U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-105-368

PACKARD ELECTRIC DIVISION, G.M.C.
PLANT 14, NORTH RIVER ROAD
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I. TOXICITY DETERMINATION

A Health Hazard Evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) in Departments 1451, 1452, and 1454, Plant 14, Packard Electric Division, G.M.C., on October 19-21, 1976. The purpose of the evaluation was to determine whether exposures to emissions from the fluxes and solders were posing a health hazard to the employees. On the basis of air sample results, confidential employee interviews, available toxicity information, and review of company medical and environmental data, it is concluded that exposures to emissions from the inks, fluxes, and solders, did not pose a health hazard to the employees at the time of the survey. Several minor recommendations are given in the text of this report.

II. DISTRIBUTION AND AVAILABILITY OF REPORT

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

Copies have been sent to:

1) Packard Electric Division, Warren, Ohio
2) Authorized Representatives of Employees, Local 717, International Union Electrical, Radio, and Machine Workers, IUE, AFL-CIO.
3) U.S. Department of Labor, Region V
4) NIOSH, Region V

To inform the 184 affected employees, copies of the report shall be provided to these employees or the report shall be posted in a place prominent to these employees for a period of 30 days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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.

NIOSH received such a request from an authorized employee representative of Local 717, International Union Electrical, Radio, and Machine Workers, to evaluate the potential hazards associated with the inking and soldering operations in Departments 1451, 1452, and 1454 of Plant 14, Packard Electric Division, G.M.C. The request was at least in part prompted by "some" employees allegedly experiencing dizziness from exposure to vapors and fumes. Also, there apparently was a misunderstanding concerning the employees' access to blood lead level determinations conducted on a periodic basis by the company.

IV. HEALTH HAZARD EVALUATION

A. Facility and Process Description

The Packard Electric Division, G.M.C., in Warren, employs about 13,000 people in the manufacture of wiring harnesses and other wiring for automobiles and trucks. The production employees are represented by Local 717, of the International Union Electrical, Radio, and Machine Workers. This evaluation was restricted to Departments 1451, 1452, and 1454 which occupy about 60,000 square feet of floor space in Building 14. These departments engage about 184 persons in the manufacture of 60,000-65,000 battery cables per day.

1. Department 1451

About 57 people are employed in Department 1451, mostly on a 2 shift per day basis. The basic function of this department is to prepare battery cables for finishing by Department 1452. Located within Department 1451 are 8 Artos cutters, 6 punch presses, 3 presses, 3 solder pots, 5 sleeving machines, and 4 loomers. Two of the Artos cutters cut the cable to length, strip insulation from the ends, and print an identification number on each section. The other cutters carry the operation further in that the cut cables are terminated and soldered. Following the cutters the cables may be treated further, depending on the desired product. At the presses, the terminals are made and assembled, and/or crimped on the battery cables. The terminal ends of the cables may be soldered at one of the solder pots. Other operations include pulling rubber sleeves over the terminals and covering the cables with a woven plastic loom. The solder pots and the water quenches had local exhaust ventilation. Hazards evaluated in this area were emissions from the inking, fluxing, and soldering operations.

2. Department 1452

About 89 people are employed in Department 1452, again, mostly on a two shift per day basis. The final products are the finished battery cables. Located in this department are 5 cable terminators, 5 solder pots, 3 bolt stake machines, 4 Van Dorn molding machines, and 11 stations for clamps, clips, etc. Hazards evaluated in this area relate to the soldering and fluxing operations, all of which had local exhaust ventilation systems.

3. Department 1454

About 38 people are employed in Department 1454, almost entirely on a 2 shift per day basis. This is basically a low volume, miscellaneous cable department, producing cables primarily for trucks and luxury automobiles. Housed within this department are 2 Artos cutters, 12 terminal presses, 4 solder pots, 13 die cast machines, 1 Van Dorn molder, and several miscellaneous operations such as bolt staking, looming, and sleeving. Hazards evaluated were the same as with the other departments.

B. EVALUATION METHODS

1. Environmental

Personal air samples, to indicate the degree of exposure to lead and tin at the solder operations, were collected by using 37 mm diameter membrane filters and personal air sampling pumps operating at air flows of 2 liters per minute (lpm). These samples were analyzed by conventional aqueous atomic absorption spectroscopy.

Personal air samples to indicate the presence of chlorides resulting from the fluxes at the solder operations were collected by using 37 mm diameter membrane filters and personal air sampling pumps operating at air flows of 1.6 and 1.7 lpm. The samples were analyzed by leaching with water and using a silver precipitation method for quantification. It should be noted that the manufacturer indicated chlorides rather than fluorides to be present in one of the solders used at the time of the survey.

Personal air samples to indicate the degree of exposure to low-boiling or volatile napthenic and aliphatic hydrocarbons resulting from the oil fluxes were collected using commercially available charcoal tubes and personal air sampling pumps operating at air flows of about 100 cubic centimeters per minute (cc/min). The samples were analyzed by gas chromatography.

Colorimetric indicator tubes were used to sample for organic and inorganic acids resulting from the fluxes at the solder operations.

Charcoal tubes and personal air sampling pumps were used to collect air samples for printing ink and ink thinner solvent analyses by gas chromatography. The pumps were operated at flow rates of about 50 cc/min.

2. Medical

On October 22, 1976, 26 workers at the soldering operations were interviewed using non-directed questionnaires. The results of these interviews are discussed in Section IV D.

C. EVALUATION CRITERIA

1. Physiological Effects

Inhalation of lead fumes or dust may result in lead poisoning. The earliest symptoms are diffuse and include weariness. The subject may be moody and irritable. With increased absorption, new symptoms such as insomnia, headache, a metallic taste, loss of appetite, epigastric discomfort, constipation or diarrhea, diffuse muscle pain, tenderness of the joints, numbness of the legs, fine tremor, increased reflexes, and mild anemia may develop. Lead poisoning is usually defined as a clinical disease in which subjective symptoms and objective signs occur in combination with abnormal clinical tests.[1]

Inhalation of tin oxide fumes and dust is recognized to result in stannosis, a benign pneumoconiosis. Inorganic tin compounds are relatively non-toxic and are not generally thought of as important industrial hazards.[2-3]

The toxicology of the other potential exposures evaluated during this survey is not discussed since these evaluations focused on either 1) proprietary compounds for which a toxicology discussion without naming the compounds would be meaningless, or 2) categorical groupings intended only to demonstrate the absence or degree of presence of emissions from the solder-flux operations.

2. Environmental Criteria

The primary sources of environmental evaluation criteria considered for this study were: 1) NIOSH criteria documents,[4] 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's)[5], and 3) the U.S. Department of Labor Federal Occupational Health Standards.[6] Environmental evaluation criteria are available for just six of the substances sampled for during the survey and four of these are proprietary (the ink solvents). The remaining two are lead and tin. Those criteria for lead and tin, judged most appropriate for this study, are as follows:

Substance	Short Term Exposure Limits (15 min.)	8-Hour Time Weighted Average
Lead	0.45 mg/M3[b]	0.15 mg/M3[a,b]
Tin	20.0 mg/M3[b]	10.0 mg/M3[a,b]

a) NIOSH Criteria Document
b) ACGIH Threshold Limit Value

D. DISCUSSION OF RESULTS/CONCLUSIONS

1. Environmental

A perusal of the air sampling results for this study shows that little air contamination is entering the work room environment. The amounts of lead and tin collected on the filter samples were all below the analytical detectable limits (Table 1). Personal air sampling for categorical constituents of the fluxes used at the time of the survey yielded nagative results (Tables 2&3). Indicator tube sampling for organic and inorganic acids showed that such substances were present within the smoke-vapor plumes or within the hoods during the time of quenching but not detectable in the breathing zone of the workers (Table 4). Air sampling for solvent vapors from the inks and ink thinners also indicated low air concentrations, the highest result being less than 1.0% of the appropriate environment criteria (Table 5). These air sampling results are consistent with company data.

The indicator tube sampling for acids indicates that the local exhaust ventilation hoods were effective in removing air contaminents from the breathing zone of the workers. A determination of the average face velocities for 5 of the enclosure type hoods at the solder pots showed a low of 80 feet per minute (fpm), a high of 180 fpm, and a mean for the five of 120 fpm. It would be expected, on a theoretical basis that such face velocities would provide adequate control for this sort of operation.

The small canopy hoods at the Artos cutters, while not as effective as enclosure hoods, are also judged to provide adequate control for the way in which they are being used. Measurements at 2 of these hoods indicated air flows of 240 cubic feet per minute (cfm) and 280 cfm respectively. The company does have a periodic maintenance program for the ventilation systems.

2. Medical

Of the 26 individuals who were interviewed, 3 mentioned symptoms which they felt may or may not be work related. One man cited a hand-skin infection which apparently occurred during a shortage of gloves when it was necessary to use one pair of gloves for a prolonged period. This may demonstrate the need for the usual periodic change of gloves. A second man complained of a sinus condition while a third had complaints regarding the odors from the inkers. These three positive responses appear to be isolated cases and not typical of other employees in the same work areas. Also considering the low environmental levels, it is unlikely that these positive responses to the questionnaires demonstrate the work environment to pose a health hazard.

The plant has what appears to be a complete health facility (e.g. various clinic capabilites, physicians, nurses, pre-employment physical examinations, audiometric examinations, special examinations for individuals in certain plant areas, etc.). For individuals working with the solders in Departments 1451, 1452, and 1454, blood lead level determinations are offered on a twice per year basis and required once per year. If the blood lead level is greater than 50 micrograms of lead per 100 milliliters of blood (50 ug/100 ml blood), the blood test is repeated. If the repeat test is greater than 50 ug/100 ml blood, the individual is interviewed, referred to a physician, and removed from exposure. The individual is re-examined after 3-6 months. The employees are not furnished with hard copy of their blood lead determinations but may look at their records if they so desire. With an employee's written consent, the company will send medical data to the employee's private physician.

NIOSH currently considers the upper "normal" blood lead level to be 40 ug/100 ml blood and the lower "excessive" blood lead level to be 80 ug/100 ml blood. Emergence of new health information related to lead suggests that blood lead levels in individual workers should be kept under 60 ug/100 ml blood.[7] A review of the company data showed that several men had blood lead levels greater than 40 ug/100 ml blood but less than 60 ug/100 ml blood. For example: In 1976, 3 of 20 blood lead determinations were between 40 and 50 ug/100 ml blood, the rest were in the normal range; in 1975, 2 of 17 blood lead determinations were between 40 and 60 ug/100 ml blood, the rest were in the normal range; in 1974, 15 blood lead determinations were all 40 or less ug/100 ml blood.

While these levels are not "excessive", they are indicative of environmental exposure. On this basis, it is worthwhile that the company continue their present program of atmospheric and biologic monitoring for lead.

The company has an active safety and health program which includes periodic inspections, educational meetings, provision of personal protective devices (gloves, safety glasses, sleeving, aprons, optional safety shoes, etc.) and the various industrial hygiene disciplines. It goes without saying that there is a need for these programs.

E. RECOMMENDATIONS

In view of the survey results and the active safety and health programs of the company and the union, it is difficult to come up with strong recommendations. However, there are several suggestions which are worthy of mention. It is suggested that:

1. The company and union, continue, and strengthen when necessary, their present programs in industrial safety and health.

2. The brake, for removing knots in the cable at the Artos cutters, be moved such that it would remove "knots" in the cable prior to the cable passing through the ink reservoir. Occasionally, knots in the cable will jam at the ink reservoir cover, thus upsetting the reservoir and spilling its contents.

3. Cleaning the face grids of the small canopy hoods which exhaust the lead and flux emissions at the Artos cutters, might be included in the company's routine maintenance program for the ventilation systems.

4. The small canopy hoods at the Artos cutters should be carefully positioned so as to achieve optimum control. It was noted that a misalignment of the hoods enables emissions from the solder pots to escape control.

5. The air flow from the fans used for comfort ventilation should not be directed into, or across the face of the exhaust hoods as this will often upset the operating characteristics of the hoods.

6. Unnecessarily long duct runs should be avoided when designing or modifying local exhaust ventilation systems.

V. REFERENCES

1. Carl Zenz, Editor, Occupational Medicine - Principles and Practical Applications (Chicago: Year Book Publishers, Inc.) 1975.

2. American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values for Substances in Workroom Air. Ed. 3, Cincinnati, Ohio 1971.

3. W.M. Gafafer, Editor. Occupational Diseases - A Guide to their Recognition. U.S. Department of Health, Education, and Welfare. Public Health Service, 1964. Public Health Service Pub. No. 1097.

4. Criteria for a Recommended Standard ... Occupational Exposure to Inorganic Lead. U.S. Department of Health, Education, and Welfare, PHS, NIOSH, 1972. Pub. No. HSM 73-11010.

5. Threshold Limit Values for Chemical Substances in Workroom Air by ACGIH for 1976. American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, Ohio 45201.

6. U.S. Department of Labor. Occupational Safety and Health Administration. OSHA Safety and Health Standards (29 CFR 1910) OSHA 2206 (Revised January 1976) p. 99.

7. Draft Technical Standard for Lead. Joint NIOSH-OSHA Standards Completion Program. September 1976.

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TABLE 1

Results of Air Samples for Lead and Tin

Packard Electric Division, G.M.C.
Warren, Ohio

October 20, 1976

Time	Dept.	Sample Description	Lead (mg/M^3)*	Tin (mg/M^3)*
0822 - 1200	1451	Artos Cutter Operator	None Detected**	None Detected**
0823 - 1149	"	" " "	" "	" "
0827 - 1147	"	" " "	" "	" "
0818 - 1148	"	Solder Pot Operator	" "	" "
0820 - 1150	"	" " "	" "	" "
0852 - 1202	1454	Artos Cutter Operator	" "	" "
0856 - 1200	"	" " "	" "	" "
0848 - 1159	"	Solder Pot Operator	" "	" "
0903 - 1157	"	Die Cast Operator	" "	" "
0905 - 1158	"	" " "	" "	" "
0832 - 1154	1452	Solder Pot Operator	" "	" "
0834 - 1153	"	" " "	" "	" "
0836 - 1153	"	" " "	" "	" "
0837 - 1152	"	" " "	" "	" "
0859 - 1202	"	" " "	" "	" "
Environmental Criteria			0.15	10.0

*Milligrams of Lead (or Tin) per cubic meter of air

**None Detected: Limit of detection for the lead samples was 0.008 mg/filter
" " " " " tin " " 0.010 mg/filter

Based on the air sample volumes and the above limits of detection, the maximum possible air concentration of lead would be 0.02 mg/M^3 and that of tin would be 0.03 mg/M^3.

TABLE 2

Results of Air Samples for Total Chlorides

Packard Electric Division, G.M.C.
Warren, Ohio

October 22, 1976

Time	Dept.	Sample Description	Total Chlorides
0803 - 1153	1451	(P)* - Cutter operator	N.D.*
0829 - 1147	1454	(P) - Solder pot operator	N.D.
0825 - 1147	1454	(P) - Solder pot operator	N.D.

* Notes

1. (P) = personal sample
2. N.D. = None Detected
3. Limit of detection = 0.015 mg/sample

TABLE 3

Results of Air samples for Volatile Aliphatic and Napthenic Hydrocarbons

Packard Electric Division, G.M.C.
Warren, Ohio

October 21, 1976

Time	Dept.	Sample Description	Pot No.	Results
0823 - 1145	1454	Solder pot operator	26	None Detected
0827 - 1140	1451	" " "	19	" "
0829 - 1140	"	" " "	20	" "
0831 - 1140	"	" " "	21	" "
0835 - 1140	1452	" " "	23	" "
0838 - 1140	1454	" " "	24	" "
0840 - 1140	"	" " "	15	" "
0842 - 1140	"	" " "	16	" "

Limit of detection = 0.01 mg/sample

Results of Indicator Tube Sampling for Proprietary Constituents or Suspected Breakdown Products of the Activated Rosin Flux or the Organic Acid Flux

Date	Time	Dept.	Location	Substance	Result
10-21-76	1400	1451	Artos cutter #5 - 2 inches from flux bath	Organic acid	None Detected
10-21-76	1405	"	" " " " " " " "	Inorganic acid	None Detected
10-21-76	1415	1454	Pot #23 - Inside hood about 1 foot from lead pot while lead was poured on fluxed metal.	Organic acid	None Detected
10-21-76	1420	1454	Pot #23 - Sample taken in smoke plume inside the hood as debris was put in the solder pot (during cleanup)	Inorganic acid	14 ppm*
1-21-76	1425	1454	Pot #23 - Sample collected in breathing zone of employee as debris was put in solder pot (during cleanup)	Inorganic acid	None Detected
10-21-76	1430	1454	Pot #23 - Sample collected in smoke plume inside the hood during cleanup.	Organic acid	1 ppm
10-21-76	1435	1454	Pot #23 - Sample collected in breathing zone of employee during cleanup.	Organic acid	None Detected
10-22-76	0930	1454	Pot #19 - Sample collected in smoke plume inside the hood while soldering.	Organic acid	1 ppm
10-22-76	0935	1454	Pot #19 - Sample collected in breathing zone of employee while soldering.	Organic acid	None Detected
10-22-76	0940	1454	Pot #19 - Sample collected in vapor plume above the freshly soldered terminals.	Organic acid	Trace
10-22-76	0945	1454	Pot #19 - Sample collected in smoke plume inside the hood.	Inorganic acid	16 ppm
10-22-76	0950	1454	Pot #19 - Sample taken in breathing zone of employee while soldering.	Inorganic acid	None Detected
10-22-76	0955	1454	Pot #19 - Sample taken in vapor plume above the freshly soldered terminals.	Inorganic acid	Trace

*ppm = parts of substance per million parts of air

TABLE 5

Results of Air Sampling for Proprietary Constituents of the Hi-speed Printing Ink and Thinner

Packard Electric Division, G.M.C.
Warren, Ohio

Date	Time	Dept.	Sample Description	Constituent* A	B	C	D
10-20-76	0957 - 1345	1451	(P)* - Operator, Cutter No. 4	0.4	N.D.	N.D.	N.D.
"	1015 - 1352	"	(P) - " " " 7	N.D.	N.D.	N.D.	N.D.
"	0950 - 1400	"	(A)* - 3' from inker, Cutter No. 4	N.D.	N.D.	N.D.	0.1.
"	1000 - 1358	"	(A) - 4' " " " " 1	N.D.	N.D.	N.D.	N.D.
"	1003 - 1357	"	(P) - Operator, Cutter No. 1	N.D.	N.D.	N.D.	N.D.
"	1008 - 1354	"	(A) - 1.5' from inker, Cutter No. 3	0.4	N.D.	N.D.	N.D.
"	1010 - 1352	"	(P) - Operator, Cutter No. 3	N.D.	N.D.	0.2	N.D.
"	1012 - 1355	"	(A) - 3' from inker, Cutter No. 7	N.D.	N.D.	N.D.	N.D.
10-21-76	0855 - 1145	1454	(P) - Operator, Cutter CS-23	N.D.	N.D.	N.D.	N.D.
"	0907 - 1145	1451	(A) - 1' from inker, Cutter No. 3	0.3	N.D.	N.D.	N.D.
"	0905 - 1145	"	(P) - Operator, Cutter No. 3	N.D.	N.D.	N.D.	N.D.
"	0856 - 1145	1454	(A) - 3' from inker, Cutter CS-23	N.D.	N.D.	N.D.	0.1
"	0913 - 1150	1451	(P) - Operator, Cutter No. 4	N.D.	N.D.	N.D.	0.1
"	0914 - 1150	1451	(A) - 3' from inker, Cutter No. 4	N.D.	N.D.	N.D.	0.1

*Notes:

1. (P) = personal sample
2. (A) = area sample
3. All results are presented as a percent of what was considered to be the most appropriate environmental evaluation criteria.