et seq.) to meet those levels specified by an OSHA standard.

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 (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures.

A. Phenol

The current OSHA-PEL for occupational exposures to phenol is 5 parts of phenol per million parts of air (ppm), which may also be expressed as 19 milligrams per cubic meter of air (mg/M^3). NIOSH recommends a limit of 20 mg/M^3 averaged over a work shift of up to 10 hours per day, 40 hours per week.[6] The ACGIH recommends a TLV of 5 ppm (19 mg/M^3) averaged over a normal 8-hour work shift. The ACGIH-TLV also notes the potential contribution to overall exposure by the cutaneous (skin) route, including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance.[7] The TLV is set at a level to prevent systemic intoxication.[8]

Phenol can affect the body if it is inhaled, comes into contact with the eyes or the skin, or is ingested. Phenol in the vapor form is an irritant to the eyes, mucous membranes, and skin; systemic absorption causes central nervous system effects, as well as, liver and kidney damage.[6] Phenol does not frequently constitute a serious respiratory hazard in industry, owing in large part to its low volatility.[9] The skin is a primary route of entry for the vapor, liquid, and solid. The vapor readily penetrates the skin with an absorption efficiency equal to that for inhalation.[6] Skin absorption can occur at low vapor concentrations, apparently without discomfort. Phenol is detectable by odor at a threshold of 0.05 ppm, which may be annoying to some people.[6]

B. Formaldehyde

The current OSHA-PEL for formaldehyde is 3.0 ppm as an eight-hour TWA. The ACGIH recommends a TLV of 1.0 ppm and a STEL of 2.0 ppm. However, NIOSH recommends that formaldehyde be handled as a potential carcinogen and that engineering controls and work practices be used to reduce exposures to the lowest feasible limit. Safe levels of exposures to carcinogens have not been demonstrated, but the probability of developing cancer should be reduced by decreasing exposure.[10]

Formaldehyde is a colorless, flammable gas with a strong, pungent odor. It can form explosive mixtures with air and oxygen. Concentrations of 0.1 to 5 ppm can cause eye, nose, and throat irritation. Higher exposures may produce coughing, tightening in the chest, decreased lung capacity, a sense of pressure in the head, and/or palpitation of the heart. Exposures at 50 to 100 ppm and above can cause serious injury, such as pulmonary edema (collection of fluid in the lungs) or pneumonitis (inflammation of the lungs). Formaldehyde has been shown to induce a rare form of nasal cancer in laboratory animals and to have mutagenic activity in several test systems. Although humans and animals may differ in their susceptibility to specific chemical compounds, any substance that produces cancer in experimental animals should be considered a cancer risk to man.[10]

C. Iron Oxide

Iron oxide dust is considered to be a nuisance particulate and the present OSHA-PEL for nuisance particulates is 15 mg/M^3 for total particulates and 5 mg/M^3 for respirable particualtes determined as an eight-hour TWA concentration. The ACGIH-TLV for nuisance particulates is 10 mg/M^3 for total particulates and 5 mg/M^3 for respirable particulates. The inhalation of iron oxide fumes or dust may cause a benign pneumoconiosis known as siderosis. It is probable that the inhalation of pure iron oxide does not cause fibrotic pulmonary changes, whereas, the inhalation of iron oxide plus certain other substances may cause injury.[11]

VI. RESULTS AND DISCUSSION

Environmental sampling in the Sub-assembly Brake Pad area showed that personal samples collected for formaldehyde were below the analytical limit of detection (2 micrograms per sample). General area air samples collected on top of the curing oven showed trace levels of phenol, 0.025 ppm in the morning sample and 0.042 ppm in the afternoon sample. This would indicate that phenol is liberated from the phenolic resin contained in either the brake pad or adhesive or both during the heating of the brake pads. General area samples for phenol collected at the sub-assembly machine were below the analytical limit of detection (0.01 milligrams per sample). The concentrations of phenol detected at the curing oven were approximately 100 times below the NIOSH recommendation, the ACGIH-TLV and the OSHA-PEL.

Personal samples collected at the Cam Line for total and respirable dusts (as iron oxide) were below the applicable environmental criteria. Total dust samples ranged from 0.78 milligrams per cubic meter (mg/M^3) to 1.89 mg/M^3 as a TWA concentration. The current OSHA-PEL for total dust is 15.0 mg/M^3 and the ACGIH recommends a TLV of 10.0 mg/M^3. Respirable dust sample concentrations ranged from 0.15 mg/M^3 to 0.43 mg/M^3 as a TWA concentration, the OSHA-PEL and the ACGIH-TLV for respirable dusts are 5 mg/M^3.

The OSHA inspection records showed that airborne concentrations of oil mists were below the OSHA-PEL of 5 mg/M^3. However, the company's OSHA 200 log of injuries and illnesses for 1984 revealed several cases of dermatitis. While airborne concentrations of oil mists were below the OSHA-PEL, the potential for skin contact remains. Repeated or prolonged skin contact with lubricating oils may produce dermatitis. Efforts to reduce the potential for dermatitis should be increased through increased employee education and use of personal protective equipment.

Although an evaluation of ergonomic hazards was not a component of this survey, the prevalence of ergonomically related problems is documented in the OSHA 200 logs and merits further investigation by the company. Several cases of carpal tunnel syndrome, tendonitis, and muscle strains and sprains were noted in the OSHA 200 log. Evidence exists that work requiring repetitive hand/wrist postures especially in conjunction with high forces, is associated with the development of cumulative trauma disorders such as carpal tunnel syndrome, tendonitis, bursitis, and ganglionic cysts.[12]

VII. CONCLUSION

Based on the environmental data collected by NIOSH invesitgators and a review of records from previous OSHA inspections, it has been determined that no health hazard existed from exposure to formaldehyde, phenol, and iron oxide, at the time of this survey.

VIII. RECOMMENDATIONS

1. Curing oven and gluing oven temperatures should be kept below 550° F to prevent the release of thermal decomposition products, particularly phenol vapors.

2. Although the company was aware of the existence of dermatitis, increased efforts to alleviate these problems should be made. The employer should educate the employees about the association between lubricating fluids and dermatitis.

3. Employees should be encouraged to avoid skin contact with the lubricating fluids by using protective clothing, gloves, splash guards, and any other devices required for work operations.

4. Employees should be encouraged to frequently practice personal hygiene including regular washing of hands with a non-abrasive soap, laundering of work clothes, and prompt removal of fluid soaked gloves and clothing.

5. Incidences of carpal tunnel syndrome and other ergonomic hazards should be investigated by the company and appropriate steps should be taken.

IX. REFERENCES

1. Clayton, G.D., Clayton, F.E. Patty's industrial hygiene and toxicology, Volume 2C, Toxicology, Third Edition. New York: John Wiley and Sons, 1982.

2. Clayton, G.D., Clayton, F.E. Patty's industrial hygiene and toxicology, Volume 1, General principles, Third Edition. New York: John Wiley and Sons, 1978.

3. Crawley, L.J., Crawley, L.V. Industrial hygiene aspects of plant operations, Volume 2, Unit operations and product fabrication. New York: Macmillan Publishing Company, 1984.

4. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods, Volume 7, Second Edition. Cincinnati, Ohio: National Institute for Occupational Safety and Health 1981. [DHHS(NIOSH) Publication No. 82-100].

5. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods, Volume 1, Third Edition. Cincinnati, Ohio: National Institute for Occupational Safety and Health 1984. [DHEW(NIOSH) Publication No. 84-100].

6. National Institute for Occupational Safety and Health. NIOSH/OSHA Occupation Health Guidelines for Chemical Hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. DHHS (NIOSH) publication No. 81-123.

7. American Conference of Governmental Industrial Hygienists. Threshold limit values and biological exposure indices for 1985-86. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, 1985.

8. American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values. Fourth Edition. Cincinnati, Ohio: ACGIH, 1980.

9. National Institute for Occupational Safety and Health. Criteria for a recommended standard--occupational exposure to phenol. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. [DHEW publication No. (NIOSH 78-196)].

10. NIOSH/OSHA Current Intelligence Bulletin #34, National Institute for Occupational Safety and Health/Occupational Safety and Health Administration, DHHS(NIOSH) Publication No. 81-111, December 23, 1980.

11. National Institute for Occupational Safety and Health. Occupational diseases: a guide to their recognition. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. [DHEW (NIOSH) Publication No. 77-181].

12. National Institute for Occupational Safety and Health. Health hazard evaluation report no. 83-142. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1983.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:	Daniel Almaguer Industrial Hygienist NIOSH - Region V Chicago, Illinois
Environmental Assistance:	Richard S. Kramkowski, P.E. Regional Consultant for OS&H NIOSH - Region V Chicago, Illinois
Originating Office:	Division of Surveillance, Hazard Evaluations & Field Studies Hazard Evaluation and Technical Assistance Branch Cincinnati, Ohio
Laboratory Analyasis:	Utah Biomedical Laboratory Salt Lake City, Utah

IX. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Port Royal Road, Springfield, Virginia 22161. 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 the following:

A. Requestors

B. Tecumseh Products, Lausen Engine Division

C. U.S. Department of Labor, OSHA - Region V

D. NIOSH, Region V

For the purposes of informing the affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.

Personal Breathing Zone Air Concentrations of Formaldehyde
Lausen Engine, New Holstein, Wisconsin
May 9, 1985

Job classification and/or location	Sample Time (minutes)	Sample Volume (liters)	Formaldehyde (ppm)
Brake pad assembler	198	9.9	<LOD
(appling adhesive)	253	12.6	<LOD
Sub-assembly machine Operator	223	11.8	<LOD
(assembling brake pad & bracket)	231	12.2	<LOD

Laboratory limit of detection: 2 micrograms (ug) of formaldehyde per sample

Abbreviations:
<LOD - Less than laboratory limit of detection
ppm - parts of formaldehyde per million parts of air

Environmental Criteria:
NIOSH - Lowest Feasible Level
ACGIH-TLV - 1.0 ppm as an 8-hour TWA
2.0 ppm as a 15-minute STEL
OSHA-PEL - 3.0 ppm as an 8-hour TWA

Table 2

Personal Breathing Zone Air Concentrations of Phenol
Lausen Engine, New Holstein, Wisconsin
May 9, 1985

Location of Area Sample	Sample Time (minutes)	Sample Volume (liters)	Phenol (ppm)
Top of curing oven	208	208	0.025
" " "	255	255	0.042
Top of Sub-assembly machine	206	206	<LOD
" " " "	247	247	<LOD

Laboratory limit of detection: 0.01 milligrams (mg) of phenol per sample

Abbreviations:
- <LOD - Less than laboratory limit of detection
- ppm - parts of phenol per million parts of air
- mg/M^3 - milligrams of phenol per cubic meter of air

Environmental Criteria:
- NIOSH - 20 mg/M^3
- ACGIH-TLV - 5 ppm (19mg/M^3)
- OSHA-PEL - 5 ppm (19 mg/M^3)

Personal Breathing Zone Air Concentrations of Iron Oxide Dusts
Lausen Engine, New Holstein, Wisconsin
May 9, 1985

Job Classifaction and/or location	Sample Time (minutes)	Sample Volume (liters)	Iron Oxide (mg/M^3)
	Total Particulate		
Operator G194	404	606	0.78
Operaror 369	403	604	1.89
Operator H24	459	688	1.18
Operator BB4	413	620	1.65
	Respirable Particulate		
Operator G194	404	687	0.15
Operaror 369	403	685	0.25
Operator H24	459	780	0.22
Operator BB4	413	702	0.43

Abbreviations:
mg/M^3 - milligrams per cubic meter of air

Environmental Criteria:
ACGIH-TLV - 10 mg/M^3 total dust, 5 mg/M^3 respirable dust
OSHA-PEL - 15 mg/M^3 total dust, 5 mg/M^3 respirable dust

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396