U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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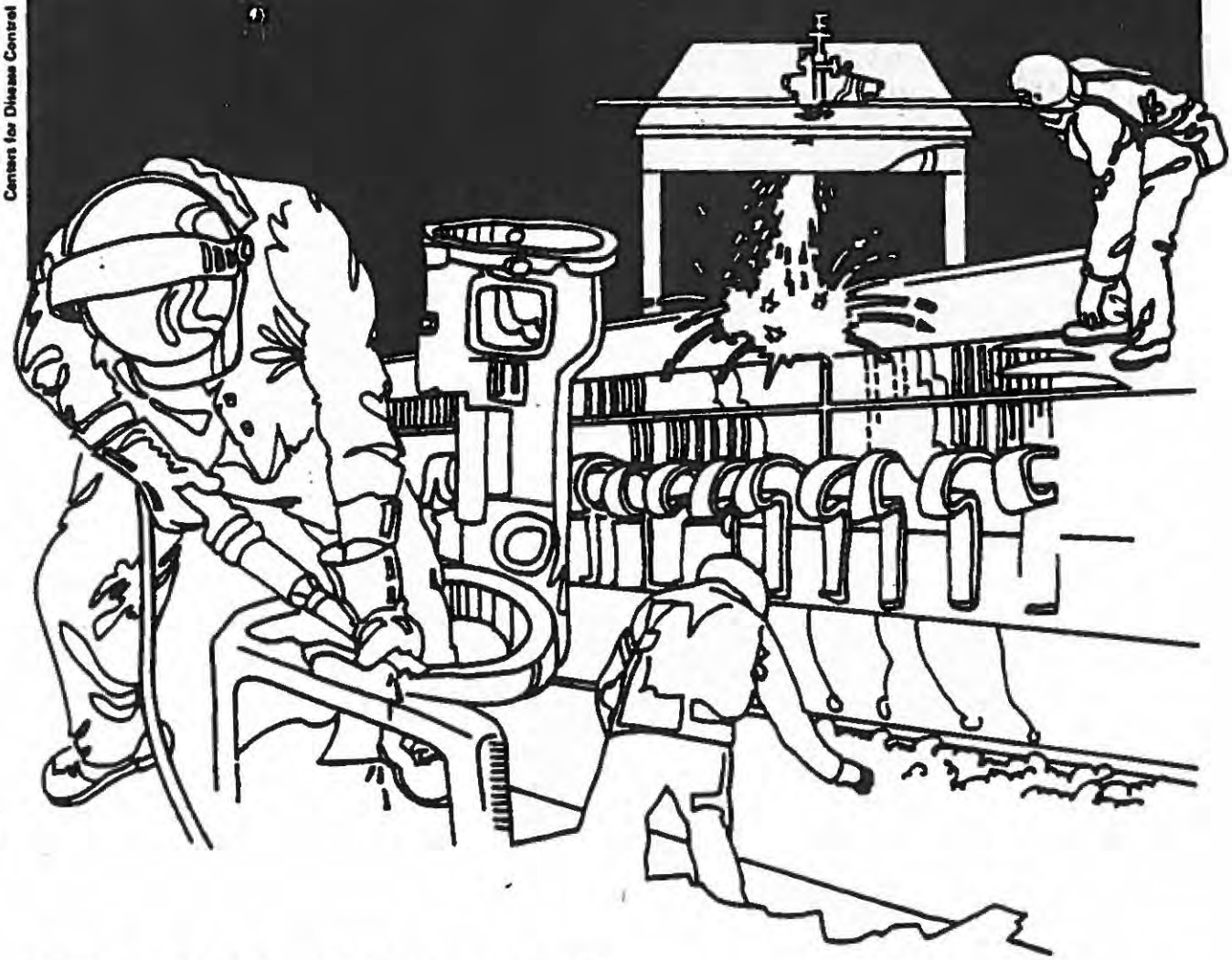
NIOSH



Health Hazard Evaluation Report

HETA 84-406-1617
PACKARD ELECTRIC
WARREN, OHIO

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 84-406-1617
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PACKARD ELECTRIC
WARREN, OHIO

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I. SUMMARY

On June 27, 1984 the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the International Union of Electrical Workers (IUE) Local 717 AFL-CIO for evaluation of irritative and constitutional symptoms among employees of the Packard Electric facility, Warren, Ohio. Packard Electric produces electrical components for GM autos at this plant.

NIOSH investigators conducted an environmental and medical evaluation on July 18-19, 1984. Environmental monitoring was conducted near a nylon injection molding operation which had been associated with the symptoms of ill health. Sampled substances included ammonia, hydrogen chloride, hydrogen cyanide, nitric oxide, nitrogen dioxide, and pyridine. All results were below detectable levels.

A prepared questionnaire was administered to 31 randomly selected workers. The symptoms investigated included sinus congestion, nasal congestion, nosebleeds, throat irritation, skin irritation, wheezing, chest tightness, difficulty breathing, coughing, abdominal pain, and nausea. Analysis of the questionnaires demonstrated a relatively high prevalence of a number of symptoms of acute mucosal irritation (90%), respiratory tract irritation (42%), and systemic/constitutional effects (58%). However, these could not be associated with the molding process or any other activities conducted in the work area under investigation.

The environmental and medical data collected during this evaluation did not demonstrate the existence of a health hazard expected to result in any long-term or chronic health effects. However, based upon the relatively high prevalence of a number of symptoms, recommendations are made in Section VII of this report toward reduction of workplace contaminants generated from the nylon injection molding operation.

KEYWORDS: SIC 3699 (Electric Machinery, Equipment, and Supplies, not elsewhere classified) Ammonia, Hydrogen chloride, Hydrogen cyanide, Nitrogen dioxide, Nitric oxide, Pyridine, Mucosal irritation, Respiratory tract irritation, Systemic/constitutional effects.

II. INTRODUCTION

On June 27, 1984, a request was received from the International Union of Electrical Workers (IUE) Local 717 AFL-CIO for investigation of nausea, eye irritation, sore throat, and fatigue among assemblers, press operators, and service employees of the Packard Electric facility located in Warren, Ohio. The complaints of ill health were associated with fumes generated from a nylon injection molding operation. A NIOSH medical officer and industrial hygienist conducted a site visit of the facility on July 18-19, 1984. At that time, environmental air samples were collected directly over the injection molder and in the surrounding work area. In addition, a prepared questionnaire was administered to 31 randomly selected department 4431 workers from the 1st and 2nd shifts. An interim letter with initial findings was distributed on July 31, 1984.

III. BACKGROUND

Packard Electric, a division of General Motors Corporation, produces electrical components for GM autos (ie. wiring harness) at their Warren, Ohio, facility. The building was constructed in 1979, and covers approximately 3.5 acres. The industrial process involved in the NIOSH evaluation consisted of six injection molders which produce various types of fusible links and couplers for automotive electrical wiring harnesses. This area operates on three shifts, with 40 hourly employees on 1st shift, 36 on 2nd, and 4 on 3rd.

The general configuration and plant lay-out of the manufacturing operations was changed during the summer of 1983. At that time, an injection molding operation utilizing a nylon resin (Zytel®) was installed, which coincided with the initial health complaints. These complaints were from employees in areas adjacent to this operation. Jobs in these areas included; 1) press operators where terminals were attached to the ends of insulated wire, 2) dip soldering the exposed ends of insulated wire, 3) clamping insulated wire via presses, 4) installing fusible links via presses, and 5) spin wrapping insulated wire. Operations in these areas that required heat and generated fumes (ie. dip solder) were locally exhausted.

Observation of the nylon molding operation indicated that airborne emissions tended to rise directly above the injection molder, and disperse to the surrounding areas. In an attempt to alleviate the complaints associated with the injection molder, management installed several "Casablanca®" fans overhead the adjacent work areas to disperse any effluents. In addition to the general ventilation in the facility, supply and exhaust fans are located in the ceiling above the general area of concern.

IV. EVALUATION DESIGN AND METHODS

Environmental

As a preliminary evaluation of possible pyrolysis products liberated from the injection molder using the Zytel material, environmental air samples were collected directly over the molder, and in the surrounding work area. The strategy was to ascertain which, if any, effluents were being generated by this process through direct measurement above the molder, and to then measure the airborne concentrations of these substances in the surrounding work areas. Samples were analyzed for hydrogen chloride, hydrogen cyanide, ammonia, pyridine, nitric oxide, and nitrogen dioxide. These substances were identified in the scientific literature as possible pyrolysis products of nylon materials which, when present in adequate airborne concentrations, may cause health effects similar to those reported by the Packard Electric employees. Table 1 presents specific information on the methods of sample collection and analysis.

Medical

The medical component of the investigation consisted primarily of a prepared questionnaire, which was administered to a random selection of workers from Department 4431, including personnel from the day and evening shifts. No comparison group completed the questionnaire, and all Department 4431 members had potential for exposure to the molding process in question. The questionnaire obtained demographic information, a brief job history, smoking history, and a survey for the prevalence of 16 irritative and constitutional symptoms (along with an estimate of their work relatedness). The symptoms investigated were: sinus congestion, nasal congestion, epistaxis (nosebleeds), throat irritation, sneezing, headaches, dizziness, fatigue, eye irritation, skin irritation, wheezing, chest tightness, difficulty breathing, coughing, abdominal pain, and nausea. We also interviewed an additional seven employees who requested to see us. Information from these self-selected individuals was noted but was not included in the statistical analysis. Finally, we interviewed members of the dispensary staff about their experience with the health complaints of Department 4431 personnel.

V. EVALUATION CRITERIA

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

Table II presents information on the NIOSH recommended standards, the OSHA Permissible Exposure Limits, and the ACGIH Threshold Limit Values, plus brief descriptions of the primary health effects of the substances monitored at the Packard Electric facility.

VI. RESULTS AND DISCUSSION

Environmental

Gas chromatographic/mass spectrometric analysis was conducted on three charcoal tube air samples collected directly above the nylon molder during the injection molding operation. To analyze for a broad range of possible contaminants, one tube each was desorbed with carbon disulfide, methylene chloride, and methanol. Several small peaks were identified, but in quantities too low for positive confirmation. Based on retention times and peak patterns, however, these compounds were probably toluene and some aliphatic hydrocarbons (at concentrations of less than 10 micrograms/tube). Based on these extremely small quantities obtained directly in the smoke stream of the nylon molder, it was decided not to analyze the charcoal tubes collected in the work area, because they would probably have been reported at less than the analytical limits of detection. Detector tube sampling for ammonia, hydrogen chloride, and hydrogen cyanide in the smoke stream did not identify these compounds as being present (less than one part per million).

A total of 10 samples collected for pyridine above the molding operation and the surrounding work area were reported as less than the analytical limit of detection (0.02 mg./sample) which was generally less than 0.1 ppm, adjusted for sampled air volume. Likewise, all samples collected for nitric oxide and nitrogen dioxide (four each) were below the analytical limits of detection (1 microgram/sample or generally less than 0.4 ppm for nitric oxide and 0.3 ppm for nitrogen dioxide, air volume adjusted).

Medical

We obtained questionnaire information from 31 (41%) of the 76 day and evening shift Department 4431 workers. These individuals were randomly selected from an employment list provided by the company. The median age of the respondents was 41 years, with a range of 34 to 67. They had been in their current job for a median of 0.8 years (range 0.1 to 4.5) and at the Austintown facility for a median of 4 years (range 0.1 to 5.0). Twelve (39%) of the 31 were current smokers. Twenty-six (84%) were females and five (16%) were males.

The most frequently reported symptoms were as follows: sinus congestion (65% of respondents), throat irritation (55%), nasal irritation (42%), headache (39%), eye irritation (36%), cough (32%), and nausea (32%). When reported symptoms were grouped into broader categories, 28 of 31 respondents (90%) had one or more symptoms of mucosal irritation (sinus congestion, nasal congestion, epistaxis, throat irritation, sneezing, or eye irritation.

Eighteen (58%) had at least one systemic constitutional symptom (headache, dizziness, fatigue, abdominal pain, or nausea) and 13 (42%) had at least one respiratory symptom (wheezing, chest tightness, difficulty breathing, or cough). If symptoms were restricted to those that were deemed to be work-related (i.e., were perceived as being more severe at work than at home and occurring at least twice per week), 18 respondents (58%) still reported at least one work-related irritative symptom, 12 (39%) at least one constitutional symptom, and 7 (28%) at least one respiratory symptom.

The mean number of symptoms reported by each interviewee was 4.4 (s.d.=2.8). The mean number of work-related symptoms reported per person was 2.2 (s.d.=2.7). Smokers reported a mean of 4.3 symptoms per person (s.d.=3.1); non-smokers reported 4.4 (s.d.=2.7). Women reported a mean of 4.5 symptoms (s.d.=3.0) and men reported 4.0 (s.d.=1.9). None of these differences were statistically significant by t-test at a $p < 0.05$ level.

To assess any effect of specific job or work station on the frequency of symptoms, we first compared the five workers (four mold operators and one mold-setter) who were directly involved in the molding process with the rest of the department. The five molders reported a mean of 4.2 (s.d.=2.6) symptoms per person. This compared with 4.4 (s.d.=2.9) in the group with presumed lower exposures to the molding fumes. We also compared those who considered themselves "exposed" to molding fumes with those who did not so indicate on the questionnaire. The "exposed" group reported a mean of 5.0 (s.d.=3.5) symptoms; the "non-exposed" group reported a mean of 4.1 (s.d.=2.5). In neither comparison was the difference statistically significant (t-test). Similar results (with lower means in all categories) were found when the analysis was restricted to work-related symptoms.

Some clinical history was gathered from individuals who were not selected to complete the questionnaire, but who wanted to volunteer additional information. This information was not included in the above analysis, but it described clinical responses to the mold fumes that were consistent with the symptom survey results. This information also suggested that the worst periods corresponded to times when the mold presses were first turned on and when area ventilation in the department was diminished. Finally, the dispensary staff stated that it was their impression that Department 4431 personnel presented to the plant clinic with complaints suggestive of illnesses more often than did other plant personnel, who more frequently sought treatment for injuries. This impression could not be documented, however.

The medical analysis demonstrates relatively high prevalences of a number of symptoms of acute mucosal irritation, respiratory tract irritation, and systemic/constitutional effects. These subjective effects could not, however, be specifically associated with the molding process or any other aspect of the department's activity. Similarly, the environmental sampling did not demonstrate the presence of any substances at levels likely to induce such symptoms. Finally, we found no evidence to suggest that any long-term or chronic effects are likely.

VII. RECOMMENDATIONS

Although environmental monitoring was unable to identify the presence of specific compounds responsible for the relatively high symptom prevalences, remedial actions directed toward reduction of exposure to the effluents generated by the nylon molding operation are recommended. These include:

1) Reversal of the air direction of the existing supply/exhaust ceiling fans located in the injection molding work area. Currently, supply air is being directed down upon the nylon injection molder, interfering with the natural convection of the effluents from the molder to the ceiling area. If the exhaust fan located above the press area were supplying fresh air, molder effluents might possibly be directed away from operators.

2) The Casablanca fans may be acting to force the molder effluents near the ceiling downward into the surrounding work areas. Reversing these fans or discontinued use may aid in reducing exposures to the molder effluents.

3) Position floor fans so that the natural rise of molder effluents is not altered. Also, floor fans should be positioned so as not to interfere with the local exhaust systems located on the dip solder operations.

4) Local exhausting of the nylon molding operation may be warranted if the above recommendations do not reduce the symptom prevelances.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 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. Packard Electric
2. IUE Local 717
3. NIOSH, Region V
4. OSHA, Region V

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 METHODODLGY
PACKARD ELECTRIC
WARREN, OHIO

JULY 18-19, 1984
HETA 84-406

Substance	Collection Device	Analysis	Detection Limit	Reference
Ammonia	Detector Tube	Color Change	1 ppm[1]	---------
HCl[2]	Detector Tube	Color Change	1 ppm	---------
HCN[3]	Detector Tube	Color Change	1 ppm	---------
NO[4]	TEA Tube[5]	Visible spectroscopy	1 ug[6]	NIOSH P&CAM S321
O_2[7]	TEA Tube	Visible Spectroscopy	1 ug	NIOSH P&CAM S321
Pyridine	Charcoal Tube	Gas Chromatography	20 ug	NIOSH P&CAM S161

1 ppm = part per million.
2 Hydrogen chloride.
3 Hydrogen cyanide.
4 Nitrogen dioxide.
5 Triethanol amine.
6 ug = microgram.
7 Nitrogen dioxide.

TABLE II

EVALUATION CRITERIA
PACKARD ELECTRIC
WARREN, OHIO

JULY 18-19, 1984
HETA 84-406

Substance	Evaluation Criteria (mg/m^3) NIOSH Recommended Standard	OSHA Standard	ACGIH TLV	Primary Health Effects
Ammonia	35c	35*	18	Mild to moderate exposure to the gas can produce headache, salivation, burning of the throat, anosmia, perspiration, nausea, vomiting, and substernal pain.
Hydrogen Chloride	--	7c	7c	High concentrations of the gas are highly corrosive to eyes, skin and mucous membranes
Hydrogen Cyanide	--	10	10c	Mild upper respiratory and nose or throat irritation may result from exposure to the vapor.
Nitrogen Dioxide	2c	10	6	May cause severe breathing difficulties which are usually delayed in onset, and at high concentrations may cause death. Irritation of the eyes, nose, throat, and wet skin may occur with acute exposures.
Nitric Oxide	30	30	30	May change into nitrogen dioxide in air, therefore causing the health effects associated with the latter.
Pyridine	--	15	15	Very high concentrations may cause narcosis. Repeated, intermittent, or continuous low level exposure may lead to transient effects on the central nervous system and gastrointestinal tract. The symptoms include headache, dizziness, insomnia, nervousness, anorexia, nausea, vomiting and diarrhea.

c = Ceiling concentration which may not be exceeded.
* = Unless noted with "c", time-weighted average concentration, usually averaged over an 8- to 10-hour work-shift.