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

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 75-147-318

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

AUGUST 1976

I. TOXICITY DETERMINATION

A minimal but potential health hazard is considered to exist in Section D-12 of the LRA Division due to direct contact with JZ and YR epoxy resin systems. It was determined by means of patch testing that 7 or 37% of the 19 workers tested for sensitization to epoxy resins had some type of reaction. Of those tested 2 or 11% had a sensitization reaction. Additional information was obtained from reviewing medical records. Review of the records of 93 employees presently working in Section D-12 indicated that 5% were believed to be sensitized and 15% had some type of skin problems of unknown source. A review of an additional 85 records of workers who had worked in Section D-12 in the past five years revealed 19% had some type of skin reactions with 4.7% being diagnosed as possibly sensitized. (Without patch testing, no definite cause can be stated.)

A potential health hazard is also considered to exist from exposure via vapor inhalation and direct contact to the JZ resin. This is based not upon measured airborne concentrations but on the work practices in effect at the time of this evaluation and upon employee interviews.

Employees exposure to 1,1,1 trichloroethane did not pose an inhalation health hazard at the concentrations measured during this evaluation, however, physical examinations and histories revealed defatting of the skin due to direct contact resulting in red, rough and scaling hands.

Based on the environmental and medical information collected the solderers' exposure to lead, tin and an alcohol based flux does not constitute a health hazard.

It also has been concluded on the basis of environmental data that no health hazard exists to tapers due to exposure to varnish and enamel as determined by measuring exposure to naphtha and xylene.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. Copies have been sent to:

a) Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania
b) Authorized Representatives of Employees
c) U.S. Department of Labor - Region III
d) NIOSH - Region III

For the purpose of informing the approximately 90 "affected employees" this report shall be posted in a prominent place(s) readily workers for a period of at least 30 calendar days.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorized 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 (NIOSH) received such a request from an authorized representative of Local 601 of the International Union of Electrical, Radio and Machine Workers regarding the exposure of employees to epoxy resins and other unidentified substances in Section D-12 of the LRA Division. Reported symptoms included skin rash, blisters, nausea, breathing difficulties, irritated sinuses and dryness of the throat.

IV. HEALTH HAZARD EVALUATION

A. Condition of Use

The survey conducted at the Westinghouse Electric Corporation involved the area designated as the Large Rotating Apparatus Division (LRA), Section D-12. Several processes are performed in the department dealing with the placement of the coils into large rotating generators. While in Section D-12, the construction of the generator progresses through several stages.

Several steps in the construction process involve the use of epoxy resins. The resins are mixed in the mixing kitchen and transported to the various sites for use. The mixing kitchen for the resins is located along one wall of the building and is enclosed on three sides and overhead. Two exhaust fans are located in the area. One employee works in the mixing kitchen per shift. The mixing kitchen operator has two main duties, mixing resins and coating Dacron strips with resins. In mixing the resins, the resin and amine hardener are first measured from 55 gallon drums. The resin and amine are then poured into a paper container and mixed with a blender.

The greatest quantity of resin used is the resin designated as YR. The YR resin is used for banding and resining the clamps. Another resin, JZ also is used in the banding process. The JZ resin is received from the supplies in small metal cans and is mixed and applied directly from these cans. After application the resin is heated with a blow dryer to hasten the drying process. (The use of the JZ resin is more limited than that of the YR resin.)

Those employees using resins are provided cotton sleevings and neoprene gloves. Talc powder is available to apply to the hands for easy wearing of the gloves. More recently white cotton gloves have been provided to wear inside the neoprene gloves. Barrier creams and hand cleaners also are available.

Solvent safety containers containing 1,1,1 trichlorcethane are located throughout the work areas and used frequently by employees. The 1,1,1 trichloroethane is used extensively as a cleaning agent for the employees' tools and gloves and in some cases hands and arms.

A considerable quantity of soldering is conducted in this section. A solder flux containing an alcohol base is used. The solder flux is applied using a brush before the soldering is started and reapplied before the work is completed. The solder strip which is used in this work contains tin and lead.

Another operation, somewhat distinct from the winding and banding processes also is performed in the area. In the initial preparation of the coils, the coils are wrapped with a tape. Two to three employees work in Section D-12 as tapers. Their job consists of wrapping a fabric tape around the coils during which a varnish is continuously applied. After the wrapping is complete, the tape - wrapped coil is painted with a red enamal.

b. Evaluation Design Progress

An initial survey was conducted on November 24-26, 1975. This survey included obtaining background information, conducting a walk-through survey of the section, collecting environmental samples and interviewing and conducting brief medical examinations on employees. The company medical records of 93 employees were reviewed on March 15, 1976 following a time delay in which NIOSH was forced to obtain a subpoena to gain access to Westinghouse medical records. A follow-up environmental medical survey was conducted on April 12-15, 1976. Environmental samples were taken, patch testing was performed and blood samples for lead were collected. Additional medical records were also reviewed.

C. Evaluation Methods

1. Environmental

Exposure to 1,1,1 trichloroethane, xylene, naphtha, styrene, and alcohol was evaluated by collecting breathing zone and areas samples on charcoal tubes. Samples for the YR amine hardener were collected on silica gel tubes. The samples were analyzed by gas chromatography for the individual components.

The solderers' exposure to lead and tin was determined by utilizing filters which were analyzed for the specific metals by atomic absorption.

2. Medical

On the initial survey, employees were privately asked non-directed questions followed by directed questions regarding their health and employment. A limited physical examination was performed which emphasized vital signs and skin conditions. On the follow-up survey, patch testing was conducted on nineteen individuals who had visible skin lesions or had reported a history of skin problems and blood lead samples were drawn on fourteen workers.

D. Evaluation Criteria

1. Physiological Effects

Epoxy Resins - Epoxy resin systems are capable of producing both primary irritant and allergic contact dermatitis. The usual lesion typical of contact dermatitis is one characterized by redness and edema, with weeping followed by crusting and scaling.

Sensitization (allergic response) may follow the initial contact resulting in the development of an eczema. This is accompanied by considerable itching and extension beyond the original contact point. If the worker is withdrawn from further contact, the lesions usually subside in 10 to 14 days. However, it may recur on further contact. If the worker is not withdrawn from contact, the dermatitis usually persists longer.

Epoxy Amine Hardener YR - The YR amine hardener is considered to be a skin sensitizer. Contact with the skin may result in burns as well as dermatitis. Contact with the eyes may result in burns with possible permanent impairment of vision.

Lead - Inhalation of lead fumes may result in lead poisoning. Some of the signs and symptoms include abdominal pain with tenderness, constipation, headache, weakness, muscular aches and cramps, loss of appetite, nausea, vomiting, weight loss, anemia with pallor and lead lines in the gum tissues.

Tin - Exposure to dust and fume of tin is recognized to result in stannosis, a benign pneumoconiosis, that shows no symptoms of interference with pulmonary function.

1,1,1 Trichloroethane - The main effect of exposure to 1,1,1 trichloroethane is anesthesia. High concentrations may produce mild irritation and minimal impairment of coordination. The skin shows only slight reddening and scaliness from contact. The reaction is increased on repeated exposures.

Xylene - Excessive exposure to xylene may cause dermatitis, irritation of mucous membranes, nausea, vomiting, anorexia and heart burn. Dizziness, incoordination and a staggering gait may also occur.

Naphtha - Naphtha vapors are mildly irritating to mucous membranes. Repeated or prolonged skin contact will dry and defat the skin.

Styrene - Styrene vapor has a transient irritating effect on the eyes and mucous membranes of the nose. Exposure to high concentrations may result in neurologic impairment.

2. Environmental Standards

To assess the concentrations of air contaminants found in the place of employment, three primary sources of criteria were used: (1) NIOSH criteria for recommended standards for occupational exposure to substances (Criteria Documents); (2) occupational health standards as promulgated by the U. S. Department of Labor (29 CFR Part 1910.1000); and (3) recommended and proposed threshold limit values (TLVs) and their supporting documentation as set forth by the American Conference of Industrial Hygienists (ACGIH) (1975).

In the following tabulation, criteria selected for this evaluation by the author are presented with references.

Substance	Permissible Exposures (8-hour Time Weighted Average)
[1] Lead, inorg., fumes and dust	0.15mg/m^3
[2] 1,1,1 Trichloroethane	350 ppm
[2] Tin Oxide	10 mg/m^3
[2] Styrene	100 ppm
[3] Xylene	100 ppm

1. The NIOSH 1972 criteria document and the 1975 ACGIH TLV. The current Occupational Safety and Health Administration (OSHA) standard is 0.2 mg/m^3

2. The 1975 ACGIH TLV and the current OSHA standard.

3. The NIOSH 1975 criteria document, the 1975 ACGIH TLV and the current OSHA standard.

TLV's or standards for substances are established at levels designed to protect workers occupationally exposed on an 8-hour per day, 40-hour per week basis over a working lifetime. Because of the wide variation in individual susceptibility, some workers may experience discomfort at or below the designated levels. Thus, an evaluation of the workplace cannot be based entirely upon comparisons made against such TLV's or standards, as various TLV's and standards do not represent absolute protection of all workers.

E. Evaluation Results and Discussion

During the preliminary investigation by NIOSH personnel, 76 employees from three shifts were asked nondirected and directed questionnaires. Of the 76 workers interviewed 34 or 45% had one or more complaints they believed were work related. (Table 1) Of those workers, 12 or 16% had visible skin lesions. An additional eight workers or 11% reported histories of skin problems. It was decided that patch testing would be required to determine (1) whether allergic sensitization was responsible for the dermatitis and (2) which substance or substances were responsible.

As a prelude to patch testing, it was essential to determine the skin primary irritation index of each material to be tested so that appropriate non-irritating concentrations could be prepared for utilization in the tests. Samples of the resins and hardener were supplied to the Experimental Toxicology Branch, NIOSH. Skin irritation indices were determined for each substance by applying concentrations of 100%, 50%, 25%, 10%, 1% and 0.1% to separate intact and abraded skin areas on each of three rabbits. Each animal and site was examined both 24 and 48 hours after application. Positive responses were graded on a 1 to 4 scale (mild irritation to corrosive) and the highest concentration failing to produce mild irritation in the majority of animals (irritation index) determined. The results were as follows:

Material	Solvent	Primary Irritation Index	
		Intact Skin	Abraded Skin
JZ Resin	Acetone	25%	25%
YR Resin	Acetone	10%	1%
YR Hardener	Acetone	25%	10%

Concentrations 50% lower than the irritation index for intact skin were then prepared for patch test use. This extra dilution provides an increased margin of safety by ruling out the occasional human hyperreactor to irritants.

Of the 76 workers interviewed on the initial survey, 20 workers had histories and/or physical findings suggestive of occupational contact dermatitis. On the April 1976 visit, these workers were asked to participate in a patch test using the above three substances and an appropriate control (diluent). The patch tests were applied to the workers left forearm, with the test sites being read 48 hours after application. (One worker due to hyperhidosis was unable to finish the test and was therefore disqualified leaving 19 usable workers for patch testing.)

The patch test reading (Table 2) showed that the YR hardener caused a slight erythema in four of the workers and in two of the workers it caused a definite edematous and erythematous reaction. The JZ resin caused one worker to have a slight erythematous reaction and one worker to have a edematous reaction. On the control patch, all 19 workers exhibited no reaction. In summary of the patch testing, seven people reacted or 37%. Two people (11%) had sensitization

reactions and five people (26%) had erythematous reactions. (One worker reacted to both the YR hardener and JZ resin).

Volunteers were informed of the patch test results at the time final readings were made and its significance explained. It was emphasized that repeated exposure is important in initiating sensitization. Thus the present lack of sensitization in a given individual did not preclude the eventual development of allergy. Recommendations and preventative measures are given in Sections F and G of this report.

Environmental air samples for the YR amine hardener were collected and no detectable levels were found. Therefore any problems associated with the YR epoxy resin system appear to be due to contact.

The JZ resin, which contains styrene and MEK peroxide, was the material which resulted in the greatest number of complaints from workers. The airborne concentration of styrene was measured and found to be low (2.4ppm and 1.5ppm). MEK peroxide concentrations were not evaluated because a satisfactory analytical and sampling techniques was not available. Therefore the potential toxicity of the resin system is difficult to evaluate. However, a minimal but potential hazard is considered to exist from exposure to the JZ resin. This is based not upon measured concentrations but on the work practices in effect at the time of this evaluation and upon employee interviews. The JZ resin is used in confined spaces (inside the generator) and dried with a blow dryer, often blowing the fumes directly into the faces of the workers. Because of these practices, there is very little opportunity for natural dilution of the resin fumes to occur. The employees reported symptoms including hyderhidrosis during resin drying, nasal, throat and skin (face) irritation from resin fumes and headaches. Two individuals also showed a reaction to JZ resin on the patch tests. Based on this information a potential problem may exist and suggestions for improved practices and ventilation are given in Sections F and G of this report.

Nineteen environmental samples for 1,1,1 trichloroethane were collected on November 24-25, 1975 and on April 12-13, 1976. The concentrations ranged from 2.5ppm to 154ppm. (Table 3). The standard for 1,1,1 trichloroethane is 350ppm. All values, therefore, were below the levels believed to cause adverse effects in workers. It was noted, however, that workers were washing their hands and arms in the solvent to remove the epoxy resins and would only wipe the excess solvent from the skin (washing facilities are not readily available to each work area.) Physical examinations and histories revealed defatting of the skin due to solvent contact resulting in red, rough and scaling hands. This situation was pointed out during the initial visit at the plant and recommendation for corrective measures were made. These recommendations are listed in Sections F and G. It should be stated that improved work practices and skin conditions were noted on the follow-up survey. The need, however, to continue such improved work practices cannot be overemphasized.

Samples were collected on the solderers for lead, tin and the alcohol from the flux. No detectable levels of alcohol were found. Only one sample had a detectable level of lead (0.018 mg/m^3) and only one sample a detectable level of tin (0.075 mg/m^3). (Table 4) The levels were well below existing standards. In addition, 14 workers were selected who may have been exposed to lead fumes in unventilated areas and blood samples were collected. The test results are presented in Table 5. The range of values is 21-38 ug lead/100ml with a mean of 29.4 µg/100ml. The guidelines issued by OSHA for controlling occupational exposure to lead, (March 2, 1976), indicated a safe blood lead level was 60 µg/100g of whole blood. Therefore, the values of the blood leads of all 14 workers studied were within the acceptable level.

The tapers were sampled for xylene and naptha. The maximum xylene concentration was 18.8ppm and the maximum naphtha concentration was 14 mg/m^3. Sampling periods and concentrations are given in Table 5. All values are below levels believed to cause adverse health effects.

F. Preventive Measures

1. Skin contact with epoxy resins must be kept to a minimum. This is usually possible if scrupulous attention is paid to proper work practices. Workers must be educated in the hazards associated with these substances if management is to expect compliance with protective clothing and glove use requirements.

2. In addition to neoprene gloves, long protective sleeves must be worn. Disposable smocks are also recommended. Rubber gloves should not be worn uninterruptedly unless plain white cotton liner gloves are worn under them. These liner gloves should be changed at least twice daily to prevent maceration due to accumulated perspiration. Persons with hand dermatitis problems should change their liner gloves more frequently. Gloves must be cleaned thoroughly before removal from the hands and inspected for defects. If sleeves or gloves get damaged or contaminated they should be replaced immediately. Soiled personal clothing must be washed before wearing.

3. Some spills on the skin are almost inevitable in a hand type operation. It is imperative that the epoxy be removed immediately, using copious amounts of mild soap and water. Organic solvents should not be used for cleansing. Even persons with known sensitivity or allergy can usually continue to work with epoxies if skin contamination is promptly removed, since up to several hours of contact are usually required to elicit the dermatitis which becomes clinically apparent several days later. Sensitive individuals should also try to avoid any fumes given off, especially during mixing operations.

4. Employees should be encouraged to report every case of dermatitis, no matter how minor, so that prompt medical attention may be received. Early therapy usually can prevent the development of extensive or disabling dermatitis.

5. Persons with suspected allergy to epoxies should not be hired for jobs involving utilization of these substances. Patch testing should be carried out as a pre-employment test in doubtful situations. Atopic individuals need not be eliminated from employment considerations, since they are no more susceptible to sensitization than non-atopics. However, they may be less tolerant of frequent cleaning, protective clothing, etc. required in this work.

Once employed, persons developing recurrent dermatitis should be patch tested to establish a cause. Reference to the data presented earlier in this report can be referred to in order to determine the proper test concentrations and solvent.

G. Recommendations

1. All employees should be provided with plain white cotton gloves to be worn as liners inside the neoprene gloves. It is recommended that the use of talc-powder be discontinued.

2. Sinks should be installed in the various work areas for easy access by worker. Hands should be washed with soap and water after contact with the resins or solvents.

3. The ventilation system in the mixing kitchen should be in proper working order and in operation when the kitchen is in use. At the time of the follow-up survey, only one fan was functional and it would automatically shut-off after operating approximately 10 minutes. As a result no ventilation was often present when resins and solvents were being handled.

4. Local ventilation should be provided when the JZ resin is being used inside the generators. The problem with providing ventilation is recognized due to the various types and sizes of generators and the mobility of the generators while in the department. Such ventilation may, however, be in the form of a large portable fan or similiar system which would move air through an individual generator while resin is being applied. This system would eliminate the build-up of resin fumes inside the generator. It is also recommended that the use of blow-dryers on the JZ resin be as limited as possible. When used, proper work practices should be employed such that the resin fumes are not blown toward the workers.

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TABLE 1

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

NOVEMBER 24-25, 1975

COMPLAINTS ELICITED FROM WORKERS

Day Shift (7:30-3:30) 30 participated - 10 declined

Denied problems and/or no visible lesions	- 16
Job related complaints or visible skin lesions	- 14
Burning from trichloroethane	- 3
Hidrosis from gloves	- 1
Urinary frequency	- 4
Hyperhidrosis during resin heating	- 3
Nasal irritation from resin fumes	- 3
Visible skin rash	- 3

Afternoon Shift (3:30-11:30) 24 participated - 3 declined

Denied problems and/or no visible skin lesions	- 7
Complaints or visible skin lesions	- 11
Dried solvent on hands	- 2
Visible skin lesions	- 4
Epoxy fumes irritating throat and face	- 2
Irritated hands from fiberglass tape	- 1
Hyperhidrosis when resin heating up	- 1
Urinary frequency	- 1

Night Shift (11:30-7:30) 22 participated - 4 declined

Denied problems and/or no visible skin lesions	- 13
Complaints or visible skin lesions	- 9
Visible skin lesions	- 5
Skin irritated by solvents	- 2
Headache due to JZ fumes	- 1
Hands burning gloves	- 1

TABLE 2

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

APRIL 12-15, 1976

SKIN PATCH TEST LEFT FOREARM

Number of workers tested 20

Number usable 19

CHEMICAL		NUMBER OF WORKERS RESPONDING BY GRADE				
		0	1	2	3	4
#1	YR resin	19				
#2	YR hardner	13		4	2	
#3	JZ resin	17		1	1	
#4	Control	19				

Summary:

8 Reactions	37%	(7)	
Sensitized Reactions	11%	(2)	(.105)
Possible Sensitized Reactions	26%	(5)	(.263)

Grade Read

0 - No reaction
1 - Simple erythema
2 - Erythema and induration, papules raised and firm
3 - Vesicular formation
4 - Severe reaction'

TABLE 3

CHARCOAL TUBE SAMPLES FOR 1,1,1-TRICHLOROETHANE

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

NOVEMBER 24-25, 1975

Sample Location	Sample Number	Sampling Period	Sample Volume (liters)	1,1,1-Trichloroethane (ppm)
Mixing Kitchen Operator	CT-1	16:02-22:43	19.1	9.7
Solderer	CT-2	16:17-22:51	22.0	4.9
Solderer	CT-3	16:10-22:55	18.2	3.1
Area in Mixing Kitchen	CT-4	16:27-22:43	61.5	4.4
Employee Resining Clamps	CT-6	17:34-22:51	14.4	7.8
Employee Resining Clamps	CT-7	17:42-22:51	16.7	8.0
Employee Resining Clamps	CT-8	17:53-21:37	11.2	4.1
Mixing Kitchen Operator	CT-10	8:02-14:46	16.9	4.6
Solderer	CT-11	8:06-14:46	27.3	2.7
Area in Mixing Kitchen	CT-12	7:58-14:46	74.7	2.5
Employee Resining Clamps	CT-15	8:25-14:53	18.5	14.9
Employee Resining Clamps	CT-16	8:26-14:53	23.5	79.5
Solderer	CT-17	8:33-14:53	16.5	4.1
Employee Applying JZ Resin	CT-18	12:02-14:51	32.9	28.8
Employee Applying JZ Resin	CT-19	12:04-14:51	34.3	18.2
		APRIL 12-13, 1976		
Mixing Kitchen Operator	CT-1	17:12-20:18	10.7	10.6
Mixing Kitchen Operator	CT-2	20:18-22:49	8.9	8.7
Mixing Kitchen Operator	CT-3	8:10-11:05	8.8	15.4
Mixing Kitchen Operator	CT-4	11:05-14:50	10.9	10.1
Environmental Criteria				350

TABLE 4

FILTER SAMPLES FOR LEAD AND TIN

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

APRIL 12-13, 1976

Sample Location	Sample Number	Sampling Period	Sample Volume (liters)	Lead (mg/m^3)	Tin (mg/m^3)
Solderer	AA-1	16:47-22:47	540	N.D.*	N.D.**
Solderer	AA-2	16:50-22:47	535	N.D.	N.D.
Solderer	AA-3	7:56-14:45	613	0.018	N.D.
Solderer	AA-4	7:57-14:45	612	N.D.	0.075

*N.D. - Not Detected; Limit of detection 0.005 mg/filter

**Limit of Detection 0.012 mg/filter

Environmental Criteria	0.15	10

TABLE 5

BLOOD LEAD RESULTS

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

APRIL 12-15, 1976

WORKER COHORT NUMBER	LEAD IN BLOOD ug/100 ml
35	38
94	37
37	36
87	35
58	32
32	32
51	31
13	29
52	26
89	26
54	25
45	22
59	22
66	21

MEAN 29.4

NORMAL less than 60

TABLE 6

CHARCOAL TUBE SAMPLES FOR XYLENE AND NAPHTHA

WESTINGHOUSE ELECTRIC CORPORATION
EAST PITTSBURGH, PENNSYLVANIA

NOVEMBER 24-25, 1975

Sample Location	Sample Number	Sampling Period	Sample Volume (liters)	Xylene (ppm)	Naphtha (mg/m^3)
Taper (A)	CT-5	16:37-22:47	15.0	7.7	6.0
Taper (B)	CT-13	8:16-14:43	18.8	9.1	10.1
Taper (C)	CT-14	8:15-14:43	16.4	10.1	14.0
Environmental Criteria				100	400