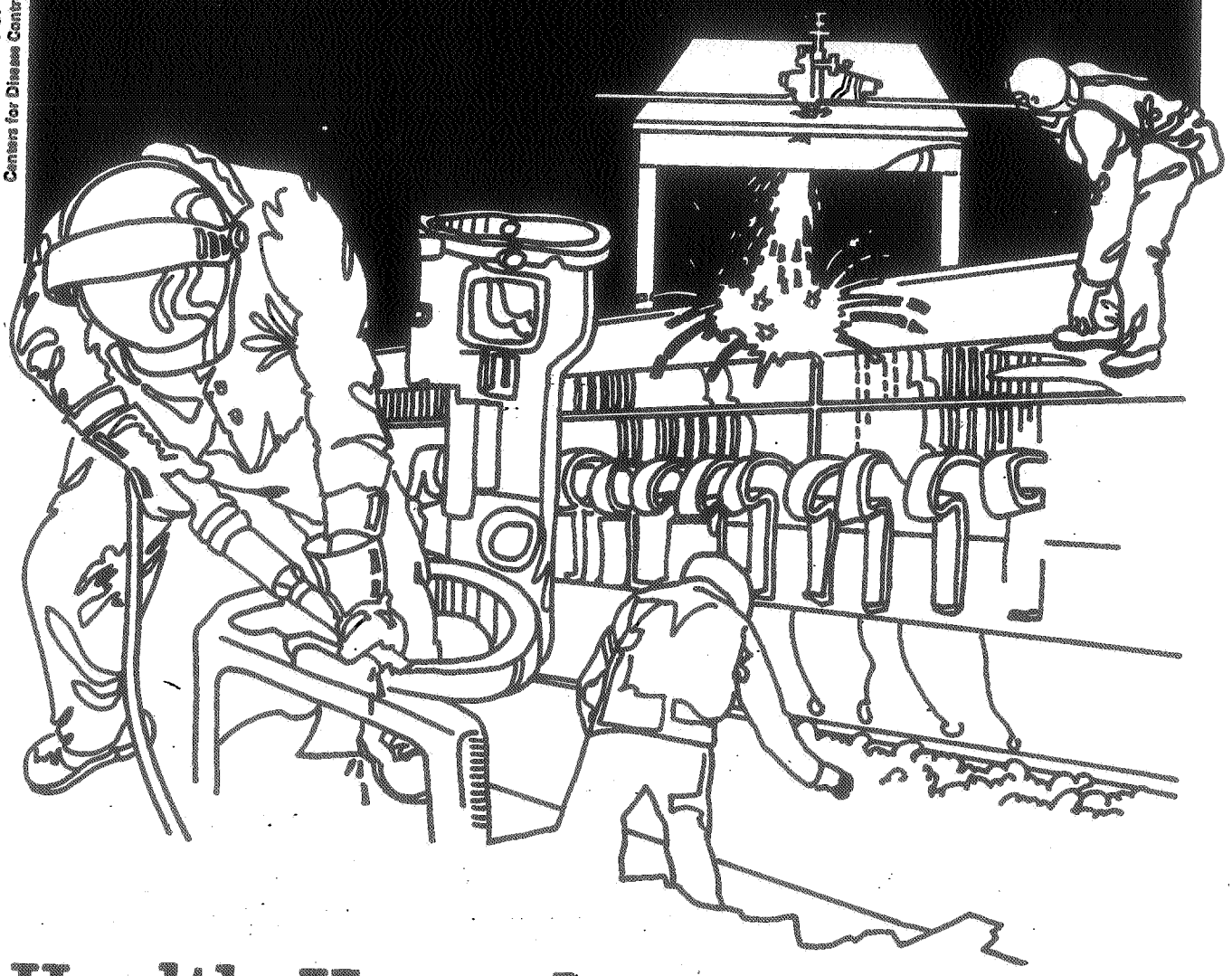
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 81-288-1257
ARKANSAS GENERAL INDUSTRIES
BALD KNOB, ARKANSAS

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 81-288-1257
JANUARY 1983
ARKANSAS GENERAL INDUSTRIES
BALD KNOB, ARKANSAS

NIOSH INVESTIGATORS:
Thomas Wilcox, M.D.
Raymond L. Ruhe, I.H.

I. SUMMARY

On April 24, 1981, NIOSH received a request from Local 1146 of the International Union of Electrical, Radio, and Machine Workers to evaluate the employee exposures on Assembly Line 5 at the Arkansas General Industries Plant located in Bald Knob, Arkansas. The request stated that these workers had experienced sinus congestion, headaches, difficulties in breathing, and rash, as well as other health complaints. These symptoms were thought to be associated with the use of Vischem 352, a proprietary diester-based lithium grease that is used to lubricate the gear boxes produced on Line 5. In addition, concern was expressed about electrical solder fume exposure to employees in the subassembly area and about 1,1,1-trichloroethane vapors from a degreasing operation that occasionally caused discomfort to some workers.

On August 3-4, 1981, NIOSH personnel visited the Arkansas General Industries facility and conducted preliminary industrial hygiene measurements and medical interviews with employees. A follow-up industrial hygiene survey was performed on November 17, 1981.

The levels of 1,1,1-trichloroethane in the degreaser room and on Line 5, which ranged from 42 mg/m^3 to 430 mg/m^3, were below the existing OSHA standard for occupational exposure (permissible exposure limit 1900 mg/m^3, 8-hour TWA). No airborne lead exposure from electrical solder was detected in the 12 samples taken in the subassembly soldering area.

Medical interviews, conducted during the initial visit, indicated that workers experienced significant discomfort while working with Vischem 352 on Line 5. However, a new system to inject the Vischem 352 lubricant into the assembled gear box was installed after this visit. This system decreased the number of employees with contact with the lubricant from 15 to 2, and the 2 employees who still had minimal exposure to Vischem 352 reported that they did not experience discomfort while working with the compound.

At the time of the November 1981 industrial hygiene survey, NIOSH found no chemical exposures that exceeded occupational exposure standards. Nasal and respiratory symptoms, that employees on Line 5 previously experienced when working in close contact with the lubricant Vischem 352, have abated after a system to mechanically inject the lubricant was installed. Recommendations are contained in Section VIII.

KEYWORDS: SIC 3621 (Electrical Industrial Apparatus) solder, lead, lithium grease, Vischem 352, 1,1,1-trichloroethane

II. INTRODUCTION

On April 24, 1981, NIOSH received a request from Local 1146 of the International Union of Electrical, Radio, and Machine Workers to evaluate the employees who work on Assembly Line 5 at the Arkansas General Industries Plant located in Bald Knob, Arkansas. The request stated that these workers had experienced sinus congestion, headaches, difficulties in breathing, and rash, as well as other health complaints. These symptoms were thought to be associated with the use of Vischem 352, a lubricant used only on Line 5. In addition, concern was expressed about electrical solder fume exposure to employees in the subassembly area and about vapors from a degreasing operation that occasionally caused discomfort in some workers.

On August 3, 1981, NIOSH personnel visited the Arkansas General Industries facility. An opening conference was held with representatives of the union and management and a walk-through inspection of the facility was conducted. Preliminary industrial hygiene measurements and medical interviews were conducted on the following day. A follow-up industrial hygiene survey was performed on November 17, 1981. Interim reports were sent to the union and management in October 1981 and February 1982.

III. BACKGROUND

The Arkansas General Industry Plant in Bald Knob, Arkansas, which has been in operation since 1959, has 500 hourly employees and 23 salaried employees. The plant's main products are electric motors (approximately 27,000 per day are produced). Assembly Line 5 makes an additional product, a gear box for refrigerator ice makers, which has been manufactured for approximately 8 to 9 years. The plant has a dispensary that is staffed by licensed practical nurses on the day and evening shifts. No annual or periodic physical examinations are performed, and there is no biological or medical monitoring of employees.

The facility is separated into roughly three areas: the parts manufacture and modification area; the motor subassembly area, where subcomponents for the electric motors are assembled; and the final assembly area, which produces the completed electric motors and the ice maker gearboxes (on Line 5).

The parts manufacturing and modification area, which employs several hundred people, produces and modifies the parts used to assemble the electric motors. The manufacturing processes are mostly mechanical in nature and reportedly entail no objectional chemical exposures to the employees working there.

In the subassembly area, 30 to 40 employees use soldering pots containing 50% lead and 50% tin to attach electrical connections on the

motor subassemblies. On each work table, there are slotted hoods with fans to capture the fumes from the soldering pots, but the emissions from these ventilation hoods are discharged directly back into the work area 5 feet above the work benches.

Varnish is placed on certain motors in the varnish room. This room, which is located near the subassembly area, contains two varnish application lines. Both lines have local exhaust ventilation to capture the varnish vapor.

One employee operates the degreaser, which uses 1,1,1-trichloroethane and is located in a room next to the subassembly area. The degreaser has no local exhaust ventilation and the only ventilation in the room is a ceiling fan located about 20 feet directly above the degreaser. In November 1980, the degreaser operation malfunctioned during the night and caused objectionable levels of 1,1,1-trichloroethane vapors to be disseminated throughout the plant during the following workday. During this day, many employees felt ill and some sought medical attention because of their symptoms. Since that time, there have been no similar malfunctions of the degreaser, but the employees report that occasionally the solvent odors are at objectional levels in the plant.

In the final assembly area, approximately 125 people worked on 12 assembly lines which were placed side by side in an open area. The work force in the final assembly area was predominantly female (only the supervisory personel and a few material handlers were male) and is divided into the following classifications:

Primary Assemblers	Approximately 23
Secondary Assemblers	Approximately 22
Air Driver Assemblers	Approximately 48
Material Handlers	Approximately 7
Motor Repair Persons	Approximately 15
Packaging	Approximately 17

Line 5 (the gear box production line) employs either 8 or 15 people per shift (depending on the rate of production). The people on this production line are selected mainly from the group of about 48 Air Driver Assemblers. Workers are intermittently rotated so that no person is likely to work for more than a 1- or 2-month uninterrupted period on this line, although occasionally an individual may spend up to 6 months there. At the time of the initial visit, the Line 5 workers lubricated the gears with Vischem 352 (a proprietary diester-based synthetic lithium grease), placed the gears into the gear box by hand, and then secured the cover onto the gear box. Line 5 was the only location in the plant where this lubricant was used. There were air ducts overhead that could provide fresh air to the Line 5 area, but there was no local exhaust ventilation in the area to draw the odors emanating from the Vischem 352 away from the workers' breathing zones.

IV. METHODS

A. Environmental

During the initial visit, the NIOSH industrial hygienist performed smoke tube and velometer assessment of the local exhaust ventilation for the soldering pots in the subassembly area and for a varnish line in the varnishing room.

During the follow-up environmental survey in November, the following environmental sampling was performed:

1. Ten personal and two area air samples for inorganic lead were obtained in the subassembly soldering area. These samples were collected on mixed cellulose ester filters, using MSA Model G battery-operated vacuum pump at a flow rate 1.7 liters per minute (LPM) and analyzed by NIOSH Method No. S-341.

2. Two personal and two area air samples for 1,1,1-trichloroethane (methyl chloroform) were collected in the degreaser room. Two personal samples were collected on Line 5 to determine if significant amounts of this solvent spread from the degeaser room into the final assembly area. These 6 samples were collected on 150 mg activitated charcoal sorbent tubes, using vacuum pumps operating at flow rates ranging from 0.05 to 0.20 LPM. The 1,1,1-trichloroethane was desorbed from the charcoal with carbon disulfide and analyzed using a gas chromatograph equipped with a flame ionization detector according to NIOSH P&CA Method 127.

3. Two personal breathing zone air samples for lithium (a constituent of Vischem 352) were obtained in the Line 5 area. These samples were collected on preweighed Millipore M-5 PVC filters, using MSA Model G personal sampling pumps operating at 1.7 LPM and analyzed according to NIOSH Method No. P&CAM 173.

B. Medical

During the initial visit, interviews were held on the line with 7 final assembly area employees that were known by the union representatives to have experienced symptoms while working on Assembly Line 5. Interviews were also held with the current Line 5 employees and with 18 individuals randomly selected from the 51 individuals known to the union representatives to have worked on the ice maker gearbox line (No. 5) in the preceeding 6 months. In addition, 16 workers in the final assembly area, whose job duties did not entail work on the ice maker gear box line, were interviewed to determine what symptoms might be experienced at work by individuals who did not have contact with the Vischem lubricant.

V. EVALUATION CRITERIA

A. Environmental

Occupational health standards and criteria for substances are usually established at levels designed to protect workers occupationally exposed for an 8-hour-per-day, 40-per-week basis over a working lifetime. NIOSH criteria are for up to a 10-hour workday, 40-hour workweek over a working lifetime. Because of a wide variation in individual susceptibility, some workers may experience ill effects at or below the designated levels. Thus, an evaluation of the work place cannot be based entirely upon comparisons made against such NIOSH criteria, ACGIH TLV, and OSHA standards, as various TLV's and standards do not represent absolute protection of all workers. Setting legal standards and enforcement is a responsibility of the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). The criteria for the contaminants are listed in the tables of results (Tables I and II).

B. Toxicological

1. 1,1,1-Trichloroethane

1,1,1-Trichloroethane is irritating to the eyes on contact. Exposure to the vapors depress the central nervous system. Symptoms include dizziness, incoordination, drowsiness, increased reaction time. Unconsciousness and death can occur from exposure to excessive concentrations.[1]

2. Lead

Inhalation of lead dust and fumes is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion of lead dust contamination of food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. The absorbed lead can damage the kideys, peripheral and central nervous systems, and the blood-forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.[1]

3. Vischem 352

Vischem 352 is a proprietary lithium ester-based lubricant that contains additives to prevent corrosion and plasticizers to improve low-temperature performance. The Material Safety Data Sheet for Vischem 352 did not mention any adverse health effects associated with this substance, but did recommend that

it be used in well-ventilated areas. The lubricant's supplier states that compounds similar to Vischem 352 are commonly used in many industries and that they have received no previous reports of this compound being associated with user discomfort.

VI. RESULTS

A. Industrial Hygiene

During the initial visit on August 3, 1981, the following results were obtained:

1. Smoke tube and velometer testing indicated that local exhaust ventilation for one of the two varnishing lines appeared to provide adequate capture of the varnish vapor. However, near the other line (which was not operating at the time of the inspection) there was a large cooling fan positioned so that use of this fan while the varnishing line was in operation might decrease the ability of that line's local exhaust ventilation to capture varnish vapors.

2. Smoke tube and velometer measurements showed that the hoods in the subassembly soldering area should prevent direct inspiration of the solder fumes by the individuals using the soldering pots, but the emissions from these ventilation hoods were discharged directly back into the work area 5 feet above the work benches.

Environmental sampling on November 17, 1981, which are summarized in Tables 1 and 2, revealed the following:

1. Ten personal breathing zone and two general area samples were collected for lead in the subassembly area. All samples showed that lead levels were below the limit of detection of 3 ug/filter.

2. The two personal breathing zone samples collected for 1,1,1-trichloroethane exposure on the degreaser operator ranged from 281 to 360 mg/m^3 (milligrams of substance per cubic meter of air) (OSHA 8-hour TWA permissible exposure limit 1900 mg/m^3). The two area samples taken in the degreaser area were 402 mg/m^3 and 430 mg/m^3. The two personal breathing zone samples collected for this solvent at Line 5 (the gear box production line) ranged from 42 to 59 mg/m^3.

3. During the interval from the initial visit on August 3, 1981, to the follow-up visit on November 17, 1981, management installed a new system at Line 5, which injects the Vischem 352 lubricant into the gear box after the gears have been assembled in the gear box. With the new system, only two employees per

shift are exposed to Vischem 352 (formerly 15 were exposed) and these two employees have minimal contact with the grease. Eight hour personal breathing zone samples on the two employees still working with Vischem 352 were collected for lithium (a constituent of Vischem 352); both samples were below the limit of detection (0.5 mg lithium per sample).

B. Medical

During the initial visit, 7 employees, who were reported by the union representatives to have experienced marked symptoms while working on the gear box assembly line, were interviewed. None were currently working on Line 5, and all were asymptomatic at the time of the interview. The majority of the symptoms they experienced while working on Line 5 consisted of marked nasal stuffiness and rhinorrhea, severe headache (attributed to sinus congestion by the employees), episodes of chest tightness or shortness of breath, and varying degrees of skin irritation (puritis, red bumps, etc.).

The majority of the 8 employees who were currently working on Line 5 had just started to work on that line a few days prior to the site visit and none reported experiencing any nasal or respiratory symptoms or headaches while working on Line 5.

To ascertain the proportion of former Line 5 employees who may have experienced the symptoms described above while working on Line 5, 18 workers were randomly selected from the group of the 51 workers known to the union representative to have worked on Line 5 in the last 6 months. These workers were interviewed with regard to possible symptoms experienced while working in the final assembly area. Over 70% reported experiencing marked nasal and/or respiratory symptoms while working on Line 5. These symptoms would improve when they left work and the employees reported experiencing few objectionable symptoms while working on other lines in the assembly area. The most common symptoms experienced on Line 5 reported by these 18 employees are as follows:

Symptoms Commonly Reported By 18 Randomly Selected Current And Former Assembly Line 5 Employees

Symptom	Number Reporting Symptom (%)
Sinus congestion and/or rhinorrhea	11 (61%)
Headaches	11 (61%)
Shortness of breath, chest tightness, or other breathing difficulty	9 (50%)
Skin rash (red bumps, etc.)	9 (50%)
Excessive fatigue (during & after work)	6 (33%)
Eye irritation	6 (33%)
Sore Throat	5 (28%)

Other symptoms or signs reported by one or more of the interviewed employees included blood count changes and intermittent episodes of elevated blood pressure and/or rapid heart rate.

The majority of all symptomatic employees felt that contact with the lubricant (Vischem 352) brought on or exacerbated their symptoms and many felt that some batches of this lubricant (which is supplied in 55-gallon drums) were especially irritating. The workers reported that their symptoms seemed to be somewhat alleviated when the overhead air supply was functioning, but that this ventilation does not operate on all days. In addition, numerous individuals stated that symptoms were often worse when lead gears that had been heated during the degreasing operation are brought to the Line 5 assembly line without sufficient time to cool. Reportedly, when the lubricant was placed upon the warm lead gears, the odor of the lubricant was much stronger, and nasal and/or respiratory symptoms became more severe.

In order to ascertain if employees who do not usually work with Vischem 352 experienced objectionable symptoms while working at Arkansas General Industries, all available persons employed as primary assemblers (whose job duties did not entail work on Line 5) and who were employeed before late March of 1981 were interviewed with regard to symptoms experienced while working on the other assembly lines. This data is summarized in the table below. These individuals stated that normally no objectionable health effects were experienced while at work on the other assembly lines at AGI with the exception of occasions when components coated with incompletely dried wax, varnish or glue are brought to the assembly lines. At these times, employees said they experienced severe headaches and eye irritation. However, these symptoms abate rapidly when the offending parts are removed from the assembly line, and the workers did not have to endure such discomfort for the entire workshift on a daily basis as did some of the Line 5 employees. Few of the primary assemblers reported experiencing the sinus congestion and respiratory symptoms that affected many of the Line 5 workers.

Symptoms Experienced By 16 Primary Assemblers
While Working On Assembly Lines Other Than Line 5

Symptoms	Number Reporting Symptom (%)
Sinus congestion and or rhinorrhea	1 (6%)
Headaches	6 (38%)
Shortness of breath, chest tightness, or other breathing difficulty	3 (19%)
Skin rash (red bumps etc.)	7 (44%)
Excessive fatigue	0 (0%)
Eye irritation	11 (69%)
Sore throat	6 (38%)

As mentioned in the environmental results, a new system to inject the Vischem 352 lubricant into the asembled gear box was installed after the initial visit. With the new system, only two employees per shift are exposed to Vischem 352 (formerly 15 were exposed) and these two employees have minimal contact with the grease. The two employees who still had minimal exposure to Vischem 352 reported that they did not now experience discomfort while working with the compound.

VII. CONCLUSIONS

The levels of 1,1,1-trichloroethane in the degreaser room and on Line 5 were below existing standards for occupational exposure. No airborne lead exposure to employees was detected in the subassembly soldering area.

Medical interviews indicated that workers experienced significant discomfort while working with Vischem 352 before the engineering modifications were made on Line 5. The frequent and prolonged contact with the lubricant experienced by the Line 5 employees while using the former assembly method and the lack of local exhaust ventilation on Line 5 may have contributed to the prevalence and severity of the nasal, respiratory, and other symptoms reported by these employees.

The new Vischem 352 injection system, which was installed after the initial visit, decreased the number of employees who have contact with the lubricant from 15 to 2, and the two employees who still had minimal exposure to Vischem 352 reported that they did not experience discomfort while working with the compound.

VIII. RECOMENDATIONS

1. All component parts that have been glued, waxed, or varnished should be thoroughly dry before being brought to the final assembly area.

2. When lead gears are being installed in the gear motors, these gears should be at room temperature before they are brought to Line 5 and lubricated with Vischem 352.

3. Cooling fans in the varnishing room and in all other plant locations should not be placed such that they interfere with the effectiveness with which local exhaust ventilation captures chemical vapors, metal fumes, or dusts.

IX. REFERENCE

1. Occupational Diseases, A Guide to Their Recognition, Revised Edition, DHEW (NIOSH) Publication No. 77-181, June 1977.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Thomas G. Wilcox, M.D.
Medical Officer
Medical Section

Raymond L. Ruhe
Industrial Hygienist
Industrial Hygiene Section

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies

Report Typed By:

Debra A. Lipps
Clerk-Typist
Industrial Hygiene Section

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, 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:

1. International Union of Electrical, Radio, and Machine Workers
2. Arkansas General Industries
3. NIOSH, Region VI
4. OSHA, Region VI

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

Results of Personal Breathing Zone and General Area Concentrations of 1,1,1-Trichloroethane on November 17, 1981

Arkansas General Industries
Bald Knob, Arkansas
HETA 81-288

Job and/or Location	Sampling Period	Sample Volume (Liters)	Type of Sample	1,1,1-Trichloroethane mg/m^3	Lithium mg/m^3
Degreaser Operator (A)	0757-1110	12.1	P**	366	-
Degreaser Operator (A)	1246-1445	11.1	P	281	-
Degreaser Area	9759-1109	13.1	GA***	430	-
Degreaser Area	1245-1445	9.2	GA	402	-
Rework Operator Line 5	0750-1507	81	P	42	-
Assembler Operator Line 5	0754-1508	86	P	59	-
Assembler Line 5	0750-1507	743	P	-	LD****
Assembler Line 5	0754-1508	738	P	-	LD
Environmental Criteria (mg/m^3)				1910(a)	-
Limit of Detection				0.01 mg/sample	0.5 ug/sample

* mg/m^3 = Milligrams of substance per cubic meter of air sampled
** P = Personal sample
*** GA = General Area
**** LD = Less than detectable limits for these samples, approximately 0.7 ug/m^3
(a) = Ceiling concentration, 15-minute sample - NIOSH
8-hour TWA - OSHA

Table II

Results of Personal Breathing Zone and General Area Concentration of Lead on November 17, 1981

Arkansas General Industries
Bald Knob, Arkansas
HETA 81-288

Job and/or Location	Sampling Period	Sample Volume (Liters)	Type of Sample	Lead(a) ug/m^3*
Coil Assembler	0716-1459	987	P**	LD***
Coil Assembler	0720-1458	779	P	LD
Coil Assembler	0722-1501	780	P	LD
Coil Assembler	0725-1506	784	P	LD
Coil Assembler	0727-1503	775	P	LD
Coil Assembler	0730-1502	768	P	LD
Coil Assembler	0733-1505	768	P	LD
Coil Assembler	0738-1500	751	P	LD
Coil Assembler	0736-1505	763	P	LD
Coil Assembler	0740-1503	753	P	LD
Area Sample Line 5	0747-1510	753	GA****	LD
Area Roter Department	0755-1511	755	GA	LD
Environmental Criteria (ug/m^3, 8-hour TWA)				50
Limit of Detection (ug/filter)				3

* mg/m^3 = Milligrams of substance per cubic meter of air sampled
** P = Personal
*** LD = Less than detectable limits - for these samples, approximately 4 ug/m^3
**** GA = General area

(a) The 8-hour TWA PEL for inorganic lead has been reduced from 200 ug/m^3 to 50 ug/m^3 (29 CFR 1910.1025). Pending current litigation of the 50 ug/m^3 lead standard, employers must achieve the 200 ug/m^3 level through engineering and administrative controls, and must protect workers at the 50 ug/m^3 PEL through any combination of controls, including the use of proper respirators.

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 HH
HHS 396