U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 74-129-268

GENERAL ELECTRIC COMPANY
WAYNESBORO, VIRGINIA

MARCH 1976

I. TOXICITY DETERMINATION

Exposures of Belt Room employees to airborne vapors of methylene dianiline, methylene bis (4-cyclohexyl isocyanate), methylene chloride, and 1, 1, 1 - trichloroethane are not believed to be toxic at the concentrations observed on May 7, 1975. Exposures of Plating Room employees to airborne concentrations of nitric acid, cyanides, hydrochloric acid, sodium hydroxide, nickel, chromium, and trichloroethylene are not believed to be toxic at levels observed on May 7, 1975. Since chemical concentrations in the air were not found to be excessive, it appears that the occasional cases of dermatitis among Plating Room employees may be due to direct skin contact with the chemicals. It has been determined that exposures of employees in the Machine Shop, Shipping Department, Paint Line, Relays Department, and Termi-Net Department to airborne chemicals were not found to be toxic under the conditions observed during the NIOSH survey of May 7 and 8, 1975. These determinations are based upon measurements of workplace concentrations of airborne chemicals, physical inspection of process operations and control measures, and private interviews with exposed employees.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

A. General Electric Company, Waynesboro, Virginia

B. Authorized Representative of Employees

C. U.S. Department of Labor - Region III

D. NIOSH Regional Program Consultant - Region III

For purposes of informing the approximately 200 "affected employees", the employer will promptly "post" the Determination Report in prominent places near where exposed employees work for a period of 30 calendar days.

II. 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.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposure of employees to a large array of chemical substances in the Plating Room, Belt Room, Machine Shop (MD-1), Relays Department, Shipping Department, Paint Line, and TermiNet (or DCP) Manufacturing Department at the General Electric plant in Waynesboro, Virginia.

IV. HEALTH HAZARD EVALUATION

A. Plant Operations

The principal products manufactured at this site are high reliability relays and data processing and control equipment. The machine shop fabricates small metal and plastic parts. Metal parts are cleaned, treated, plated, and washed in the Plating Room. Polyurethane plastic belts are molded and cured in the Belt Room. And larger parts are spray painted on the Paint Line. Finally, the pieces are assembled in the DCP Department.

The assembly of relays requires a number of operations, including cleaning and soldering.

B. Evaluation Methods

1. Measurement of Air Contaminants

Employee exposures to organic degreasing solvents and to certain organic vapors were measured using personal air sampling equipment. The vapor concentrations were determined by drawing air through small glass tubes containing activated charcoal which adsorbed the organic vapors. The amount of collected material was then analyzed by the gas chromatographic method of White et al.[1]

Certain of the aerosols, such as oil mist, chromium, nickel, zinc chloride, and lead were collected by drawing air through small membrane filters worn by employees or placed in the general area of certain machines or operations. The collected aerosols were later analyzed in a NIOSH laboratory to determine the quantity of the various contaminants which were collected.

Some of the dusts, such as metal dusts from machining operations in the machine shop, were measured by means of a GCA Corporation Respirable Dust Monitor Model 101, a direct-reading instrument utilizing a beta ray absorption technique.

Some of the gas and vapor contaminants require a liquid collection system. Substances such as vapors of methylene dianiline, methylene bis (4-cyclohexyl isocyanate), formaldehyde, and methyl-2 cyanoacrylate were collected by drawing air through standard midget impingers containing appropriate liquid collection media. The amounts of contaminants collected were later determined by chemical analytical techniques in NIOSH laboratories. Certain of the acid and alkali mists in the Plating Room were measured by this same technique.

2. Physical Inspection of the Workplace

During the plant visit the NIOSH investigators observed the methods which the company was using to protect employees such as local exhaust ventilation, process isolation or enclosure, substitution of less toxic materials in place of other materials, work practices, and personal protective equipment such as gloves, respirators, and safety glasses. Measurements were also made to evaluate the effectiveness of ventilation systems which were in use.

3. Private Employee Interviews

During the initial survey of February 25-27, 1975, day shift employees in all areas under evaluation and evening shift employees in the Plating Room, Belt Room, and Paint Line areas were questioned privately by NIOSH industrial hygienists to find out if the employees felt that they might have health problems related to their work. During the follow-up visit of May 6-8, 1975, any employee wearing personal samplers and those employees working at machines or processes where area samples were taken, were given a short questionnaire at the beginning and at the end of the work shift to evaluate what symptoms might have developed during the shift as a result of exposure to toxic substances.

C. Evaluation Criteria

Environmental standards intended to protect the health of workers have been recommended by several sources. These standards are established at levels designed to protect workers occupationally exposed to a substance on an 8-hour per day, 40-hour per week basis over a normal working lifetime. For this study the evaluation criteria were selected from two sources:

(1) ACGIH: The American Conference of Governmental Industrial Hygienists publishes an annual list of guidelines for over 400 toxic substances. These guidelines are listed in a publication of Threshold Limit Values (TLV), which are actually established hygienic airborne exposure levels. The values for 1974 were used.

(2) NIOSH: The National Institute for Occupational Safety and Health has recommended airborne exposure standards for about a score of toxic substances in thoroughly documented publications known as criteria documents.

For this study an attempt was made to select the criteria which are based on the most current state of knowledge concerning the toxicology of the substances under investigation. The substances sampled and the evaluation criteria and source are given below:

Source	Substance	8-Hour Time - Weighted Average Air Level
NIOSH	Chromium	0.05 mg/m^3 [a] as CrO_3
ACGIH	Cyanide	5 mg/m^3
ACGIH	Ethyl Acetate	400 ppm [b]
ACGIH	Ethyl Alcohol	1,000 ppm
ACGIH	Hydrochloric Acid	7 mg/m^3
ACGIH	Isopropyl Alcohol	400 ppm
NIOSH	Lead	0.15 mg/m^3
ACGIH	Methyl-2 Cyanoacrylate	2 ppm
ACGIH	Methylene bis (4-cyclohexyl isocyanate)	0.01 ppm
ACGIH	Methylene Chloride	100 ppm
NONE	Methylene Dianiline	--
ACGIH	Nickel	0.1 mg/m^3
ACGIH	Nitric Acid	5 mg/m^5
ACGIH	Oil Mist	5 mg/m^5

ACGIH	Rosin Core solder (formaldehyde)	0.1 mg/m^3
ACGIH	Sodium Hydroxide	2 mg/m^3
ACGIH	1, 1, 1 - trichloroethane	350 ppm
ACGIH	Trichloroethylene	100 ppm
ACGIH	VM & P Naphtha	200 ppm
ACGIH	Zinc Chloride	1 mg/m^3

a. mg/m^3 = approximate milligrams of particulate per cubic meter of air.

b. ppm = parts of gas or vapor per million parts of contaminated air by volume.

D. Evaluation Results and Discussion by Area

1. Belt Room

The fabrication of plastic belts involves the preparation of special molds, the mixing of the plastic formulation, and curing the plastic in the molds to form belts. The formulation of the plastic requires the mixing of a liquid polyurethane resin containing free methylene bis (4-cyclohexyl isocyanate) with a heated liquid catalyst, methylene dianiline.

The storage, heating, and mixing of the chemicals are performed in closed, highly automated systems. Two Chlorinated hydrocarbon solvents, methylene chloride and 1, 1, 1 - trichloroethane, are used for cleaning and degreasing.

On the initial plant visit of February 1975 the NIOSH industrial hygienists noticed that conditions and work practices involving the use of toxic chemicals in this area were not consistent with good industrial hygiene practices. Uncovered containers of urethane resin (containing free isocyanate) and of pure methylene dianiline were left in the area, exposing employees to vapors of these materials throughout the workday. No local exhaust ventilation was provided at the pouring and curing locations. O p e n containers of waste chemicals were discarded in wastepaper baskets exposing janitorial workers to skin contact with these materials. Recommendations were made to company management representatives at the closing conference for immediate corrections of work practices and for consideration of additional engineering controls to prevent escape of toxic vapors into the workroom air.

On the second NIOSH visit in May 1975, many improvements had been made. Containers of unreacted chemicals were kept enclosed, and sealed vessels were used for waste disposal. Local exhaust ventilation was also being installed at the pouring and curing stations. Air samples were collected; the results are given in Table 1, including air levels measured and limits of detection. No methylene dianiline or isocyanate could be detected in the air; methylene chloride and trichloroethane levels were found to be well within safe limits. This seems to indicate that environmental control measures now being used in the area are effective in controlling air contamination. However, the employees must be frequently warned of the hazards posed by these materials and educated in the necessity to use personal protective clothing and exercise good personal hygiene to minimize skin contact with toxic chemicals.

The toxicologic information concerning methylene dianiline (Curing Agent LD-2729) and methylene bis (4-cyclohexyl isocyanate) (an ingredient of Adiprene LW-510) is rather limited and is mostly provided by the DuPont Company which also manufactures and sells these materials. Both chronic exposures and acute high exposures to methylene dianiline have been found to cause liver and kidney damage in experimental animals. The DuPont Company also estimates that the substance might possess a very weak carcinogenic potential. The isocyanate is a strong skin sensitizer and is known to cause severe irritation to skin, mucous membranes, and eyes. All contact with skin and eyes, and inhalation of vapors, should be avoided.[2] Methylene chloride and 1, 1, 1 - trichloroethane produce the usual effects of chlorinated hydrocarbons, the most obvious of which is the temporary narcotic effect.

In private confidential interviews with the employees, some of the workers reported that they had occasionally in the past experienced headaches and light-headedness when working with the cleaning solvents. Also, between 40 and 50% of the employees interviewed had experienced kidney or urinary tract disorders. Union leaders suspected that these disorders might be work related.

These urinary complaints merited further investigation by NIOSH. Of the ten Belt Room employees interviewed, three were male and seven were female. None of the males had urinary complaints. Five of the seven females had urinary complaints. The private doctors of the five workers with complaints were contacted by a NIOSH physician to confirm their problems. The conclusions of the NIOSH physician were as follows: "In summary, although a higher than expected

number of alleged urinary problems were found in the Belt Room, on critical evaluation they do not seem to be job related. It is also of note that women are considerably more prone to urinary tract infections than are men. Thus an increase in numbers of urinary tract infections, if confined only to the female workers when male workers are also exposed, suggest sex differences rather than occupational causes."

2. Plating Room

The Plating Room contains approximately 80 to 100 small dip tanks and has been in use for 21 years. The tanks contain a large variety of chemicals including nickel solutions, cyanide solutions, sodium hydroxide, hexavalent chromium, phosphoric acid, nitric acid, hydrofluoric acid, hydrochloric acid, cadmium, sulfuric acid, and tin for cleaning, treating, or plating metal parts. Due to the close proximity of the various tanks, any given employee is exposed to a variety of substances. Approximately 45 persons were employed in this area at the time of the February 1975 NIOSH visit; 34 of these employees were interviewed. Four persons reported dermatitis or occasional rashes. Other reported symptoms included occasional nausea, eye irritation, headaches, tightness in chest, and shortness of breath.

Due to the large variety of chemicals to which any given employee is exposed, personal sampling for specific chemical exposures was not considered practical or very useful. Rather, area samples were collected directly above or beside the various dip tanks to measure the highest concentrations in the room and to assess the effectiveness of the local exhaust ventilation systems. The sampling results are shown in Table 2 as well as the environmental criteria used by NIOSH to assess the degree of hazard. These results show that the workroom air contaminant levels are effectively controlled and that inhalation of toxic chemicals does not appear to pose a health hazard to workers in the Plating Room. One exception was a cyanide strip tank which was pointed out to the plant's Safety Director by the NIOSH project officer. The cyanide level above the tank approached the standard. Several employees and two NIOSH industrial hygienists experienced a feeling of nausea when standing near the tank.

A review of the plant's medical records confirmed a history of dermatitis among a minority of the workers in the Plating Room. Usually, employees having chronic skin problems were transferred to other areas of the plant where they would not have further exposure to the problem-causing chemicals. Interviews with current employees revealed that there were still a few persons employed in the Plating Room who had skin problems at the time of the initial NIOSH visit.

Although all the metal finish operators are required to wear long rubber gloves and safety glasses, there is still some potential for skin contact due to the many open tanks in the room, the presence of chemicals on work surfaces, and the emissions of chemicals from the tanks into the workroom air. The problem with dermatitis is likely to persist in the Plating Room as long as the plant continues to use the type of equipment and level of technology now present in this area because:

(a) As long as there are many open tanks containing toxic chemicals and many employees working with and in close proximity to the chemicals, occasional skin contact is bound to occur.

(b) Some individuals are more susceptible than others to the acids, alkalies, and metals and are likely to develop allergic reactions even when exposed to air levels which are less than those allowed by standards.

To control these problems, the company is encouraged to pursue both of the following recommendations:

(i) Continue to transfer persons having skin problems out of the Plating Room to other plant areas where they will not be exposed to the troublesome chemicals, but without reduction in pay.

(ii) For those types of solutions which have been in use for years, consider the possibility of increasing automation of dipping and rinsing to attempt to remove the employees from exposure or reduce the intimacy of contact between the chemicals and the workers.

3. Paint Line

The Paint Line area contains two spray-painting booths having a ventilation system consisting of a horizontal slot with water curtain at the rear of the booths. The northside paint booth is quite large (about 20 x 20 feet) and is used for spray-painting large objects such as cabinets. Air velocity measurements by NIOSH personnel at the booth revealed several dead spots (areas inside the booth where the air velocity is zero) although the air velocity along the face of the booth was about 100 feet per minute.

The second booth is actually on the paint line. Objects to be painted are suspended on hooks from an overhead conveyor and are painted by the operator as they pass through the booth.

During the May 1975 NIOSH visit, air samples for paint thinners and vapors were collected in this area. Results are shown in Table 3 and represent time-weighted average levels rather than short-term peak exposures. The aromatic content of these samples was very low and was not quantitated. Most of the vapors appear to be aliphatic thinner mixtures resembling VM and P naphtha, and were quantitated as such. The measured time-weighted

averages were less than allowable limits and appeared to be adequately controlled. One of the samples collected from the painter at the northside booth approached the recommended standard and may be indicative of the poor ventilation characteristics within the booth.

Several of the employees told the NIOSH investigators about occasional symptoms of dizziness and light-headedness when painting, mixing paint, and cleaning equipment and vessels using acetone. Utility operators and paint mixers showed evidence of excessive skin dryness due to the contact with the thinners and cleaners. They frequently do not use protective gloves when working with thinners and cleaners because of the inconvenience of wearing gloves and because the gloves are not sufficiently protective since they cover only the hands and lower part of the arms. At the time of the February 1975 survey, mixing and cleaning were performed in areas without local exhaust ventilation.

Several recommendations are in order for this area:

(a) Gloves which are impervious to organic solvents and which are sufficiently long to cover any part of the hand or arm which is likely to contact defatting organic liquids should be absolutely required during paint mixing operations, spraying, and cleaning of painting materials.

(b) Paint mixing and cleaning of painting materials should be performed only in areas with very good ventilation and sufficient local air velocities, preferably inside ventilated booths.

(c) The plant management should attempt to identify portions of the paint booths where air flow characteristics are poor and make appropriate corrections.

4. Machine Shop (MO-1)

A variety of operations are performed in the machine shop, including punch pressing, spot welding, sanding, drilling and reaming, degreasing, spray painting, and plastic compression molding. Chemical exposures consist of the usual metals - iron, chromium, cadmium, zinc, nickel, tin, aluminum, and copper, paints and thinners, trichloroethane degreaser, cutting oils and lubricants, chromic acid, and a variety of plastic resins.

Airborne particulates were measured throughout the area, including the breathing zones of workers at sanders and grinders, plastic compression molding, drill presses, and drills. Some of the measurements were made by means of a GCA Corporation Respirable Dust Monitor Model 101, a direct-reading instrument utilizing a beta ray absorption technique. With a one-minute sampling cycle, respirable dust levels were too low to distinguish from background clean air levels. Total dust measurements ranged from 0.0 to 0.5 mg/m^3 ($\pm$ 0.5 mg/m^3). In addition some samples were collected for specific chemicals. These results are shown in Table 4.

Airborne levels of chemical contaminants were found to be considerably lower than maximum allowable limits. No apparent health hazards due to chemical exposures were found in the machine shop.

5. Shipping

The only employee complaint in this area was a nuisance dust caused by handling of polystyrene beads as packing materials. The handling of this material on the upper level causes dust to fall down on employees working on the lower level. However, the particle size appeared large and dust concentrations very low. Several female employees on the lower level claimed that the plastic dust fell on their heads, got into their hair, and caused a nuisance. However, informal interviews with several of the employees did not reveal any irritative symptoms such as skin rash or eye irritation. The dust was judged not to be a health hazard. The nuisance could probably be considerably reduced by using a vacuum cleaning system on the upper level to collect the loose particles of plastic.

6. Relays

The Relays Department is responsible for the production of relays and switches. A large degreaser employing a freon cleaner is used to clean parts prior to welding. The operator reported that she had no health problems and that operation is well ventilated.

One item of concern to the employee representatives was the use of argon gas in the area. There is a heat treating process which operates 12-15 times per month for 1 or 2 hours per time. It uses a continuous flow of argon from a cylinder to provide an inert atmosphere for a gold plating process. Argon is a simple asphyxiant and has no known toxic properties. There is no reason to believe that the use of argon poses a health hazard.

Another area of concern to employee representatives was the use of toluene by an operator who applies a conformal coating to the relays. The mixing of the conformal coating (a urethane plastic containing toluene diisocyanate, or TDI) requires about 10 minutes and is applied at a well-ventilated station for about 30 minutes after which the excess coating mixture is discarded. A sample was collected during this operation for toluene and cellusolve acetate, but the exposure was so brief and contaminant levels so low that none was detected on the samples. There is no reason to believe that a hazard exists from this operation so long as established work practices are followed carefully.

The employee representatives had requested NIOSH to evaluate chemical exposures in the Header Room. However, the facilities were modified prior to the NIOSH surveys, and no chemicals are now used in the Header Room.

Additionally, methyl alcohol and trichloroethylene are apparently not used any longer in the Relays Department for cleaning of materials. Only isopropanol was found by the NIOSH investigators. Apparently, isopropanol is sufficiently effective as a cleaner and is considered much less hazardous than methanol or trichloroethylene.

(a) Module Area

In a section of the Relays Department designated as the Module Area, soldering is done manually at work benches. Excess solder flux is removed by dipping or wiping the soldered part with isopropyl alcohol. A rosin core solder is used. The pyrolysis products of rosin core solder can be irritating to workers. The air-contaminant standard for the pyrolysis products is set at 0.1 mg/m^3 measured as formaldehyde.

Air samples for isopropanol and pyrolysis products of rosin core solder were collected during the May 1975 NIOSH survey.[3] Results are given in Table 5 along with the evaluation criteria. Airborne levels appeared to be well controlled, and no health hazards due to airborne chemical exposures were found in this area.

(b) Nameplate Stamping Room

Another section of the Relays Department is the Nameplate Stamp and Finish Room. One of the operations performed here is the solder-spin operation. This operation involves the attachment of metal parts to a rotating wheel, application of solder flux with a brush, and dipping the part into a molten pool of solder. A 60:40 Pb/Sn solder is used; the flux is zinc chloride. The solder-spin operators sit at a work bench and perform their work inside individual hoods.

Several operators are employed at the nearby nameplate stamping machines; to remove excess ink they use a thinner which reportedly contains ethyl acetate and ethanol.

Air samples for lead, zinc chloride, ethyl acetate, and ethanol were collected on May 8, 1975. The results and evaluation criteria are listed in Table 6. Levels appear to be well controlled, and no health hazards due to airborne chemical exposures were found in this area.

7. TermiNet Assembly Area

A TermiNet is a finished piece of data processing equipment. Sub-assembly of parts and final unit assembly is done in the TermiNet Department.

(a) Coils/Bar Area

There are several soldering stations in this area which in the past used a Kester soldering flux which produced fumes which reportedly were irritating to employees. A new soldering flux is now used in the

area, and apparently there are no problems with the new flux. Furthermore, isopropanol, not methanol, is used for cleaning in this area.

One employee uses a small degreasing tank containing 1, 1, 1 - trichloroethane (also known as methyl chloroform or chlorothene NU). This tank is used to wash metal particles off of parts; an aqueous solution cannot be used because of rusting. The tank has a lid which is normally kept closed. It is opened only for a few minutes at a time for loading and unloading. The employee performing this job wore a personal air sampler on May 8, 1975; the results are given in Table 7. The time-weighted average exposure was only 18 ppm; the standard (maximum) is 350 ppm.

(b) DCP Final Assembly

In the DCP final assembly area are a number of operators using sealants and adhesives which contain methyl-2 cyanoacrylate and methacrylates. Results of air samples are given in Table 7. Exposure appears to be insignificant.

No health hazards due to airborne chemical exposure were found in the TermiNet Department.

E. Recommendations

Many recommendations particular to specific operations or areas have been presented in the previous discussion by area. The recommendations presented here are those which are generally applicable to the entire plant.

1. Transfer and pay policy. In private discussions between plant workers and NIOSH personnel, this topic was a recurring concern to employees. Several employees who were experiencing health problems at their jobs were deterred from seeking medical attention at the plant clinic or requesting transfer to areas without troublesome chemical exposure because a transfer would be likely to result in a lower paying job. These employees could cite specific cases where this had happened to friends or former work associates.

   Such a situation is very unfortunate since it is an obstacle to providing a safe and healthful working environment for all employees. Transfer, or removal from exposure, is often the preferred action when an employee is suffering from an allergic reaction or from a chronic health disorder due to exposure to a particular substance in the work environment. NIOSH recommends this action in such cases, but always recommends that the transfer be done without reduction in pay.

2. Ventilation system evaluation. It is recommended that the plant management purchase ventilation smoke tubes and a small air velocity meter, such as the Alnor Velometer Jr., to periodically evaluate the effectiveness of local exhaust ventilation systems and paint spray booths.

3. Routine monitoring. The Waynesboro plant has been using a consultant from another division of the General Electric Company to perform industrial hygiene surveys and to consult on potential problems. This is commendable and should be continued. However, the Waynesboro plant has considerable in-house expertise in analytical chemistry which could be utilized for doing certain types of routine monitoring and special short-term problem evaluation. The plant should consider equipping itself to do some of its own sampling and analysis.

4. Employee training. This appeared to be a considerably weak point at the time of the NIOSH surveys. Due to production cutbacks, plant personnel had been thoroughly reshuffled. Many employees found themselves performing new jobs and using chemicals with which they were completely unfamiliar. It is very important that employees feel involved if an occupational safety and health program is to be effective at a plant. Employees must be informed of the hazards associated with the chemical substances which they use, and must also be taught safe work practices and proper use of personal protective equipment and contaminant control devices. If the need for these measures is well understood, employee cooperation in achieving a safe and healthful workplace is much more likely.

V. REFERENCES

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3. Formaldehyde in Air, P&CAM #125, NIOSH Manual of Analytical Methods (1974).

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Table 1: Results of Enviro tal Sampling, Belt Room

General Electric Company
Waynesboro, Virginia

May 7, 1975

Sample No.	Operator/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration (PPM)	Type of Sample
SG-1	Belt Caster 1	Methylene dianiline	9.34	7:43 am-11:12 am	*N.D.	BZ
SG-2	Belt Caster 1	"	11.48	11:52 am- 3:42 pm	N.D.	BZ
SG-3	Belt Caster 2	"	9.15	7:45 am-11:12 am	N.D.	BZ
SG-4	Belt Caster 2	"	12.48	11:52 am- 3:41 pm	N.D.	BZ
SG-5	Monitor	"	9.37	7:50 am-11:12 am	N.D.	BZ
SG-6	Monitor	"	11.27	11:55 am- 3:40 pm	N.D.	BZ
SG-7	Belt Caster 3	"	8.01	7:53 am-11:12 am	N.D.	BZ
SG-8	Belt Caster 3	"	2.90	11:55 am-12:50 pm	N.D.	BZ
SG-9	Pour head	"	11.80	8:00 am-11:16 am	N.D.	GA
SG-10	Pour head	"	5.92	11:16 am- 3:43 pm	N.D.	GA
SG-11	Belt Curing	"	10.38	8:01 am-11:18 am	N.D.	GA
SG-12	Belt Curing	"	13.42	11:18 am- 3:43 pm	N.D.	GA

Sample No.	Operator/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration (PPM)	Type of Sample
HW-1	Belt Caster 1	Methylene bis (4-cyclohexyl isocyanate)	475	7:47 am-3:42 pm	N.D.	BZ
HW-2	Belt Caster 2	"	471	7:50 am-3:41 pm	N.D.	BZ
HW-3	Monitor	"	467	7:53 am-3:40 pm	N.D.	BZ
HW-4	Belt Caster 3	"	294	7:56 am-12:50 pm	N.D.	BZ
HW-5	Pour head	"	460	8:03 am-3:43 pm	N.D.	GA
CT-1	Pour head	Methylene Chloride	11.63	8:01 am-11:18 am	29	GA
CT-2	Pour head	"	6.17	11:18 am- 3:43 pm	48	GA
CT-3	Trichloroethane Degreaser	1,1,1 - Trichloroethane	6.62	8:02 am-11:20 am	14	GA
CT-4	"	"	14.01	11:20 am- 3:43 pm	14	GA

PPM = Parts of vapor or gas per million parts of contaminated air by volume.
BZ indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a personal, breathing-zone sampler worn by the employee.
GA indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a fixed sampler located in the general area of a machine or operation.
N.D. means "none detected"
For methylene dianiline, N.D. means less than 0.05 mg/sample.
For methylene bis (4-cyclohexyl isocyanate), the lowest analytical standard was 0.01 mg/sample. However, there is a possibility that a reaction occurred within the sampling solution subsequent to sampling and prior to analysis which rendered the analytical results invalid.

Environmental Criteria: Guideline Limits for Airborne Exposures		
Substance	Source of Criterion	8 hr. - Avg. Limit
Methylene Dianiline	None	-
Methylene bis (4-cyclohexylisocyanate)	ACGIH TLV, 1974	0.01 ppm
Methylene Chloride	ACGIH TLV, 1974	100 ppm
1,1,1 - Trichloroethane	ACGIH TLV, 1974	350 ppm

Table 2: Results of Environmental Sampling,
Area Samples Collected in the Plating Room

General Electric Company
Waynesboro, Virginia
May 7, 1975

Sample No.	Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration Mg/m^3	PPM
IM-1	Tank A-11 Al bright dip	HNO_3	423	9:20 am - 4:23 pm	0.10	0.04
IM-2	Tank A-19 Actane 70	HNO_3	416	9:24 am - 4:20 pm	0.20	0.08
IM-3	Tank A-21 Ni rack strip	HNO_3	410	9:25 am - 4:15 pm	0.10	0.04
IM-4	Tank A-4 Alodine 1200	HNO_3	407	9:28 am - 4:15 pm	0.34	0.13
IM-5	Tank S-10 Cu plating	CN	400	9:41 am - 4:20 pm	0.27	
IM-6	Tank S-5 Ni CN	CN	400	9:42 am - 4:18 pm	0.41	
IM-7	Salt Pot Room	CN	394	9:40 am - 4:14 pm	0.07	
IM-24	CN strip tank (Beside tank B-1)	CN	390	9:15 am - 3:45 pm (May 8, 1975)	4.27	
IM-8	Tank S-22 Acid Pickle	HCl	447	8:50 am - 4:17 pm	0.19	0.13
IM-9	Tank S-12 Bright Ni	HCl	447	8:55 am - 4:22 pm	0.08	0.06

Sample No.	Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration Mg/m^3	PPM
IM-10	Tank S-8 Moriatic Acid	HCl	443	8:57 am - 4:20 pm	0.18	0.12
IM-11	Tank H-3	HCl	442	9:00 am - 4:22 pm	0.22	0.15
IM-12	Tank A-9 Ebonol C	NaOH	439	9:04 am - 4:23 pm	*N.D.	
IM-13	Black Oxide Tank (Black Max #5)	NaOH	431	9:09 am - 4:20 pm	0.06	
IM-14	Tank S-25 Oakite 90	NaOH	426	9:11 am - 4:17 pm	0.02	
IM-15	Tank S-3 Oakite 90	NaOH	427	9:13 am - 4:20 pm	N.D.	
AA-1	Tank S-12 Bright Ni	Nickle	657	9:02 am - 4:20 pm	<0.0015	
AA-2	Tank S-14 Sulfamate Ni	Nickle	652	9:05 am - 4:20 pm	<0.0015	
AA-3	Electroless Ni Bath	Nickle	645	9:08 am - 4:18 pm	0.002	
AA-4	Tank B-18	Nickle	645	9:11 am - 4:21 pm	<0.0015	
AA-5	Tank S-27 Iridite 3	Chromium	633	9:16 am - 4:18 pm	<0.0015	
AA-6	Tank A-4 Alodine 1200	Chromium	624	9:20 am - 4:16 pm	<0.0015	
AA-7	Tank A-6 Oakite 34	Chromium	615	9:25 am - 4:15 pm	<0.0015	
CT-19	Tanks H-20 Degreaser	Trichloro-etheylene	14	11:25 am - 4:22 pm	40	7.4

Mg/M^3 means milligrams of contaminant per cubic meter of air.

PPM means parts of vapor or gas per million parts of contaminated air by volume.

< means "less than".

N.D. means "none detected".
For NaOH (sodium hydroxide), N.D. means the amount of sodium detected in the sample was no greater than that in the analytical blank (unused) sampling solution).

All samples were area samples.

Environmental Criteria: Guideline Limits for Airborne Exposures		
Substance	Source of Criterion	8 hr. Average Limit
Nitric Acid, HNO_3	ACGIH TLV, 1974	5 mg/m^3
Cyanide, CN^-	ACGIH TLV, 1974	5 mg/m^3
Hydrochloric acid, HCl	ACGIH TLV, 1974	7 mg/m^3
Sodium hydroxide, NaOH	ACGIH TLV, 1974	2 mg/m^3
Nickel, Ni, soluble compounds	ACGIH TLV, 1974	0.1 mg/m^3
Chromic acid, chromates	NIOSH Criteria Document	0.05 mg/m^3 as CrO_3^-
Trichloroethylene	ACGIH TLV, 1974	100 ppm

Table 3: Results of Environmental Sampling, Paint Line Area
Paint Solvents and Thinners Measured as VM & P Naphtha

General Electric Company
Waynesboro, Virginia

May 7, 1975

Sample No.	Operator/ Location	Sample Volume (liters)	Sampling Period	Measured Concentration (ppm)	Type of Sample
CT-5	Paint Mixer	11.36	8:19 am - 12:05 pm	28.0	BZ
CT-6	Paint Mixer	12.36	12:05 pm - 3:50 pm	20.9	BZ
CT-7	Paint Mixing Area	21.57	8:21 am - 3:50 pm	32.4	GA
CT-8	Utility Person 1	10.73	8:13 am - 12:02 pm	*N.D.	BZ
CT-9	Utility Person 1	10.59	12:02 pm - 3:50 pm	50.4	BZ
CT-10	Utility Person 2	11.57	8:16 am - 12:04 pm	40.9	BZ
CT-11	Utility Person 2	12.35	12:04 pm - 3:50 pm	52.2	BZ
CT-12	Paint booth on line	26.35	8:22 am - 3:50 pm	34.7	GA
CT-13	Painter, north side booth	10.56	8:11 am - 12:07 pm	182	BZ
CT-14	Painter, north side booth	10.94	12:07 pm - 3:50 pm	51.8	BZ
CT-15	Painter, paint line	10.30	8:10 am - 12:00 N	N.D.	BZ
CT-16	Painter, paint line	3.29	12:00 N - 3:50 pm	N.D.	BZ

PPM means parts of vapor or gas per million parts of contaminated air by volume.

BZ indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a personal, breathing-zone sampler worn by the employee.

GA indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a fixed sampler located in the general area of a machine or operation.

N.D. means "none detected". For VM & P naphtha, the lower limit of dectection was approximately 1 ppm.

Environmental Criterion: 200 ppm of VM & P naphtha as an 8-hr. average limit suggested by ACGIH as a TLV for 1975.

Table 4: Results of Environmental Sampling, MO-1 Machine Shop

General Electric Company
Waynesboro, Virginia

May 8, 1975

Sample No.	Operation/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration Mg/m³	Measured Concentration PPM	Type of Sample
AA-21	Paint Room, Oakite 187 tank	Chromium	552	9:42 am - 3:50 pm	<0.002		GA
AA-22	Paint Room Helper	Chromium	418	9:46 am - 3:48 pm	<0.002		BZ
CT-42	Painter	VM & P Naphtha	5.78	9:45 am - 11:20 am		43	BZ
CT-48	Painter	VM & P Naphtha	5.30	12:45 pm - 3:48 pm		*N.D.	BZ
CT-43	Paint Room Helper	VM & P Naphtha	4.14	9:45 am - 11:20 am		6	BZ
CT-50	Paint Room Helper	VM & P Naphtha	11:03	12:45 pm - 3:48 pm		267	BZ
CT-40	Hammerline Opr. 1, Degreaser	1,1,1 - trichloro-ethane	1.61	9:40 am - 11:20 am		28	BZ
CT-49	Hammerline Opr. 1, Degreaser	1,1,1 - trichloro-ethane	8.66	12:45 pm - 3:45 pm		21	BZ
CT-41	Hammerline Opr. 2, Degreaser	1,1,1 - trichloro-ethane	4.93	9:40 am - 11:20 am		17	BZ

Sample No.	Operation/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration Mg/m3	Measured Concentration PPM	Type of Sample
CT-47	Hammerline Opr.2, Degreaser	1,1,1 - trichloro-ethane	9.06	12:43 pm - 3:40 pm		9	BZ
CT-44	Hammerline Opr.3, Degreaser	1,1,1 - trichloro-ethane	5.39	9:40 am -11:20 am		40	BZ
CT-46	Hammerline Opr.3, Degreaser	1,1,1 - trichloro-ethane	10.90	12:42 pm - 3:45 pm		34	BZ
CT-39	Degreaser, Opr.	Freon TE	5.55	9:37 am -11:20 am	189		BZ
CT-45	Degreaser, Opr.	Freon TE	9.57	12:43 pm - 3:40 pm	270		BZ
V-204	M-93 Zagar Tapping Machine	Oil Mist	592	9:25 am - 4:00 pm	*N.D.		GA
V-154	M-94 Zagar Tapping Machine	Oil Mist	590	9:27 am - 4:00 pm	N.D.		GA
V-205	M-11 Turn Lathe	Oil Mist	582	9:30 am - 3:58 pm	N.D.		GA
V-153	M-16 Turn Lathe	Oil Mist	584	9:32 am - 4:01 pm	N.D.		GA

Mg/m^3 means milligrams of contaminant per cubic meter of air.

PPM means parts of vapor or gas per million parts of contaminated air by volume.

BZ indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a personal, breathing-zone sampler worn by the employee.

GA indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a fixed sampler located in the general area of a machine or operation.

N.D. meand "none detected".
For VM & P naphtha, the lower limit of detection was approximately 1 ppm.
For the oil mist samples, the weight change of the samples was indistinguishable from the weight change of blank (unused) filters.

Environmental Criteria: Guideline Limits for Airborne Exposures		
Substance	Source of Criterion	8-Hr. Avg. Limit
Chromic acid, chromates	NIOSH Criteria Document	0.05 mg/m^3 as CrO_3
VM&P Naphtha	ACGIH, Suggested for 1975	200 ppm
1,1,1 Trichloroethane	ACGIH TLV, 1974	350 ppm
Freon TE	None	-
Freon 11	ACGIH TLV, 1974	5,600 mg/m^3
Freon 12	" " "	4,950 mg/m^3
Freon 114	" " "	7,000 mg/m^3
Oil Mist	" " "	5 mg/m^3

Table 5: Results of Environmental Sampling,
Module Room of Relays Department

General Electric Company
Waynesboro, Virginia

May 8, 1975

Sample No.	Operator/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration (PPM)	Type of Sample
IM-29	Solder Opr. 1	Formaldehyde	451	8:04 am - 3:35 pm	*N.D.	BZ
IM-30	Solder Opr. 2	Formaldehyde	449	8:06 am - 3:35 pm	N.D.	BZ
IM-31	Solder Opr. 3	Formaldehyde	448	8:08 am - 3:36 pm	N.D.	BZ
IM-32	Solder Bench	Formaldehyde	445	8:10 am - 3:35 pm	N.D.	GA
IM-33	Soldering Bench	Formaldehyde	444	8:11 am - 3:35 pm	N.D.	GA
CT-25	Bench Near Alcohol Container	Isopropanol	9.95	8:12 am - 11:37 am	4.1	GA
CT-33	Bench Near Alcohol Container	Isopropanol	12.93	11:37 am - 3:37 pm	4.7	GA
CT-26	Solder Opr. 4	Isopropanol	10.20	8:14 am - 11:30 am	1.6	BZ
CT-34	Solder Opr. 4	Isopropanol	10.89	12:35 pm - 3:35 pm	3.4	BZ
CT-27	Above Alcohol Container	Isopropanol	12.04	8:16 am - 11:36 am	4.7	GA
CT-35	Above Alcohol Container	Isopropanol	15.11	11:37 am - 3:37 pm	4.0	GA

PPM = Parts of vapor or gas per million parts of contaminated air by volume.

BZ indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a personal, breathing-zone sampler worn by the employee.

GA indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a fixed sampler located in the general area of a machine or operation.

N.D. means "none detected". The analytical results of the formaldehyde samples were no greater than those from blank (unused) sampling solutions.

Environmental Criteria: Guideline Limits for Airborne Exposures		
Substance	Source of Criterion	8-Hr. Avg. Limit
Rosin Core Solder, pyrolysis products (as formaldehyde)	ACGIH TLV, 1974	0.1 mg/m^3
Isopropanol	ACGIH TLV, 1974	400 ppm

Table 6: Results of Environmental Sampling
Nameplate Stamping Room of Relays Department

General Electric Company
Waynesboro, Virginia

May 8, 1975

Sample No.	Operator/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration mg/m^3	Measured Concentration ppm	Type of Sample
CT-28	Nameplate Stamper 1	Ethyl Acetate	11.28	7:48 am - 11:32 am		18	BZ
		Ethanol				*N.D.	
CT-36	Nameplate stamper 1	Ethyl Acetate	8.65	11:38 am - 3:39 pm		15	BZ
		Ethanol				2.5	
CT-29	Nameplate Stamper 2	Ethyl Acetate	11.67	7:49 am -11:32 am		18	BZ
		Ethanol				N.D.	
CT-37	Namplate Stamper 2	Ethyl Acetate	12.76	11:38 am - 3:45 pm		27	BZ
		Ethanol				N.D.	
CT-30	Nameplate Stamper 3	Ethyl Acetate	13.01	7:50 am - 11:32 am		14	BZ
		Ethanol				N.D.	

Sample No.	Operator/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration mg/m³	Measured Concentration ppm	Type of Sample
CT-38	Nameplate Stamper 3	Ethyl Acetate	13.45	11:38 am - 3:44 pm		28	BZ
		Ethanol				14	
DM-1	Solder Spin Opr.	$ZnCl_2$	699	7:54 am - 3:40 pm	0.01		BZ
Dm-2	Solder Spin, Point of Operation	$ZnCl_2$	696	7:55 am - 3:39 pm	0.02		GA
AA-5	Solder Spin, Point of Operation	Lead	696	7:55 am - 3:39 pm	0.01		GA

Mg/M³ means milligrams of contaminant per cubic meter of air.

PPM means parts of vapor or gas per million parts of contaminated air by volume.

BZ indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a personal, breathing-zone sampler worn by the employee.

GA indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a fixed sampler located in the general area of a machine or operation.

N.D. means "none detected".
For ethanol, the detection limit was 0.01 mg per sample.

Evaluation Criteria: Guideline Limits for Airborne Exposure		
Substance	Source of Criterion	8 Hr. Avg. Limit
Ethyl Acetate	ACGIH TLV, 1974	400 ppm
Ethanol	ACGIH TLV, 1974	1,000 ppm
Zinc Chloride Fume	ACGIH TLV, 1974	1 mg/m^3
Lead	NIOSH Criteria Document	0.15 mg/m^3

Table 7: Results of Environmental Sampling
TermiNet Assembly Area

General Electric Company
Waynesboro, Virginia
May 8, 1975

Sample No.	Operator/ Location	Contaminant	Sample Volume (liters)	Sampling Period	Measured Concentration (PPM)	Type of Sample
IM-25	DCP Sub-Assembly	Methyl-2 cyanoacrylate	52	10:51 am - 11:43 am	0.02	GA
IM-26	DCP Sub-Assembly	Methyl-2 cyanoacrylate	53	10:50 am - 11:43 am	0.02	BZ
CT-57	Monitor, Coils Bar Area	1,1,1 - trichloro-ethane	8.87	1:00 pm - 3:52 pm	18	BZ
CT-22	DCP Sub-Assembly Operator 1	Methacrylates	21.66	8:44 am - 3:50 pm	*N.D.	BZ
CT-23	DCP Sub-Assembly Operator 2	Methacrylates	25.93	8:42 am - 3:50 pm	N.D.	BZ
CT-24	DCP Sub-Assembly Operator 3	Methacrylates	20.75	8:46 am - 3:52 pm	N.D.	BZ

PPM means parts of vapor or gas per million parts of contaminated air by volume.

BZ indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a personal, breathing-zone sampler worn by the employee.

GA indicates that the measured concentration represents an average contaminant concentration for the sampling period obtained by a fixed sampler located in the general area of a machine or operation.

N.D. means "none detected".
For methacrylates, the detection limit was 0.3 mg per sample.

Evaluation Criteria: Guideline Limits for Airborne Exposure		
Substance	Souce of Criterion	8 Hr. Avg. Limit
Methyl - 2 cyanoacrylate	ACGIH TLV, 1974	2 ppm
1,1,1 - Trichloroethane	ACGIH TLV, 1974	350 ppm
Methyl methacrylate	ACGIH TLV, 1974	100 ppm