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 HE 77-92-541

PACKARD ELECTRIC
DIVISION OF GENERAL MOTORS CORPORATION
WARREN, OHIO

November 1978

I. TOXICITY DETERMINATION

The National Institute for Occupational Safety and Health (NIOSH) conducted a Health Hazard Evaluation November 14-16, 1977, at Packard Electric, Division of General Motors Corporation, located in Warren, Ohio. The evaluation was concerned with assessment of employee exposure to thermal decomposition products from injection and extrusion molding of thermoplastics. Methodology used in the evaluation included: (1) environmental sampling, (2) medical evaluation by interviews, (3) observation of work practices, (4) review of the workplace and materials used, (5) thermal-gravimetric analyses of plastics and (6) review of scientific literature.

Non-directed medical questionnaires were administered to 40 employees. Approximately 25% of the employees interviewed reported past and/or present symptomatology possibly related to thermal processing of plastics. These symptoms primarily included mucous membrane irritation (upper respiratory and eye), headache, and nausea.

Results of the environmental sampling, however, indicated that employees were not exposed to airborne contaminants at potentially toxic concentrations during the investigation. Personal and/or area samples were collected over 8-hour work shifts to determine the airborne concentrations of acrolein, hydrogen chloride, copper, lead, zinc, total particulates, vinyl chloride, acrylonitrile, benzene, butadiene, styrene, dibutyl phthalate, dioctyl phthalate, ditert-butyl-p-cresol, formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde, valeraldehyde, and a qualitative and quantitative analyses for aliphatic and aromatic amines, and organics (hydrocarbons). Short-term measurements were taken for hydrogen cyanide, acrylonitrile, benzene, styrene, formaldehyde, carbon monoxide, phenol, nitrogen dioxide, vinyl chloride, ammonia, triethylamine, hydrogen chloride, and toluene. Most of the long-term (8-hour) and short-term samples showed either non-detectable or only trace concentrations.

Recommendations designed to insure a safe and healthful working environment are included in Section V of this Determination Report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination 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 Services (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address. Copies of this report have been sent to the following:

a. Packard Electric, Division of General Motors Corporation, Warren, Ohio.
b. Internation Union of Electrical, Radio and Machine Workers AFL-CIO-CLC, Washington, D.C.
c. Authorized representative of Local 717 IUE, AFL-CIO.
d. U.S. Department of Labor - Region V.
e. NIOSH - Region V.

For the purpose of informing the approximately 200 "affected employees" the employer shall promptly "post" for a period of 30 calendar days, the Determination Report in a prominent place (s) near where the exposed employees work.

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 an 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 National Institute for Occupational Safety and Health received such a request from an authorized representative of employees. The request alleged that personnel were exposed to thermal decomposition products of various plastics, particularly during the purging of presses. The request stated that odors flowed throughout the area with the effect of causing headaches, and nausea. The work areas specified in the request included Departments 1211, 1212, 1214, 1215, 1216, 1217, 1219, and 1232.

Preliminary reports containing results of all environmental sampling were forwarded on December 19, 1977 and August 14, 1978 to management and labor.

IV. HEALTH HAZARD EVALUATION

A. Process Description

Departments 1215, 1219 and 1232 are involved with the heat processing of plastics (extrusion and injection molding of thermoplastics), with the other cited departments being adjacently located. Department 1232 is an injection molding department using 75 ton vertical clamp injection mold presses of both reciprocating screw and plunger types; there are 45 such presses in the department. Department 1215 is a profile extrusion department engaged in the making of profile conduit and the performing of some notching operations; there are 14 profile type extruders in the department. Department 1219 is a convoluted conduit extrusion area in which 23 extruders are used. The extruders employed in Departments 1215 and 1219 are of the screw type.

The injection molding and extrusion processes consisted of plastic pellets being fed into a heated cylinder where the pellets were converted to a molten state. The temperature at which the pellets were heated varied according to the item molded and the type of plastic used. The approximate cylinder temperatures used for the various plastics were as follows: (1) polyvinyl chloride, 340-360°F; (2) polyethylene, 350-400°F, (3) nylon, 480°F; (4) polypropylene, 450°F; and (5) acrylonitrile-butadiene-styrene, 450°F. No plastics are intentionally heated to destruction.

The work force in Departments 1215, 1219, and 1232 is composed of approximately 190 production personnel distributed over 3 shifts; the first, second, and third shifts consisted of 79, 59, and 53 employees, respectively. The total floor space for the 3 departments was 49,226 square feet, with ceiling heights of 21 to 28 feet. These areas were ventilated with general ventilation and with local exhaust ventilation for specific operations. The local exhausts were used primarily on 8 conduit extruders which processed nylon and polyethylene plastics in Department 1219.

B. Evaluation Design and Methods

1. Thermal Degradation Products

Bulk samples of formulated pelletized plastics processed in Departments 1215, 1219, and 1232 were obtained and evaluated by thermogravimetric analyses. These plastics were heated through a temperature range of 25-900°C with a Mettler TA-1 Thermoanalyzer and the resulting weight losses were recorded. The instrument parameters used for the analyses were as follows:

Thermogravimetric (TG) sensitivity	10 mg/in
Atmosphere	Dry air, 10 l/hr.
Differential Thermal Analysis (DTA) Sensitivity	20 μV/in.

Reference	Al_2O_3(100 mg)
Heating Rate	10°C/min.
Thermocouple	Pt./Pt. 10% RH
Chart Speed	6"/hr.
Starting Temperature	Room Temperature
Maximum Temperature	900°C

A literature search was conducted in conjunction with this phase to determine the possible thermal decomposition products of the plastics. The specific compounds researched included acrylonitrile-butadiene-styrene(ABS) copolymers, polyvinyl chloride (PVC), polyethylene, polyamides, (nylon), polypropylene, and methyl methacrylate. A qualitative analysis was also conducted on an acrylic plastic (1C08009) used as a purging compound.

2. Air Sampling

Personal and area samples were collected to evaluate employee exposures. The personal samplers were attached to the employees' lapels in order to collect air samples representative of their breathing zones. Area samples were positioned at specific locations in the work environment and generally within 0.5 to 5 feet of immediate work areas. Tables 1 to X includes information denoting the type of samples collected and their location.

Ditert-Butyl-p-cresol (BHT), Dibutyl Phthalate, and Dioctyl Phthalate: Air was drawn through fluorisil collection media at a flow rate of approximately 50 milliliters (ml) per minute with a vacuum pump. The samples were desorbed with 1 ml of ethyl acetate and analyzed by gas chromatography according to NIOSH[1] method No. 127 using a gas chromotograph with a flame ionization detector. The lower limits of detection as reported in milligrams (mg) per sample were as follows: (1) BHT, 0.01 (2) dibutyl phthalate, 0.05; and (3) Dioctyl phthalate, 0.02.

Hydrogen Chloride: Exposure to hydrochloric acid (HCl) mist was determined by bubbling air at 1.0 liter per minute (lpm) through an impinger containing 10 ml of 0.5 N sodium acetate. Each sample was analyzed by NIOSH method S-246 using a chloride ion specific electrode.[2] The lower limit of detection was 0.04 mg of HCl per sample.

Formaldehyde: Exposure to formaldehyde was determined by bubbling air at 1.0 lpm through an impinger containing 15 ml of sodium bisulfite solution. Each sample was analyzed colorimetrically using NIOSH method No. 125.[3] The lower limit of detection was 0.0001 mg per milliliter of formaldehyde.

Acetaldehyde, Proprionaldehyde, Butyraldehyde, and Valeraldehyde: Exposures to these substances were determined using the same sampling methodology as for formaldehyde. Analyses were performed according to NIOSH method No. 127 using a gas chromatograph in conjuction with a flame ionization detector.[1] The lower limit of detection for each substance was 0.01 mg per sample.

Lead, Copper, Zinc, and Total Particulate: Exposures to these substances were determined by drawing air at 1.5 lpm through an acrylonitrile/polyvinyl chloride copolymer filter with 0.8 micron pore size. The total mass concentration of dust was assessed by weighing the filter prior to and after sampling using a semimicro balance with a sensitivity of 0.01 mg. The concentrations of lead, copper, and zinc were subsequently determined by P&CAM method No. 173,[4] whereby the filters were digested and solubilized in a nitric acid solution, then aspirated into an atomic absorption spectrophotometer. The lower limits of detection per sample were 0.003 mg for lead and 0.002 mg for copper and zinc.

Vinyl Chloride: Air was drawn through two charcoal tubes in series at approximately 50 ml per minute to trap the vinyl chloride gas. The analyte was desorbed from the charcoal with carbon disulfide and analyzed (by P&CAM No. 127) using a gas chromatograph with a flame ionization detector.[1] The first charcoal tube was analyzed as a single sample (both sections of charcoal in the tube) and the second tube as a breakthrough indicator. The lower limit of detection was 0.001 micrograms (ug) of vinyl chloride per tube.

Acrylonitrile, Benzene, Butadiene, and Styrene: Exposures to these substances were determined with samples obtained by drawing air through charcoal tubes at flow rates of 50-400 ml per minute. The samples were desorbed with carbon disulfide and analyzed according to NIOSH method No. 127[1] using a gas chromatograph with a flame ionization detector. The lower limits of detection per sample were as follows: acrylonitrile, 0.001 mg; and benzene, butadiene, and styrene, 0.01 mg.

Organics: Additional samples of organics were collected by using charcoal tubes in which air was drawn through at flow rates of 1.0 lpm. These samples were desorbed with carbon disulfide and analyzed by gas chromatography. Sample 195 was also analyzed by mass spectrometry to identify any organics present.

Aliphatic and Aromatic Amines: Exposures to these substances were determined with samples collected by drawing air through silica gel tubes at flow rates of 0.05 to 1.0 lpm. Aromatic amine samples were desorbed with methanol, sonified, and analyzed by gas chromatography using a flame ionization detector. The aliphatic amines were analyzed in a similiar fashion except that 1N H_2SO_4 was used for desorption. Some of the aliphatic amine samples were also analyzed by mass spectrometry, and by gas chromatography using a nitrogen detector (higher sensitivity for amines).

Acrolein: Atmospheric samples for acrolein were collected by bubbling air at 1.0 lpm through impingers containing an absorbing solution. The procedure outlined in NIOSH Method No. 118 was used, with the reagents being mixed immediately prior to sampling.[5] The samples were analyzed colorimetrically within 2-4 hours of collection

Detector Tube Measurements: Colorimetric detector tube units used during the survey included ammonia, benzene, carbon monoxide, hydrogen cyanide, nitrogen dioxide, and toluene which were NIOSH certified; and acrylonitrile, formaldehyde, hydrogen chloride, phenol, styrene, triethylamine, and vinyl chloride which were not certified. Detector tubes which are certified have an accuracy of ±35% at one-half the exposure limit and an accuracy of ±25% at one to five times the exposure limit.

3. Medical Evaluation

Medical questionnaires were completed on 32 of approximately 191 production employees in Departments 1215, 1219, and 1232 and 8 employees in adjacent work areas (Departments 1211, 1212, 1214, 1216 and 1217). The non-directed medical questionnaires were used to elicit any symptoms or medical problems which were immediately apparent to the employee. The interviews included employees' work history, symptoms experienced on the job, and any aggravating or alleviating factors.

C. Evaluation Study Criteria

1. Toxicological Effects

A review of the literature on health problems from molding of thermoplastics (plastic materials which are capable of being softened by increased temperature and hardened by decreased temperature) revealed few reports of significant health hazards. The major hazards associated with thermoplastics were from unreacted components used when manufacturing the polymers and from effluents produced during thermal destruction of the plastics. The operations evaluated at Packard Electric were not intentionally involved with either of these two processes.

The most common health problems associated with molding of plastics (i.e.; injection and extrusion molding) include irritation of the eyes, nose, throat, and upper respiratory system from thermal decomposition of the materials, and skin irritation from use of hydrocarbon cleaning solvents. If plastic materials are excessively heated and long hold times used then significant concentrations of contaminants would result in the converting area. Presented below are some of the degradation products common to the variety of plastics processed in Departments 1215, 1219, and 1232. These emissions would be of concern primarily when molding at temperatures above those observed at Packard Electric. The type of emissions produced are dependent upon the components of the formulation.

PVC[6,7,8,9]

Plasticizers (ie; phthalates)
Hydrogen Chloride
Hydrocarbons (ie; benzene)
Vinyl Chloride (from residual monomer contained in the PVC)
BHT

Polyamide (Nylon)[13]

Ammonia
Amines
Hydrogen Cyanide
Oxides of Nitrogen

Polypropylene[7,13]

Phenol
Hydrocarbons
Possible Aldehydes

ABS[7,10,11,12,13]

Hydrogen Cyanide
Monomers (acrylonitrile, styrene, and butadiene)
BHT
Terpene
Benzene
Toluene
Ammonia
Dimethylstyrene

Polyethylene[7,13,14]

Formaldehyde
Acrolein
Hydrocarbons

Polymethyl Methacrylate[7,12,13]

Methyl Methacrylate
Acetic Acid
Methyl Formate

Additional carbonaceous degradation products which would occur at elevated temperatures include water, carbon monoxide, carbon dioxide, and particulate (soot), etc.

2. Environmental Evaluation Criteria

Airborne exposure limits intended to protect the health of workers have been recommended or promulgated by several sources. These limits represent conditions under which it is believed that nearly all workers may be repeatedly exposed to a substance for an 8-hour or up to a 10-hour workday, 40-hour per week basis without adverse effect. For this investigation, the criteria used to assess the degree of health hazards to workers were selected from three sources: (1) airborne exposure limits which NIOSH has recommended to OSHA for occupational health standards, (2) Threshold Limit Values (TLV's) for 1978 and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), and (3) Occupational Health Standards as promulgated by the U.S. Department of Labor (Federal Register, 29CFR1910, pp. 291-293, January 1, 1978).

The NIOSH Recommended Standards and the TLV's presented in the following tabulation are given prominence in this evaluation since they represent the most current health criteria. The OSHA Standards are provided only as a reference to determine the state of compliance or non-compliance with Federal Regulations. The Federal standards are legal standards and enforcement is a responsibility of the U.S. Department of Labor, OSHA.

Table A

EXPOSURE LIMITS PRESENTED IN mg/M^3*

Substance	NIOSH	TLV	OSHA
Butyl-p-cresol(BHT)		10	
Copper (dust)		1	1
Dibutyl phthalate		5	5
Dioctyl phthalate		5	5
Hydrogen chloride		7(C)**	7(C)
Lead	0.1	0.15	0.2
Zinc (oxide fume)	5	5	5
Total particulate		10	15
Propylamine***			
Trimethyamine***			

*mg/M^3- denotes milligrams of substance per cubic meter of air.
**(C)- denotes a ceiling value which should not be exceeded (determined for intervals of 30 minutes or less depending on source of criteria and/or on contaminant). All other values presented in the table are permissible exposure levels based on either an 8 or 10-hour time weighted average.
***No exposure limit has been assigned.

Table B

EXPOSURE LIMITS PRESENTED IN PPM*

Substance	NIOSH	TLV	OSHA
Acetaldehyde		100	200
Acrolein		0.1	0.1
Acrylonitrile	4	20	20
Ammonia	50(C)**	25	50
Benzene	1(C)	10	10
Butadiene		1000	1000
Carbon monoxide	35	50	50
Formaldehyde	1(C)	2(C)	3
Hydrogen chloride		5(C)	5(C)
Hydrogen cyanide	5(C)	10	10
Nitrogen dioxide	1(C)	5(C)	5
Phenol	5	5	5
Styrene		100	100
Toluene	100	100	200
Triethylamine		25	25
Vinyl chloride	1(C)	***	1
Valeraldehyde		50	
Propionaldehyde****			
Butyraldehyde****			

*ppm- parts of contaminant per million parts of air by volume.
**(C)- denotes a ceiling value which should not be exceeded (determined for intervals of 30 minutes or less depending on source of criteria and/or on contaminant). All other values presented in the table are permissible exposure levels based on either an 8 or 10-hour time weighted average.
***Awaiting reassignment of TLV pending further data acquisition.
****No exposure limit has been assigned.

D. Evaluation Results

1. Thermogravimetric Analyses of Bulk Plastic Materials

Results of the thermogravimetric analyses conducted for various plastics used in Departments 1215, 1219, and 1232 are presented in Table XI. A number of general observations can be made concerning these results.

a. None of the samples showed any weight loss before heating to 230°C(446°F).

b. All samples showed a major weight loss starting at approximately 250°C(482°F). This weight loss was associated with an exothermic reaction, thus indicating probable oxidization (burning).

c. By 900°C(1650°F), all samples had lost at least 83% of their initial weight, and in the majority of the cases, the loss was 90% or greater.

Information provided in Table XI includes the identification number and type of plastic tested, and the percent of weight loss which occurred at different termperature ranges.

2. Environmental

Personal and area samples (8-hour time weighted average and/or instantaneous samples) were collected to determine the airborne concentration of the following contaminants: acetaldehyde, acrolein, acrylonitrile, ammonia, benzene, butadiene, butyraldehyde, ditert-butyl-p-cresol, carbon monoxide, copper, dibutyl phthalate, dioctyl phthalate, formaldehyde, hydrogen chloride, hydrogen cyanide, lead, nitrogen dioxide, phenol, propionaldehyde, styrene, toluene, triethylamine, vinyl chloride, valeraldehyde, zinc, and total particulate. Additionally, qualitative and quantititive analyses were conducted for aliphatic and aromatic amines, and for organics (hydrocarbons). Results of the air sampling have been presented in Tables I to X.

As determined by a comparison of sampling results to the evaluation criteria, all samples collected in both the employee's breathing zone and the general work area were within acceptable limits. With exception of the detector tube results for benzene, all other contaminant concentrations were less than 25% of the applied criteria. Although appreciable concentrations of benzene were indicated with detector tubes in the smoke plume of various extruders, these measurements were believed to the the result of an interference and not due to the presence of benzene. Measurements taken with charcoal tubes and analyzed by gas chromatography (a more accurate method of evaluation) revealed that benzene was not present.

3. Medical

Medical questionnaires were completed on extrusion operators, injection molders, mold setters, die setters, and general service personnel in Departments 1215, 1219, and 1232 and on inspectors, press operators, AHP assembly personnel, and tapers in Departments 1211, 1212, 1214, 1216, and 1217. Questioning was conducted in a non-directed manner to elicit complaints and/or symptoms believed by the employees to be job related. A total of 40 employees (22 female/18 male) were interviewed from the first and second shifts. The average age of those interviewed was 42 years, with a median age of 40 years of and range of 29-61 years. The average duration of employment at Packard Electric was 15 years, with a median of 13 years, and a range of 5-35 years.

Table XII summarizes the job related medical complaints mentioned during the employee interviews. Of the 40 employees interviewed, 12 mentioned health problems/annoyances possibly associated with their work areas. The symptomatology included tissue irritation (eye, nose, throat, and skin), headache, light headedness, nausea, cough, sneezing and eczema. Six of the 12 employees associated their symptoms with the molding and the purging of plastics, while 4 employees could not attribute their malady to a specific process. The remaining 2 employees complained of muscle aches/strains and tendonitis from pushing and pulling of wires during preparation for molding.

E. Conclusions and Discussion

Approximately 25% of the employees interviewed complained of upper respiratory and mucous membrane irritation possibly due to the thermal processing of plastics. Review of the literature revealed that thermal decomposition of the types of plastics used at Packard Electric could result in irritating emissions such as aldehydes, hydrogen chloride, acrolein, phthalates, ammonia, and BHT. Air sampling was performed for these substances as well as for acrylonitrile, benzene, butadiene, carbon monoxide, copper, hydrogen cyanide, lead, nitrogen dioxide, phenol, styrene, toluene, triethylamine, vinyl chloride, zinc, and total particulate. These samples were collected during the molding of thermoplastics used in Departments 1215, 1219, and 1232 (polyethylene, polypropylene, nylon, ABS, and PVC) and the purging of presses with these plastics. Results of the air sampling were within acceptable exposure limits for all substances; most samples showed either non-detectable or only trace concentrations.

Purging is occasionally performed with an acrylic plastic compound analyzed by NIOSH as methyl methacrylate (MMA). This compound was used during the six month period immediately preceeding the evaluation, during which time purging was performed on 25 presses. No presses were purged with MMA during the environmental evaluation. It was reported that the purge time required when using this compound was 3 to 10 minutes per press. In the past the company purged at approximately 480°F, however the procedure is currently done at 400°F. In view of the infrequent use of the compound, the time required for purging, and the temperature presently used for purging, the potential for a health hazard should be minimal provided inhalation of the concentrated emissions

is avoided. It should be noted that the presence of odors during use of polymethyl methacrylate does not necessarily indicate a health hazard. The odor threshold for MMA is approximately 0.2 ppm, which is significantly below the exposure limit of 100 ppm.

V. RECOMMENDATIONS

1. Insure that proper temperatures (minimum required processing temperatures) and hold times are maintained during injection and extrusion molding of plastics. Elevated temperatures and long hold times will cause thermal degradation thus releasing such contaminants as monomers and other volatile organic and inorganic substances. Without adequate ventilation these substances could reach hazardous levels in the converting area.

2. In the event of equipment malfunctions (ie; presses over-heating) and evaluation of degradation products to significant levels, employees in the affected area should be removed.

3. During purging operations, inhalation of concentrated emissions should be avoided. Local ventilation should be used to facilitate contaminant removal whenever possible.

4. Hot plastic scrap released during purging should be properly disposed of and not permitted to smoulder in the work area.

5. It is recommended that the company obtain decomposition data (ie; thermogravimetric and qualitative analyses data) for the acrylic purging compound. Environmental sampling data should also be collected during the purging process.

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Table I

SUMMARY OF MEASUREMENTS TAKEN FOR VARIOUS CHEMICAL SUBSTANCES WITH DRAGER INDICATOR TUBES

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Type	Sample Time	Type of Plastic	Press Temperature	Contaminant	Tube Reading
11/15/77	Dept. 1219 - Extruder 6	A	1031	Polyethylene	350-400°F	Acrylonitrile	None
		A	1040			Carbon Monoxide	<5 ppm
		A	1042			Toluene	None
		A	1045			Nitrogen Dioxide	None
		A	1046			Formaldehyde	None
		A	1050			Phenol	None
	Dept. 1219 - Extruder 19	A	1059	Nylon	480°F	Acrylonitrile	None
		A	1101			Formaldehyde	None
		A	1105			Carbon Monoxide	<5 ppm
		A	1110			Toluene	None
		A	1115			Nitrogen Dioxide	None
		A	1119			Benzene	None
		A	1305			Hydrogen Cyanide	None
		A	1918			Benzene	None
		A	1925			Formaldehyde	None
		A	1927			Carbon Monoxide	<5 ppm
	Dept. 1215 - Extruder 14	A	1245	Polyethylene	350-400°F	Triethylamine	None
		A	1248			Nitrogen Dioxide	None
		A	1252			Carbon Monoxide	<5 ppm
		A	1300			Formaldehyde	None
		A	1302			Phenol	None
		SP	1825			Benzene	40 ppm*
		SP	1900			Toluene	None
		SP	2056			Benzene	20 ppm*
		A	2103			Phenol	None

Table I (Cont'd)

SUMMARY OF MEASUREMENTS TAKEN FOR VARIOUS CHEMICAL SUBSTANCES WITH DRAGER INDICATOR TUBES

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Type	Sample Time	Type of Plastic	Press Temperature	Contaminant	Tube Reading
11/15/77	Dept. 1215 - Extruder 13	A	1830	Polyethylene	350°-400°F	Phenol	None
		A	1835			Carbon Monoxide	<5 ppm
		A	1837			Formaldehyde	None
		SP	2110			Benzene	5 ppm*
	Dept. 1215 - Extruder 11	SP	1815	Polyethylene	350°-400°F	Benzene	10 ppm*
	Dept. 1215 - Extruder 15	SP	2122	Polyethylene	350°-400°F	Benzene	<5 ppm*
	Dept. 1232 - Press 34	BZ	1145	PVC	345°F	Vinyl Chloride	None
	Dept. 1232 - Press 1	BZ	1147	ABS	440°F	Benzene	None
		BZ	1130			Styrene	None
		BZ	1325			Acrylonitrile	None
		BZ	1900			Ammonia	None
	Dept. 1232 - Press 14	BZ	1345	PVC	360°F	Benzene	None
		BZ	1340			Carbon Monoxide	5 ppm
	Dept. 1232 - Press 2	BZ	1335	ABS	450°F	Carbon Monoxide	5 ppm
		BZ	1320			Acrylonitrile	None
		BZ	1905			Hydrogen Cyanide	None
	Dept. 1232 - Press 3	BZ	1330	ABS	450°F	Styrene	None
		BZ	1915			Acrylonitrile	None
	Dept. 1232 - Press 17	BZ	1135	PVC		Benzene	None
	Dept. 1232 - Press 26	BZ	1345	PVC	340°F	Benzene	None
	Dept. 1232 - Press 37	BZ	2220	PVC	350°F	Carbon Monoxide	<5 ppm
		BZ	1900			Vinyl Chloride	None

Table I (Cont'd)

SUMMARY OF MEASUREMENTS TAKEN FOR VARIOUS CHEMICAL SUBSTANCES WITH DRAGER INDICATOR TUBES

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Type	Sample Time	Type of Plastic	Press Temperature	Contaminant	Tube Reading
11/15/77	Dept. 1232 - Press 22	BZ	2230	PVC	350°F	Carbon Monoxide	<5 ppm
	Dept. 1232 - Press 9	BZ	1900	PVC	350°F	Hydrogen Chloride	None
11/16/77	Dept. 1219 - Extruder 14	BZ	0941	Polypropylene	450°F	Acrylonitrile	None
		BZ	0944			Formaldehyde	None
		BZ	0946			Benzene	None
		BZ	0950			Carbon Monoxide	None
	Dept. 1232 - Press 1	SP	1005	ABS	440°F	Acrylonitrile	None
		BZ	1005			Hydrogen Cyanide	None
		SP	1006			Hydrogen Cyanide	Trace(<2ppm)
	Dept. 1232 - Press 6	BZ	0945	PVC	340°F	Vinyl Chloride	None
	Dept. 1232 - Press 39	BZ	1000	PVC	340°F	Vinyl Chloride	None
	Dept. 1232 - Press 15	BZ	0947	PVC	360°F	Formaldehyde	None
	Dept. 1232 - Press 22	BZ	0955	PVC	350°F	Formaldehyde	None

A - Area sample.
SP - Sample collected in smoke plume.
BZ - Sample collected in breathing zone of employee.
ppm - Parts of contaminant per million parts of air by volume.
* - Indicates layer turned brown. The concentration indicated by the tube may have been due to an interference.
Note: Several of the indicator tubes used on 11/15/77 for monitoring benzene levels in Departments 1215 and 1219 exceeded the expiration date.

Contaminant	Evaluation Criteria	Lower Range of Measurement for Indicator Tube
Hydrogen Cyanide	5 ppm	2 ppm
Acrylonitrile	4 ppm	5 ppm
Benzene	1 ppm	5 ppm
Styrene	100 ppm	50 ppm
Formaldehyde	1 ppm	0.5 ppm
Carbon Monoxide	35 ppm	5 ppm
Phenol	5 ppm	5 ppm
Nitrogen Dioxide	1 ppm	5 ppm
Vinyl Chloride	1 ppm	1 ppm
Ammonia	50 ppm	5 ppm
Triethylamine	25 ppm	5 ppm
Hydrogen Chloride	5 ppm	1 ppm
Toluene	100 ppm	25 ppm

Table II

SUMMARY OF AIR SAMPLING FOR ACROLEIN

PACKARD ELECTRIC
WARREN, OHIO

11/15/77

Location	Sample Type	Sample Period	Type of Plastic	Press Temperature	Concentration (ppm)[1]
Dept. 1232 - Press 30	A[2]	0935 - 1030	PVC	340°F	<0.01
	A	1032 - 1129			<0.01
	A	1129 - 1244			<0.01
	A	1302 - 1402			<0.01
	A	1423 - 1520			<0.01
Dept. 1232 - Press 17	A	0925 - 1026	PVC	340°F	<0.01
	A	1028 - 1128			<0.01
	A	1128 - 1240			<0.01
	A	1304 - 1400			<0.01
	A	1420 - 1520			<0.01
Dept. 1215 - On saw table between extruders 10 and 11	(A)[3]	1006 - 1110	Polyethylene	350-400°F	<0.01
		1110 - 1322			<0.01
		1325 - 1427			<0.01
		1625 - 1732			<0.02*
		1732 - 1840			<0.01
		2115 - 2222			<0.02*
Dept. 1215 - Near front of extruder 14	(A)	1008 - 1112	Polyethylene	350-400°F	0.01*
	(A)	1112 - 1257			<0.01
	(A)	1313 - 1428			0.02*
Dept. 1215 - On table between extruders 12 and 13	(A)	1627 - 1735	Polyethylene	350-400°F	<0.01
	(A)	1735 - 1840			<0.01
Dept. 1215 - In smoke plume at exit port on extruder 14	SP[4]	2120 - 2149	Polyethylene	350-400°F	0.03*

1. Evaluation Criteria - 0.1 parts of acrolein per million parts of air by volume (0.1 ppm).
2. A - Area sample collected at a distance of .5 to 1.5 feet from worker's breathing zone.
3. (A) - General area sample.
4. SP - Sample collected in smoke plume.

* Sample was turbid with no visible color change present. The absorbance measured may have been due to suspended particulate.

Sampling media composed of 4-hexylresorcinol in an ethyl alcohol-trichloracetic acid solvent solution.

Table III

SUMMARY OF AIR SAMPLING FOR HYDROGEN CHLORIDE
PACKARD ELECTRIC
WARREN OHIO

Date	Location	Sample Type	Sample Period	Type of Plastic	Press Temperature(^{O}F)	Concentration(mg/M^3)*
11/15/77	Dept. 1232-Press 24	A	0920-1236	PVC	370	N.D.
			1236-1515			N.D.
	Dept. 1232-Press 15	A	0830-1230	PVC	360	N.D.
			1230-1515			N.D.
	Dept. 1232-Press 15	A	1725-2114	PVC	360	N.D.
			2114-2314			N.D.
11/16/77	Dept. 1232-Press 39	P	0815-0831	PVC	340	N.D.
		P	1040-1055			N.D.
		P	1140-1155			N.D.

A - Area sample (positioned within 1-2 feet of employees breathing zone)
P - Personal sample collected in breathing zone of employee
N.D. - (None Detected) The lower limit of detection for hydrogen chloride is 0.04 mg per sample. The sampling volumes ranged from 14 to 225 liters.

*Evaluation Criteria - 7 milligrams of hydrogen chloride per cubic meter of air (7 mg/M^3).

Samples collected in 0.5M sodium acetate solution.

Table IV

SUMMARY OF AIR SAMPLING FOR METALS AND TOTAL PARTICULATE*

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Period	Type of Plastic	Press Temperature(^{o}F)	Concentration (mg/M^3)**			
					Copper	Lead	Zinc	Total Particulate
11/15/77	Dept. 1215-Grinder	0834-1517	Polyethylene		<0.01	<0.01	<0.01	0.43
	Dept. 1215-Grinder	0837-1534	Polyethylene		<0.01	<0.01	<0.01	0.79
	Dept. 1215-Extruder 17	0857-1530	Polyethylene	350-400	<0.01	<0.01	<0.01	0.09
	Dept. 1232 Press 3	0813-1515	ABS	450	<0.01	<0.01	<0.01	0.10
	Dept. 1232-Press 44	0901-1515	PVC	350	<0.01	<0.01	<0.01	0.12
	Dept. 1215-Grinder	1637-2312	Polyethylene		<0.01	<0.01	<0.01	0.14
11/16/77	Dept. 1215-Extruders 10 and 11	0800-1505	Polyethylene	350-400	≤0.01	<0.01	<0.01	0.09

*Sampling media worn by employee

** Evaluation Criteria: Copper Dust - 1 milligram of contaminant per cubic meter of air (1 mg/M^3).
Lead - 0.1 mg/M^3
Zinc Oxide Fume - 5 mg/M^3
Total Particulate - 10 mg/M^3

Samples collected on DM-800 filters.

Table V

SUMMARY OF AIR SAMPLING FOR VINYL CHLORIDE*

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Period	Type of Plastic	Press Temperature(°F)	Concentration of Vinyl Chloride(ppm)**
11/15/77	Dept. 1232-Press 36	0905-1515	PVC	350	< 0.001
	Dept. 1232-Press 26	0840-1515	PVC	340	< 0.001
	Dept. 1232-Press 14	0828-1515	PVC	360	< 0.001
	Dept. 1232-Press 38	1643-2315	PVC	340	< 0.001
11/16/77	Dept. 1232-Press 30	0807-1513	PVC	360	< 0.001
	Dept. 1232-Mold Setter	0858-1135***	PVC		< 0.001

*Sampling media worn by employee.
**Evaluation Criteria: 1 part of vinyl chloride per million parts of air by volume (1.0ppm).
***Sample terminated at 1135 due to employee leaving work.

Samples collected on activated charcoal.

Table VI

SUMMARY OF AIR SAMPLING FOR ACRYLONITRILE, BENZENE, BUTADIENE, AND STYRENE

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Type	Sample Period	Type of Plastic	Press Temperature(°F)	Concentration ppm*			
						Acrylonitrile	Benzene	Butadiene	Styrene
11/15/77	Dept. 1232-Press 2	P**	0810-1515	ABS	450	N.D.***			
	Dept. 1219-Serviceman	P	0810-1505	Polyethylene			N.D.	N.D.	
	Dept. 1219-Serviceman	P	0815-1515	Polyethylene			N.D.	0.02	
	Dept. 1219-Extruders 6 to 10	P	0820-1507	Polyethylene	350-400		N.D.	N.D.	
	Dept. 1219-Extruders 18 to 23	P	0825-1511	Nylon(Extruders 19,20,22) Polyethylene(Extruders 18,21,23)	480 350-400		N.D.	N.D.	
	Dept. 1215-Service Asst.	P	0830-1520	Polyethylene			N.D.	0.04	
	Dept. 1215-Extruders 12 & 13	P	0850-1527	Polyethylene	350-400		N.D.	0.02	
	Dept. 1215-Service(grinding)	P	0830-1518	Polyethylene			N.D.	0.02	
	Dept. 1232-Press 15	P	0835-1515	PVC	360		N.D.		
	Dept. 1232-Press 24	P	0853-1515	PVC	370		N.D.		
	Dept. 1232-Press 34	P	0908-1515	PVC	345		N.D.		
	Dept. 1232-Press 1	P	0810-1515	ABS	440		N.D.	0.89	N.D.
	Dept. 1219-Extruders 11,14, 15, 17	P	1630-2305	Polyethylene Polypropylene(Extruder 14)	350-400 450		N.D.	0.05	
	Dept. 1215-Extruder 15	P	1642-2309	Polyethylene	350-400		N.D.	N.D.	
	Dept. 1215-Extruders 12 & 13	P	1645-2306	Polyethylene	350-400		N.D.	N.D.	
	Dept. 1219-Serviceman for Extruders 1 to 10	P	1620-2300	Polyethylene			N.D.	N.D.	
	Dept. 1232-Press 1	P	1616-2308	ABS	440	N.D.			
	Dept. 1219-Operator's desk between Extruders 19 and 20	A****	1606-2304	Nylon	480		N.D.		
	Dept. 1232-Press 2	P	1620-2312	ABS	450		N.D.	0.22	N.D.
	Dept. 1232-Press 9	P	1650-2315	PVC	350		N.D.	N.D.	N.D.
	Dept. 1232-Press 22	P	1633-2312	PVC	350		N.D.	0.23	N.D.

Table VI (continued)

Date	Location	Sample Type	Sample Period	Type of Plastic	Press Temperature (°F)	Concentration ppm*			
						Acrylonitrile	Benzene	Butadiene	Styrene
11/16/77	Dept. 1215-Serviceman	P	0805-1506	Polyethylene			N.D.	N.D.	
	Dept. 1215-Extruder 17	P	0812-1508	Polyethylene	350-400		N.D.	N.D.	
	Dept. 1219-Extruders 19,20 & 22	P	0822-1513	Nylon	480		N.D.	N.D.	
	Dept. 1219-Extruder 14	P	0930-1035*****	Polypropylene	450		N.D.	N.D.	
	Dept. 1232-Press 3	P	0811-1508	ABS	445		N.D.	N.D.	N.D.
	Dept. 1232-Press 6	P	0800-1510	PVC	300		N.D.	N.D.	N.D.
	Dept. 1232-Service	P	0901-1455	PVC/ABS			N.D.	0.24	N.D.

*ppm - parts per million.

** P - Personal sample collected in breathing zone of employee. Personnel monitored included press/extruder operators and servicemen.

***N.D. - (None detected) The lower limits of detection for the various substances were as follows: (1) Acrylonitrile, 0.001 mg per sample; (2) benzene 0.01 mg per sample; (3) Butadiene, 0.01 mg per sample; and (4) Styrene, 0.01 mg per sample. The sample volumes ranged from 13.2 to 543 liters.

****A - Area Sample.

*****Sampling period included a clean out process of Extruder 14 by the operator.

Evaluation Criteria:

1.	Acrylonitrile	4 ppm
2.	Benzene	1 ppm
3.	Butadiene	1000 ppm
4.	Styrene	100 ppm

Samples collected on activated charcoal.

Table VII

SUMMARY OF AIR SAMPLING FOR DIBUTYL PHTHALATE,
DIOCTYL PHTHALATE, AND DITERT-BUTYL-P-CRESOL(BHT)

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Type	Sample Period	Type of Plastic	Press Temperature(^{o}F)	Concentration (mg/M^3)* Dibutyl Phthalate	Dioctyl Phthalate	BHT
11/15/77	Dept. 1232-Press 1	P**	0805-1515	ABS	440	N.D.***	N.D.	N.D.
	Dept. 1232-Press 10	P	0817-1515	PVC	350	N.D.	N.D.	N.D.
	Dept. 1232-Press 28	P	0842-1515	PVC	340	N.D.	N.D.	N.D.
	Dept. 1232-Press 44	P	0903-1515	PVC	350	N.D.	N.D.	N.D.
	Dept. 1219-Serviceman	P	0815-1515	Polyethylene		N.D.	N.D.	N.D.
	Dept. 1219-Extruders 6-10	P	0820-1507	Polyethylene	350-400	N.D.	N.D.	N.D.
	Dept. 1219-Serviceman	P	0810-1505	Polyethylene		N.D.	N.D.	N.D.
	Dept. 1219-Extruders 18 to 23	P	0825-1511	Polyethylene (Extruders 18,21,23)	350-400	N.D.	N.D.	N.D.
				Nylon (Extruders 19,20,22)	480			
	Dept. 1215-Service Asst.	P	0830-1520	Polyethylene		N.D.	N.D.	N.D.
	Dept. 1215-Service(Grinding)	P	0835-1521	Polyethylene		N.D.	N.D.	N.D.
	Dept. 1215-Extruder 15	P	1642-2309	Polyethylene	350-400	N.D.	N.D.	N.D.
	Dept. 1215-Extruders 12 and 13	P	1645-2306	Polyethylene	350-400	N.D.	N.D.	N.D.
	Dept. 1219-Serviceman for Extruders 1 to 10	P	1621-2300	Polyethylene		N.D.	N.D.	N.D.
	Dept. 1219-Extruders 1 to 5	P	1636-2307	Polyethylene	350-400	N.D.	N.D.	N.D.
	Dept. 1232-Press 3	P	1625-2309	ABS	450	N.D.	N.D.	N.D.
	Dept. 1232-Press 12	P	1658-2307	PVC	350	N.D.	N.D.	N.D.
	Dept. 1232-Press 37	P	1640-2314	PVC	350	N.D.	N.D.	N.D.

Table VII (continued)

Date	Location	Sample Type	Sample Period	Type of Plastic	Press Temperature(°F)	Concentration(mg/M³)* Dibutyl Phthalate	Dioctyl Phthalate	BHT
11/16/77	Dept. 1232-General Service	P	0901-1455			N.D.	N.D.	N.D.
	Dept. 1232-Press 39	P	0803-1515	PVC	340	N.D.	N.D.	N.D.
	Dept. 1215-Extruder 17	P	0814-1508	Polyethylene	350-400	N.D.	N.D.	N.D.
	Dept. 1219-Extruder 19,20, and 22	P	0820-1513	Nylon	480	N.D.	N.D.	N.D.

*mg/M^3 - Milligrams of substance per cubic meter of air.

**P - Personal sample collected in breathing zone of employee.

***N.D. - (None-detected) The lower limits of detection per sample for the substances were as follows:(1) Dibutyl Phthalate. 0.05 mg; (2) Dioctyl phthalate, 0.02 mg; and (3) BHT, 0.01 mg. The sample volumes ranged from 13.4 to 216 liters.

Evaluation Criteria:

Dibutyl phthalate	- 5 mg/M^3
Dioctyl phthalate	- 5 mg/M^3
BHT	- 10 mg/M^3

Samples collected on fluorisil tubes.

Table VIII

SUMMARY OF AIR SAMPLING FOR FORMALDEHYDE, ACETALDEHYDE, PROPIONALDEHYDE, BUTYRALDEHYDE, AND VALERALDEHYDE

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Sample Type	Sample Period	Type of Plastic	Press Temperature(^{o}F)	Concentration (ppm)* Formaldehyde	Acetaldehyde	Propionaldehyde	Butyraldehyde	Valeraldehyde
11/15/77	Dept. 1215-Operator's desk between Extruders 10 & 11	A**	0913-1321	Polyethylene	350-400	0.01	0.2	N.D.***	N.D.	N.D.
			1350-1535			0.02	1.4	N.D.	N.D.	N.D.
	Dept. 1215-By Extruder 14	A	0915-1318	Polyethylene	350-400	0.02	3.4	N.D.	N.D.	N.D.
			1352-1532			0.03	6.0	N.D.	N.D.	N.D.

*ppm - Parts per million.
**A - Area sample.
***N.D.- (None detected) The lower limits of detection for propionaldehyde, butyraldehyde, and valeraldehyde are 0.01 mg per sample.

Evaluation Criteria:
Formaldehyde - 1 ppm
Acetaldehyde - 100 ppm
Valeraldehyde - 50 ppm
Exposure limits have not been established for propionaldehyde or butyraldehyde.

Samples collected in sodium bisulfite solution.

Table IX

SUMMARY OF QUALITATIVE AND QUANTITATIVE ANALYSES FOR
ALPHATIC AND AROMATIC AMINES

PACKARD ELECTRIC
WARREN, OHIO

Date	Location	Type of Sample	Sample Period	Type of Plastic	Press Temperature(°F)	Concentration (mg/sample) Aromatic Amines	Aliphatic Amines	
11/15/78	Dept. 1215-Extruders 12 & 13	P	0850-1527	Polyethylene	350-400	N.D.*		
	Dept. 1219-Extruders 11,14,15, and 17	P	1632-2305	Polyethylene Polypropylene (Extruder 14)	350-400 450	N.D.		
	Dept. 1219-Operators's desk between Extruders 19 and 20	A	1606-2304	Nylon			0.14** (trimethylamine)	0.19** (propylamine)
11/16/78	Dept. 1219-Operator's desk between Extruders 19 and 20	A	0750-1512	Nylon			0.09** (trimethylamine)	0.09** (propylamine)

*N.D. (None Detected)
**Sample displayed 1 or 2 peaks not detected in the blank. Positive identification was attempted by GC/MS, however the concentrations were too low to qualitate. Unknown peaks were found to have the same GC retention time as trimethyl and propyl amines when compared to known solutions prepared in our laboratory. Approximate concentrations are provided in the table, assuming the peaks to be trimethyl or propyl amine. (Values should be taken as minimum amounts since breakthrough on the sampling media may have occurred).

NOTE: Sample volumes ranged from 25 to 442 liters.
Exposure limits have not been established for trimethylamine or propylamine.

Samples collected on silica gel.

Table V

SUMMARY OF QUALITATIVE AND QUANTITATIVE ANALYSES FOR ORGANICS(HYDROCARBONS)

PACKARD ELECTRIC
WARREN, OHIO

Date	Sample Number	Location	Type of Sample	Sample Period	Type of Plastic	Press Temperature(^{o}F)	Concentration (mg/sample) Benzene	Total Aromatics	Total Alphatics
11/15/78	195	Dept. 1215-Extruder 14	SP	1902-2040	Polyethylene	350-400	N.D.*	N.D.	4.05**
	149			2045-2140			N.D.	N.D.	2.37**
11/16/78	44	Dept. 1215-Operator's desk between Extruders 12 and 13	A	0756-1510	Polyethylene		N.D.	N.D.	0.60**

*N.D.(None detected) No indication of benzene or any other aromatics were observed.
**Displayed gas chromatograph patterns similar to those observed for mineral spirits or kerosene. Analysis of sample 195 by GS/MS identified the peaks as aliphatic hydrocarbons (alkanes, alkenes, or cycloalkanes) in the C_8-C_{18} range. Major peaks were $C_{10}H_{22}$ to $C_{12}H_{26}$ alkanes.

SP - Sample collected in smoke plume of extruder
A - Area sample
Exposure Criteria: 1 part of benzene per million parts of air by volume (1 ppm).
NOTE: Sample volumes ranged from 55 to 434 liters

Samples collected on activated charcoal.

Table XI

RESULTS OF THERMOGRAVIMETRIC ANALYSES CONDUCTED
ON VARIOUS PLASTICS USED IN DEPARTMENTS 1215, 1219, AND 1232

PACKARD ELECTRIC
WARREN, OHIO

Identification Number	Type of Plastic	Temp. Range(^{o}C)	Percent Weight Loss*
R-64798	PVC-Virgin	260^{o} - 360^{o}	72%
		360^{o} - 410^{o}	3%
		410^{o} - 480^{o}	6%
		480^{o} - 660^{o}	11%
		660^{o} - 760^{o}	3%
R-68284	PVC-Regrind of R-64798	260^{o} - 360^{o}	71%
		360^{o} - 410^{o}	2%
		410^{o} - 470^{o}	7%
		470^{o} - 650^{o}	11%
		650^{o} - 770^{o}	3%
R-64797	PVC-Virgin	250^{o} - 370^{o}	68%
		370^{o} - 405^{o}	1%
		405^{o} - 490^{o}	8%
		490^{o} - 660^{o}	10%
		660^{o} - 720^{o}	1%
		720^{o} - 790^{o}	3%
R-61385	PVC-Regrind of R-64797	240^{o} - 360^{o}	67%
		360^{o} - 410^{o}	2%
		410^{o} - 490^{o}	8%
		490^{o} - 640^{o}	8%
		640^{o} - 730^{o}	1%
		730^{o} - 800^{o}	3%
R-67663	ABS-Regrind	230^{o} - 490^{o}	90%
		490^{o} - 525^{o}	1%
		525^{o} - 715^{o}	9%
R-67550	Polypropylene-Regrind	260^{o} - 425^{o}	100%
M-665-002	PVC	260^{o} - 340^{o}	74%
		340^{o} - 410^{o}	2%
		410^{o} - 470^{o}	7%
		470^{o} - 505^{o}	1%
		505^{o} - 700^{o}	16%

Table XI(continued)

Identification Number	Type of Plastic	Temp. Range(^{o}C)	Percent Weight Loss*
R-67549	PVC-Regrind of M665-002	250^{o} - 360^{o}	59%
		360^{o} - 410^{o}	3%
		410^{o} - 670^{o}	21%
		670^{o} - 760^{o}	2%
R-67568	PVC-Regrind	270^{o} - 340^{o}	68%
		340^{o} - 410^{o}	3%
		410^{o} - 460^{o}	8%
		460^{o} - 705^{o}	18%
M-2088-001	PVC	270^{o} - 360^{o}	53%
		360^{o} - 400^{o}	2%
		400^{o} - 465^{o}	11%
		465^{o} - 640^{o}	11%
		640^{o} - 810^{o}	5%

*Prior to 230^{o}C, no samples showed any weight loss.

NOTE: Analysis of plastic 1C08009 (purging compound) revealed the major constituent to be methyl methacrylate.

Table XII

JOB RELATED MEDICAL PROBLEMS AS OBTAINED BY EMPLOYEE INTERVIEWS

Packard Electric
Warren, Ohio

Case Number	Complaints	Source of Problem Cited
1	None	
2	Allergy-Eczema	Not stated
3	Throat irritation	Not stated
4	None	
5	None	
6	None	
7	None	
8	Rashes and cough	Rash from fiberglass tubes
9	None	
10	None	
11	None	
12	None	
13	Headache and nausea	Purging with acrylic
14	None	
15	None	
16	Dry throat	Not stated
17	None	
18	None	
19	None	
20	Cough	Molding
21	None	
22	Itching eyes, nausea, running nose	Window Lift Area and Molding
23	None	
24	None	
25	None	
26	None	
27	None	
28	None	
29	None	
30	Muscle strain and tendonitis	Pushing and pulling on wires
31	None	
32	Muscle aches	Pushing and pulling on wires
33	Eye irritation and light headedness on hot days	Fumes from weld presses
34	None	
35	None	
36	Nausea and eye irritation	Purging
37	Occasional headaches, eye & throat irritation	Molding area
38	None	
39	None	
40	Itching about nasal area and sneezing	Not stated