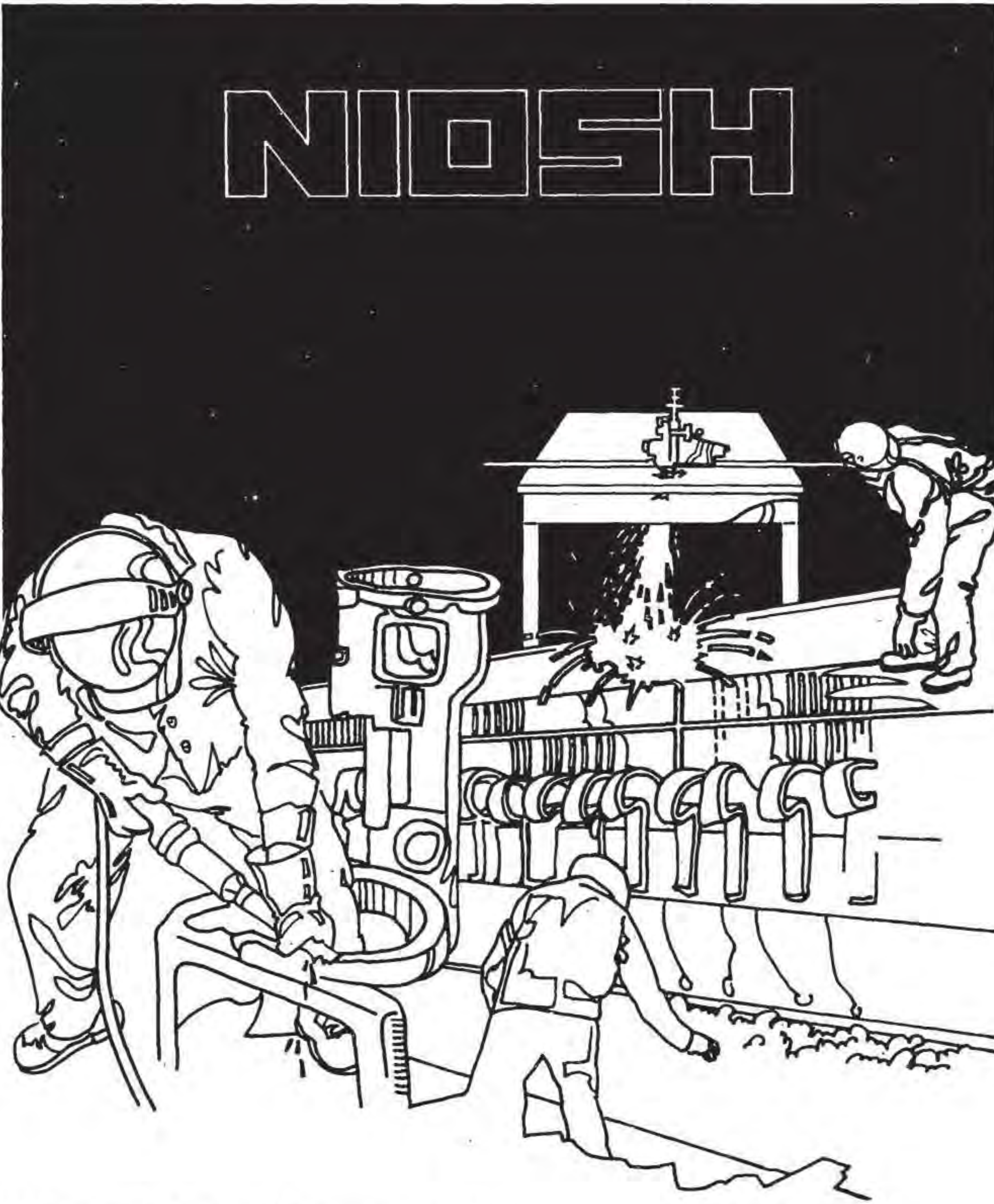
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 82-173-1325
WESTINGHOUSE ELECTRIC CORP
ST. LOUIS, MISSOURI

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 82-173-1325
JUNE 1983
WESTINGHOUSE ELECTRIC CORPORATION
ST. LOUIS, MISSOURI

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I. SUMMARY

In March 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate employee exposures to chemicals used in the Paint Line Area at Westinghouse Electric Corporation, St. Louis, Missouri.

In May 1982, a NIOSH survey team conducted a walk-through survey and a combined environmental/medical evaluation.

Samples were collected to evaluate employee exposures to solvent vapors, chromium VI, and inorganic metals in the Paint Line Area. Company records for blood lead and hemoglobin determinations were reviewed. NIOSH investigators interviewed all 12 paint line employees and 11 other employees not working on the paint line and collected urine samples for measurement of methylhippuric acid (a metabolite of xylene) and serum samples for evaluation of liver function.

Airborne concentrations of xylene (the major solvent component of the paint) ranged from 0.9 to 14 mg/m^3. Airborne concentrations of chromium VI ranged from nondetectable to 0.011 mg/m^3 (nine personal samples). Two area samples for inorganic metals, collected on the wall at the exit end of the paint booth, had airborne concentrations of 0.077 and 0.093 mg/m^3 for chromium, 0.333 and 0.386 mg/m^3 for zinc, and lead was not detected. All personal sample results were below the evaluation criteria for this report (xylene - 435 mg/m^3, chromium VI - 0.025 mg/m^3).

The two area chromium values exceeded the NIOSH criteria (0.025 mg/m^3), but were below the OSHA PEL (0.1 mg/m^3). These results indicate the potential for higher exposures if employees spend longer periods in the paint booth. During the survey, only one employee painted in the paint booth at any time, with a total of four employees painting during each shift. This resulted in each employee spending a total of approximately 1.5 hours in the paint booth per shift. This technique was effectively controlling employee exposures, as evidenced by the results of the area samples for inorganic metals.

There was no evidence of increased blood lead levels. The prevalence of reported mucous membrane irritation (50% versus 10%) was greater in paint line employees than in the comparison group, of borderline statistical significance. The prevalence of liver function abnormalities was no different between the two groups, although a case of granulomatous hepatitis had been noted in a paint line employee. Low levels of methylhippuric acid were detected in the urine of two employees compatible with exposure to low levels of xylene.

Based on these results, NIOSH has determined that a health hazard did not exist for employees working in the Paint Line Area under the conditions observed during the investigation. Recommendations are contained in Section VIII of this report.

KEYWORDS: SIC 3613 (Switchgear and Switchboard Apparatus), xylene, chromium VI, spray paint line, granulomatous hepatitis.

II. INTRODUCTION

On March 22, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation at Westinghouse Electric Corporation, St. Louis, Missouri, to evaluate employee exposures to hazardous chemicals in the Paint Line Area. In particular, employee concerns involved possible liver disease associated with working on the paint line; granulomatous hepatitis had been found in one paint line employee.

NIOSH conducted an initial survey at the St. Louis facility in May 1982. The initial visit consisted of an opening conference and subsequent walk-through survey on May 10, a combined environmental/medical field survey on May 11-13, and a closing conference on May 13.

An interim report was distributed in November 1982, which presented the preliminary results of this investigation.

III. BACKGROUND

The Westinghouse Electric Corporation, St. Louis Facility, began production in its present location in 1974 (prior to 1974, a separate facility had been in operation elsewhere in the St. Louis area). The facility is involved in manufacturing electrical distribution equipment. The plant is divided into three groups called Feeder Group, Switch Board, and Panel Board. The Feeder Group is involved in steel and copper fabrication. Metal enclosure components (steel and copper) are pressed out and subsequently combined with electrical components in the Switch Board and Panel Board shops to form switch boxes and electrical distribution equipment for industrial uses. The Feeder Group is composed of the Steel Shop, Copper Shop, and the Paint Shop. Sheet metal components are delivered to the Lay-Down Area of the Paint Shop, where four employees hang the components onto a continuously moving conveyor. The conveyor takes the enclosure components into the Paint Booth Area.

Prior to going into the paint booth, the enclosure components are sent through an enclosed pretreat wash operation, where they are washed with an iron phosphate solution and rinsed with water, after which they go into an oven to dry. After coming out of the oven, the enclosure components go to the paint booth, where one to two employees paint each component. The paint normally used (80% of the time) contains primarily xylene with lesser quantities of other materials including chromium trioxide. The paint booth is exhausted with a downdraft system. While painting, employees wear half-face chemical cartridge respirators, cloth hoods (with clear plastic viewing ports), coveralls, and thick cloth gloves. After the spray paint operation, the components are returned to the oven for drying. After the components come out of the oven, the conveyor takes them to the Lay-Down Area, where employees remove the painted enclosure components and put unpainted components onto the conveyor line.

IV. METHODS AND MATERIALS

A. Environmental

Environmental sampling was conducted to evaluate employee exposure to airborne concentrations of solvent vapors and hexavalent chromium (chromium VI). In addition, area samples were collected to evaluate the potential for employee exposure to inorganic metals (specifically, lead - Pb, chromium - Cr, and zinc - Zn).

Liquid bulk samples were collected in glass sample vials. Solvent vapor samples were collected with charcoal tubes attached via flexible tubing to battery-operated pumps calibrated at 0.02 liters per minute (LPM) for personal samples and at 1 LPM for area high-volume samples. A total of 12 personal samples were collected for airborne solvent vapors. Prior to analysis of personal samples, liquid bulk samples and area airborne samples were evaluated to determine the type and concentration of vapors present. Subsequently, these results were used in determining which solvent vapors to analyze personal samples for. The liquid bulk and area high-volume samples were evaluated using gas chromatography/mass spectrometry. The personal samples were analyzed using gas chromatography according to a modified version of NIOSH Method P&CAM S-318.[1]

Chromium VI samples were collected on polyvinyl chloride filters attached via flexible tubing to a battery-operated pump calibrated at a flow rate of 1.5 LPM. These samples were analyzed using spectrophotometry according to NIOSH Method P&CAM 319.[2]

Inorganic metals samples were collected on mixed cellulose ester membrane filters attached via flexible tubing to a battery-operated pump calibrated at 1.5 LPM. These samples were analyzed using inductively coupled plasma-atomic emission spectroscopy. Sampling and analytical methods are presented in Table I.

In addition to the collection of airborne samples, the paint booth exhaust system was evaluated visually by observing the airflow patterns of the spray paint exhaust.

B. Medical

The medical officer reviewed company medical records for the paint line employees, concentrating on results of previous blood lead and hemoglobin determinations. Also, the NIOSH investigators evaluated all (12) employees who worked on the Paint Line and 11 employees who did not. This latter group, which was used as a comparison population, consisted of 10 volunteers of similar age to the paint line employees (three from shipping and receiving, seven from the steel shop) plus one maintenance worker who asked to be assessed. The evaluation of all workers included administration of a questionnaire, collecting blood specimens for liver function tests and urine specimens for determination of methylhippuric acid, a metabolite of xylene. Liver function tests determined included serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), gamma-glutamyl transpeptidase (GGT), and alkaline phosphatase (AP). All of these are commonly used tests of "liver function". Serum bile acids (SBA) also reflect liver function, but their role as indicators of liver damage is not well established. Two SBA, sulfolithocholylglycine (SLCG), and cholylglycine (CG) were determined on fasting serum using a radioimmunoassay (Abbott Laboratories, Chicago, Illinois) at the University of Cincinnati Medical Center.

Notification letters of individual blood and urine results were distributed on August 26, 1982.

V. EVALUATION CRITERIA

A. Environmental

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 (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 solely 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 legally required to meet only 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 or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Specific environmental criteria for materials evaluated at the Westinghouse facility are included in Table I.

B. Physiologic Effects/Toxicology

1. Xylene[3-7]

Xylene (also called xylol or dimethylbenzene) is a colorless liquid that exists in three isomeric forms differing in the distribution of the methyl groups. These isomers are often found as components of solvents used in paints, lacquers, cleaning agents, and gasoline, and in laboratories in the preparation of histologic tissue specimens. Commercial xylene is produced both from petroleum and from coal tar. NIOSH estimates that approximately 140,000 workers are potentially exposed to xylene in the United States.

Xylene is metabolized in man to methylhippuric acid, which unlike hippuric acid, is not a normal urinary constituent.

Like other solvents such as toluene, xylene has narcotic properties; thus, exposure to high concentrations can produce nausea, vomiting, dizziness, headache, and incoordination, eventually leading to unconsciousness and death at very high concentrations. It is also an irritant of the eye, mucous membranes, and skin.

Baselt[3] claims that chronic organ toxicity has not been noted in man. Reports of hematopoietic (bone marrow) suppression associated with xylene exposure in the past, may have been due to the presence of benzene in the xylene.[5]

Because organic solvents (particularly chlorinated hydrocarbons) as a class are associated with hepatotoxicity, this has also been linked with xylene as one of its potential adverse effects. Indeed, in Section 2 (medical) of NIOSH's Recommendations for a Xylene Standard (Reference 5, Page 2), laboratory tests recommended at the time of biennial examination include "appropriate liver function tests". In fact, there is little documentation for this. An often-quoted reference[8] describes three painters in a shipbuilding yard enclosed in a confined space where exposure to xylene estimated to have been 10,000 ppm occurred. Discovered after up to 18.5 hours, one of the men died while the other two were unconscious, but eventually recovered. Both had "what was interpreted as evidence of hepatic impairment (elevation of serum transaminase levels)".[5] However, there is little evidence that chronic low-level exposure to xylene at concentrations not causing irritation or narcotic effects (i.e. in the range of the current criteria) is associated with hepatotoxicity.

2. Chromium[15-19]

Chromium compounds (chromic acid and the chromates) are oxidizing agents and irritating to the mucous membranes, skin, and conjunctivae. Chromates have long been recognized for their primary irritant effects on skin and potent skin-sensitizing properties and ability to produce allergic contact dermatitis. Chromium can exist in bivalent, trivalent, and hexavalent forms. Trivalent compounds are generally low in toxicity, while Cr^{+6} is irritating and ulcerogenic (producing chrome ulcers of the skin or "chrome holes"). Most investigators claim that the allergic manifestations are limited to hexavalent chromium compounds, while Hamilton and Hardy felt that this was just as prevalent with trivalent compounds.

Excess respiratory cancer has been found in workers in chromate (i.e. chromate-producing) plants.[18] The hexavalent chromium compounds have been divided into noncarcinogenic Cr(VI) [monochromates and dichromates of hydrogen, lithium, sodium, potassium, rubidium, cesium, ammonium plus Cr(VI) oxide] and carcinogenic Cr(VI) (all not included in above).[15] Royle[19] found excess cancer deaths in chrome platers as well.

VI. RESULTS

A. Environmental

1. Airborne Samples

Table II presents the results of sampling for airborne xylene in the Paint Line Area. Due to relatively low concentrations on general area airborne samples, only six of twelve personal samples were analyzed. Concentrations for these six personal samples ranged from 0.9 to 14 milligrams per cubic meter of air (mg/m^3). All samples were well below current criteria with the highest (14 mg/m^3) being approximately 3% of the lowest current criterion of 435 mg/m^3 as a time-weighted average (TWA).

Table III presents the results of sampling for airborne chromium VI in the Paint Line Area. The concentrations ranged from below the laboratory limit of detection to 0.011 mg/m^3. All nine samples were below the NIOSH recommended criteria of 0.025 mg/m^3 for noncarcinogenic chromium VI. The highest concentration is approximately 45% of the NIOSH criteria. The chromium VI component (per the material safety data sheet) of the paint normally used in the paint booth is chromium trioxide (CrO_3), which is one of a group of chromium VI compounds considered to be noncarcinogenic.[15]

Table IV presents the results of general area airborne sampling for inorganic metals in the Paint Booth. Three metals were specifically requested (lead, zinc, and chromium). The concentration for zinc (0.33 and 0.38 mg/m^3) and lead (below the limit of detection) were both below current criteria. The concentration for chromium were 0.077 and 0.093 mg/m^3. Both samples are above the NIOSH recommended standard for noncarcinogenic chromium of 0.025 mg/m^3. The criteria are based on personal sampling and the area sample results should not be used for direct comparison to the criteria. In addition, chromium detected on area samples would include the bivalent, trivalent, and hexavalent forms. The chromium VI criteria is used for comparison purposes because it was the only form of chromium reported on the material safety data sheet for the paint being used. Chromium VI compounds present a greater health hazard and thus have a lower criteria than the bivalent and trivalent forms. These results indicate a potential for employee exposure above the NIOSH criteria if employees spend a large (for example, 6 hours) portion of their shift in the paint booth.

2. General Observations

It was reported that during higher production periods, two employees paint in the booth simultaneously. On these occasions, one employee would paint inside the entrance of the booth and the second employee would paint somewhere near the middle of the booth. Visual observation of the airflow patterns of the exhaust system indicated that the booth exhaust was adequate when only one employee was painting. The combined effects of the downdraft exhaust system and the position in which one employee painted resulted in the paint overspray being carried downstream and then exhausting through the grid floor. A second employee painting in the booth would potentially be in the exhaust path from the first painter. This could result in considerably higher exposures to the second painter. The painters as a group did the majority of their painting in the first one-third of the booth. Occasionally, however, the employees moved further down the booth. Employee work practices, while painting, influenced the effectiveness of the exhaust. The system worked best when employees directed the paint gun in front of themselves or downstream. When employees directed the gun upstream, they were often in the exhaust path of the overspray.

The grid floor of the paint booth accumulated a considerable buildup of paint particulates. By the end of the second day shift, the open area in the grid floor had been reduced by approximately 25%. Some of the grid sections were not fastened down securely. One employee was observed tripping while painting in the booth.

The storage and maintenance of personal protective equipment needs to be improved.[20] Respirators were stored in lockers located in the paint booth area. Employees clothing and other materials were also stored in these lockers. Inspection of employees' respirators revealed that some had paint deposits on the sealing surface. Any material that exists between the respirator's sealing surface and the employee's skin can result in contaminated air leaking into the respirator.

Employees were observed storing lunches and subsequently eating in the paint booth area. Both practices are undesirable due to the ingestion hazard of the paint components (chromium VI, xylene).[5,15]

A reservoir lid on the pretreat wash needs to be repaired. The lid is misshapen such that it cannot be completely closed. This results in heat and moisture escaping into the paint room from the reservoir.

B. Medical

1. Demographic Data

Demographic data concerning the employees seen are displayed in Table V.

2. Blood Lead and Hemoglobin Levels from Company Medical Records

Data were available on 11 of the 12 exposed employees. Blood lead and complete blood counts had been performed annually. The blood lead levels were performed at an OSHA-approved laboratory. For 1981, the last year for which all employees had been tested, the mean blood lead value was 15.8 ug/dl (range 8-26). Only one employee had a blood lead level above 30 ug/dl (38 ug/dl in 1980). The level was 23 ug/dl in 1982. This employee had the longest (over 25 years) duration of paint line employment at Westinghouse. In adults, blood lead levels below 40 ug/dl are not generally associated with adverse effects. The OSHA standard currently requires removal from exposure for blood lead levels exceeding 60 ug/dl. For 1981, the mean hemoglobin was 15.0 gm/dl (range 13.7-16.6). Three of the 11 employees had had at least one hemoglobin determination below 14 gm/dl (lower limit of normal for contracting laboratory). There was no consistent follow-up by the company of values that were below the normal range or had changed within the normal range.

3. Questionnaire Data

Before examining symptoms and liver function test results, the two groups were compared for possible confounding factors (Table V). No significant differences were observed in prevalence of travel, hobbies involving chemicals, previous liver disease, previous general anesthetic, or alcohol consumption. The prevalence of consuming potentially hepatotoxic medications was greater in those not on the paint line, of borderline statistical significance. Review of occupational histories showed that none had a past history of exposure to beryllium.

There was no statistically significant difference between the two groups in reporting of symptoms referable to the gastrointestinal or central nervous systems. Mucous membrane irritation was reported more frequently in paint line employees ($.05<p<.10$). Skin rash or irritation did not appear to be a significant problem (Table V).

4. Liver Function Tests

a. Enzyme Tests

The average levels of SGOT (normal range 12 to 37) (mean ±S.D., 30.3±19.4 versus 22.3±7.5) and AP (normal range 15 to 65) (mean ±S.D., 86.9±140.7 versus 49.7±11.0) were somewhat greater in paint line employees while SGPT (normal range 6 to 39) was slightly greater in the comparison group (30.0±16.1 versus 26.3±20.4). However, there were no significant differences in mean serum levels for any of the four enzymes considered, whether transformed or log-transformed. There was no difference in prevalence of abnormal enzyme tests between the two groups (Table VI).

b. Serum Bile Acids

There was no difference in mean SLCG or CG values between the two groups, whether untransformed or log-transformed. There were no significant differences in the prevalence of abnormal results for either bile acid (Table VI).

5. Methylhippuric Acid

Methylhippuric acid is not a normal urinary constituent, but is detectable in the urine as a result of exposure to xylene. Exposure to environmental xylene concentrations of about 100 parts per million for 8 hours has been associated with methylhippuric acid concentrations in urine of about 1.9 g/l or 1.9 mg/ml.[3] Methylhippuric acid was detectable in only two workers, one of whom (0.11 mg/ml) worked in the paint line. The other had methylhippuric acid at the limit of detection (0.04 mg/ml) and worked as a spot welder in the Steel Shop. The spot welders are located next to the paint shop. These low metabolite levels are consistent with the low environmental xylene levels observed.

VII. DISCUSSION

Based on the results of this investigation, NIOSH has determined that a health hazard did not exist for employees working in the Paint Line Area under the conditions observed during the field survey.

The NIOSH industrial hygienist remained in the lay-down/paint line area for 5 to 6 hours on each of the three shifts sampled. During this survey, a total of four employees took turns painting. Two employees painted during the first half of a shift and two different employees painted during the second half of the shift. Only one employee painted in the booth at any one time. This resulted in each painter spending approximately 1.5 hours in the paint booth. The practice of employees alternating in the paint booth, helped control daily exposures as evidenced by the fact that all personal sampling results were below the currently accepted criteria. If individual employees had painted for longer periods, the personal sampling results would probably have been higher. In addition, the respiratory protection (worn by employees while painting) if used properly should reduce the airborne concentrations they breathe to levels lower than those listed in Tables II and III.

Airborne chromium VI levels on personal samples indicate that respiratory protection is not required since the levels are less than one-half of the NIOSH recommended criteria. However, use of respiratory protection is advisable, particularly considering that employee exposures could go up significantly during increased production periods. The respirators currently used by employees would be acceptable for protection against noncarcinogenic chromium VI (Testing and Certification No. TC-23-40) up to a concentration of 10 times the NIOSH recommended criteria.[21] However, they need to be equipped with high-efficiency filters per the NIOSH recommended standard for exposure to chromium VI. The respirators inspected during the field survey were not equipped with high-efficiency filters.

The recommendations for working with noncarcinogenic chromium VI are less stringent than the recommendation for carcinogenic chromium VI, due to the increased health concerns.[15] Included in the recommendations for carcinogenic chromium VI are the use of self-contained breathing apparatus with positive pressure in full facepiece or combination supplied air respirator, pressure-demand type, with auxiliary self-contained air supply. This facility in the past and for special jobs still uses paints containing lead compounds and/or zinc chromate (per material safety data sheets). Lead chromate and zinc chromate are among the chromium compounds considered to be carcinogenic.[15,22,23] Management should refrain from using paints containing carcinogenic chromium VI due to the increased health concerns and more stringent controls for working with these materials.

The absence of elevated lead levels, the low environmental lead levels, and the reported infrequent use of lead-containing paints suggest that there is no excessive exposure to or absorption of lead occurring. However, the presence of several low hemoglobin values (<14 gm/dl) representing approximately 25% prevalence in an apparently healthy population deserves follow-up.

The prevalence of abnormal liver function tests in the paint line employees was not excessive and there was no evidence for differences between these employees and those not working on the paint line.

Granulomatous Hepatitis

The type of liver disease of concern in this study, and found in one paint line employee, was granulomatous hepatitis. An attempt was made to review the literature for possible associations of this entity with particular occupations. Granulomatous hepatitis has been the subject of numerous articles and reviews.[9-13] A large number of diseases has been associated with hepatic granulomas. Sarcoidosis and infectious diseases (particularly tuberculosis) were among the most common associated entities in many series, accounting for from 22 to 36% and from 10 to 25% (for tuberculosis), respectively. Other infectious causes include bacteria (brucellosis, granuloma inguinale, tularemia), rickettsia (Q fever), fungi (histoplasmosis), and parasites (schistosoma mansoni). Drug-induced granulomatous hepatitis is well recognized[14] and accounted for 29% of cases in one series.[11] Fauci and Wolff[12] grouped cases associated with drugs, berylliosis and erythema nodosum, together as "hypersensitivity diseases" that cause granulomatous hepatitis. Agents involved include sulfonamides, penicillin, allopurinol, phenylbutazone, halothane, hydralazine, and methyldopa.[12,14]

Of interest is the fact that following extensive work-up, as in the present case, no etiology was determined in a significant proportion of cases of granulomatous hepatitis, quoted as 13-36% of cases.[12] Unfortunately, none of the reports have seriously addressed occupation. In fact, the only mention is its occurrence in association with berylliosis. Thus, there is an obvious lack of information related to the role of occupational and environmental toxins, other than drugs, in this disease.

VIII. RECOMMENDATIONS

1. Eating, drinking, and smoking should be prohibited in the paint shop (lay-down and paint room areas).

2. A program of worker education should be instituted by management explaining the health hazards associated with chemicals used in the paint shop and proper handling procedures for the chemicals. There should be an opportunity for union input while setting up the program.

3. Individual workers should be informed of the results of the company's medical and environmental testing of the paint shop employees.

4. Further monitoring of hemoglobin to detect lead toxicity may no longer be indicated if the use of lead-based paints continues as at present. Closer follow-up of hemoglobin values below 14 gm/dl or those having dropped significantly from a previous determination,

might be attempted, whether or not there is a possible occupational cause for the change.

5. Respirators used in the paint shop should be inspected routinely by a management representative and any defective parts replaced. In particular, the sealing surface of the respirators should be examined to ensure the paint is not accumulating on the surface. In addition, the respirators should be equipped with high-efficiency filters.

6. The grids located in the paint booth floor should be fastened to prevent the corners from sticking up and potentially causing falls and/or other accidents. Management should continue cleaning floor grids on a periodic basis. Frequency of cleaning should be such that paint buildup on the floor grids are controlled.

7. The misshapen lid located on the reservoir of the pretreatment wash should be repaired.

8. Management should refrain from using paints containing carcinogenic chromium VI compounds. Compounds such as lead chromate and zinc chromate are among those considered to be carcinogenic. An inventory of all paints, listing all chemical components, should be maintained at the St. Louis facility. If carcinogenic chromium compounds are used, management should follow the recommendations contained in the NIOSH recommended standard for exposure to chromium VI.

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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. Westinghouse Electric Corporation, St. Louis, Missouri
2. The Requestors
3. Authorized Representative of Employees, Local 2352, International Brotherhood of Electrical Workers
4. NIOSH, Region VII
5. OSHA, Region VII

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

Sampling and Analytical Methods and Environmental Criteria

Westinghouse Electric Corporation
St. Louis, Missouri
HETA 82-173

Material	Flow Rate (LPM)	Sampling Media	Analytical Method	Environmental Criteria (mg/m^3) As a TWA
Liquid Bulks	-	Glass sample vials	GC/MS	-
High Volume Airborne Bulks	1.0	Charcoal tubes	GC/MS	-
Xylene	.02	Charcoal tubes	Gas chromatography according to P&CAM S-318 (with modifications)	OSHA = 435 NIOSH = 435 ACGIH = 435
Chromium VI	1.5	Polyvinyl chloride filters	Spectrophotometery according to P&CAM 319	OSHA = 0.10[A] NIOSH = 0.025[B] ACGIH = 0.05[C]
Inorganic Metals (specifically Pb, Zn, Cr)	1.5	Mixed cellulose ester membrane filters	Inductively coupled Plasma - Atomic Emission Spectroscopy	Pb: OSHA = 0.05 NIOSH = 0.05 ACGIH = 0.15 Zn (as zinc oxide fume): OSHA = 5.0 NIOSH = 5.0 ACGIH = 5.0 Cr (as chromium VI): OSHA = 0.10[A] NIOSH = 0.025[B] ACGIH = 0.05[C]

A = Chromic acid and chromate
B = Noncarcinogenic Cr VI compounds
C = Water soluble Cr VI compounds

TABLE II

Airborne Concentrations for Xylene Collected in the Paint Line Area

Westinghouse Electric Corporation
St. Louis, Missouri
HETA 82-173

May 11 and 13, 1982

Job/Location	Date	Volume (Liters)	Sample Time	Concentration (mg/m^3)
Painter Helper - Grade 3	5-11-82	10.8	0702-1521	0.9
Painter Helper - Grade 3	5-13-82	7.9	0710-1055 1129-1520	1.3
Painter - Grade 6	5-11-82	7.5	0710-1510	12.5
Painter - Grade 6	5-13-82	10.2	0704-1520	14.0
Painter - Grade 8	5-11-82	9.2	0712-1056 1130-1522	1.1
Painter - Grade 8	5-13-82	7.6	0720-1055 1133-1521	1.3

Environmental criteria (mg/m^3): 435 (OSHA, NIOSH, and ACGIH) as a time-weighted average

TABLE III

Airborne Concentrations for Chromium VI in the Paint Line Area
Personal Samples

Westinghouse Electric Corporation
St. Louis, Missouri
HETA 82-173

May 12-13, 1982

Job/Location	Date	Volume (Liters)	Sample Time	Concentration (mg/m^3)
Painter Helper Labor Grade 3	5-12-82	741	0704-1518	LLD
Painter Labor Grade 6	5-12-82	723	0708-1510	.004
Painter Labor Grade 6	5-12-82	732	0711-1519	.001
Painter Labor Grade 6	5-12-82	728	0712-1517	LLD*
Painter Labor Grade 6	5-13-82	744	0704-1520	LLD*
Painter Labor Grade 6	5-13-82	737	0712-1523	.001
Painter Labor Grade 6	5-13-82	695	0705-1055 1128-1521	LLD*
Painter Labor Grade 6	5-13-82	689	0708-1055 1130-1522	LLD*
Painter Labor Grade 8	5-12-82	684	0707-1056 1130-1517	.011

LLD = below the laboratory limit of detection (0.3 ug/filter)
* Chromium VI may have been lost from this sample during the laboratory extraction procedure.

Environmental criteria (mg/m^3): 0.025 (NIOSH for noncarcinogenic Chromium VI)

TABLE IV

Airborne Concentrations for Inorganic Metals In the Paint Booth
Area Samples

Westinghouse Electric Corporation
St. Louis, Missouri
HETA 82-173

May 13, 1982

Location	Volume (Liters)	Sample Time	Inorganic Metal Concentration mg/m^3 Cr	Zn	Pb
On Wall at Exit End of Paint Booth	651	0750-1504	.077	.333	LLD
On Wall at Exit End of Paint Booth	651	0750-1504	.093	.386	LLD

Filters were analyzed specifically for Pb, Zn, and Cr. Process used (inductively coupled Plasma-Atomic Emission Spectroscopy) evaluates each filter for a total of 28 metals. Nine other metals (Al, Ca, Cu, Fe, Mg, Mn, Na, P, Ti) were detected on one or both filters at varying amounts ranging from Fe at 204 ug/filter to Cu at 1.4 ug/filter.

LLD = Below the laboratory limit of detection (1.0 ug/filter).

Environmental criteria (mg/m^3):

Cr = 0.025 (NIOSH criteria for noncarcinogenic Chromium VI)
Pb = 0.050 (NIOSH, OSHA)
Zn = 5.0 (ACGIH as zinc oxide)

TABLE V

Demographic and Questionnaire Data

Westinghouse Electric Corporation
St. Louis, Missouri
HETA 82-173

May 11-12, 1982

	Paint Line (n=12)	Not on Paint Line (n=10)	p Value*
Race (White/Black)	4/8	6/4	N.S.**
Age, year, mean ± S.D.	27.9+7.8	31.8+4.2	
(range)	(23-52)	(27-39)	
Travel out of country	2	5	N.S.
Hobbies with chemicals	0	2	N.S.
Previous liver disease	1	0	N.S.
General anesthesia	6	8	N.S.
Medications	5	9	$.05<p<.10$
Atopic (allergic diathesis)	3	3	N.S.
Alcohol: Presently	9	9	N.S.
Never	2	1	
No gastrointestinal symptoms	6	8	N.S.
Nausea	3	1	
Feeling down, fatigued	4	2	
Mucous membrane irritation	6	1	$.05<p<.10$
Central nervous system symptoms			
None	7	6	N.S.
One or more	5	4	N.S.
More than one	3	0	
Reported skin complaints	2	3	N.S.

* Fisher's Exact Test, 1 tail.
** N.S. = Not Significant.

TABLE VI

Liver Function Test Results

Westinghouse Electric Corporation
St. Louis, Missouri
HETA 82-173

May 11-12, 1982

Test (Normal Range)	Paint Line (n=12) Mean* ±SD	Paint Line (n=12) Abnormal Results** # (%)	Not on Paint Line (n=10) Mean* ±SD	Not on Paint Line (n=10) Abnormal Results** # (%)
SGOT (12-37 IU)	30.3±19.4	2 (17)	22.3±7.5	0 (0)
SGPT (6-39 IU)	26.3±20.4	1 (8)	30.0±16.1	1 (11)
GGT (5-37 IU)	118.0±299.6	2 (17)	38.9±28.3	3 (30)
AP (15-65 IU)	86.9±140.7	2 (17)	49.7±11.0	0 (0)
SLCG (up to 1 umol/L)	1.5±1.7	4 (33)	0.75±0.32	2 (20)
CG (up to 1 umol/L)	2.3±6.3	2 (17)	0.54±0.22	0 (0)

* No significant differences (p>0.05, by t-test) in means between groups, whether untransformed or log-transformed.

** No significant differences (p>0.05, Fisher's Exact Test) in prevalences of abnormality.