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

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 72-67-87

WESTINGHOUSE ELECTRIC CORPORATION - LAMP DIVISION
BLOOMFIELD, NEW JERSEY
OCTOBER 1973

I. TOXICITY DETERMINATION

It has been determined that the concentration of solvent vapors (i.e. stoddard solvent, cellosolve acetate and toluene) measured during certain periods of normal operating conditions for the Maintenance Paint Crew are considered to be toxic. Non-volatile components of the epoxy paint products used in this establishment were not observed to produce toxic effects. This determination is based upon an assessment of conditions observed during various site visits, the analysis of worker responses to a medical questionnaire, the interpretation of patch testing four of the painters for evidence of skin allergy, and environmental measurements.

There was no worker illness reported on the days of this evaluation. The occurrence of headaches, nausea, dizziness, burning of the eyes, nose, throat and skin eruptions described by the workers prior to this investigation was more than likely related to the improper handling of the epoxy resin paint being used at this facility. It is impossible to determine the solvent levels that developed on previous occasions but based on reported circumstances such as poor ventilation and working in confined quarters with a lack of personal protective gear, there was most likely a cause-effect relationship between worker illness and exposure to solvent vapors. None of the men on the Paint Crew were determined to be allergic to any of the components of the epoxy resin paint.

It is strongly recommended that the accepted guidelines for the safe handling of any epoxy materials (including provisions for adequate ventilation and the use of personal protective gear) be stringently followed to prevent the recurrence of conditions similar to those that precipitated this hazard evaluation.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

a) Westinghouse Electric Corporation, Bloomfield, N.J.
b) Authorized Representative of Employees
c) US Department of Labor - Region III
d) NIOSH - Region III

For the purposes of informing the approximately six "affected employees" the employer will promptly "post" the Determination Report in a prominent place(s) near where affected employees work for a period of 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), 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 to the vapors of a newly acquired epoxy-type paint being used by the Maintenance Paint Crew of the Westinghouse Electric Corporation, Lamp Division, Bloomfield, New Jersey. The request was precipitated after the majority of the six man paint crew experienced repeated episodes of headaches, nausea, dizziness, skin eruptions and other symptoms that were noted to occur during each assignment that required the use of the new epoxy-type paint called "Pitt-Glaze"(Trade Name).

IV. HEALTH HAZARD EVALUATION

A. Description of Process - Conditions of Use

The Maintenance Paint Crew is engaged in an ongoing program of structural improvements at the Westinghouse facility. The paint to be used for each assignment is manually prepared for application at the job site(eg. halls, bathrooms, etc.). The epoxy paint components are marketed in separate one gallon containers which are opened and mixed together in an uncovered pail. A strong odor is generated during the mixing process which is detectable throughout the entire work area. Because of the chemical characteristics of epoxy-type products, the paint can only be mixed in quantities sufficient for a few hours of useage. Additional paint is prepared for application at least two or three times during the normal eight-hour work shift. Brushes, rollers and an airless spray gun are utilized by the painters to apply the paint to various structural members. In order to provide increased ventilation for jobs that are being performed in confined spaces, the management supplies the workers with one or two area fans as deemed necessary. Despite the use of these fans, a strong, disagreeable odor is present during the painting operation. Prior to August 1972, the painters were not required to wear any type of personal protective gear.

The composition of "Pitt-Glaze" was made available to NIOSH by PPG Industries(see Table I). It was learned that this particular formulation was a relatively recent development during the last decade and in lieu of the standard epoxy hardener an alkyd resin was being used in the product. The epoxy portion of the paint also differed

from the traditionally used epichlorhydrin-bisphenol A formulation in that epoxidized oils (i.e. linseed and soya) were being used. A warning on the commercial label states that prolonged or repeated skin contact and breathing of the vapors (i.e. principally ethylene glycol monoethyl ether acetate...also referred to as cellosolve acetate) should be avoided.

B. Evaluation Design

Following a preliminary observational survey (August 21, 1972) which facilitated recognition of the most probable health hazard, it was necessary to return to the facility to conduct a more indepth analysis of employee exposure to "Pitt-Glaze." The procedures used to assess the validity of the alleged hazard included on-site interviews with the management, a walk-through inspection of the work place, administration of a medical questionnaire to each of the painters, a review of the medical records for all employees who had reported ill to the dispensary during the period in question, and collection of ambient and breathing zone air samples to detect potentially toxic contaminants.

It was also felt to be important to determine if any of the painters had developed an allergy to the various components of "Pitt-Glaze." However, because many of the chemical agents found in the paint had no skin testing precedents in the literature, it was necessary to test each chemical for its irritant skin concentration first in animals before any human patch testing could take place.

C. Evaluation Methods

A NIOSH Staff Research Industrial Hygienist performed all animal skin testing. Closed (i.e. covered) and open patch test evaluation techniques were employed. Various concentrations of each test chemical were applied to the shaved skin of laboratory animals. One-tenth milliliter of each concentration was placed over a twenty millimeter square area of rabbit skin and test sites were covered with adhesive patches. The same concentrations were also placed on the uncovered skin of guinea pigs in an identical manner. At the end of 24 hours the patches were removed and all test sites were read and interpreted.

Once irritant concentrations for each of the test materials had been determined, a group of five controls from the NIOSH Staff were patched with appropriate test concentrations. On October 24, 1972, two NIOSH Staff Medical Officers returned to the Westinghouse facility to perform patch tests on each of the workers. A medical questionnaire was administered at this time.

Because of unexpected circumstances, the environmental aspects of the investigation were delayed until April 11, 1973. On this date workers were monitored with air sampling equipment while painting a rest room. The tile walls and floors of the room were cleaned

by the painters (following spray painting procedures) using cloths that were saturated with toluene. On the following day, painters were again monitored while performing an assignment in a fire tower. On the latter occasion cleaning with toluene was not required. It should be noted that workers were supplied with appropriate personal protective gear, including cotton-lined neoprene gloves and sleeves, eye goggles, uniforms and respirators, during the April environmental survey.

Area and breathing zone air samples were obtained with MSA Model G Vacuum Pumps and charcoal sampling tubes. The tubes were sent to the NIOSH-Cincinnati Laboratory where they were analyzed for solvent contaminants using the gas chromatographic method of White, et al.[1]

D. Evaluation Criteria

The Occupational Health Standards promulgated by the U.S. Department of Labor (Federal Register, October 18, 1972, Title 29, Chapter XVII, Subpart G, Tables G-1 and G-2) applicable to the individual substances of this evaluation are as follows:

Substance	8-Hour Time Weighted Average	Acceptable Ceiling Concentration	Acceptable Maximum Peak Above The Acceptable Ceiling Concentration For An 8-Hour Shift	
			Concentration	Maximum Duration
Cellosolve acetate-skin	100 ppm*	-	-	-
Stoddard Solvent	500 ppm	-	-	-
Toluene	200 ppm	300 ppm	500 ppm	10 minutes

* ppm - Parts of vapor or gas per million parts of contaminated air by volume.

Occupational Health Standards for individual substances are established at levels designed to protect workers occupationally exposed on an 8-hour per day, 40-hour per week basis over a normal working lifetime. Evaluation of exposures to multiple contaminants requires assessment of "total exposures" with regard to combined, potentiated or inhibited toxic effects.

Additionally, the American Conference of Governmental Industrial Hygienists (ACGIH) have published "Threshold Limit Values" (TLV) for airborne contaminants. These authoritative limits are lower for stoddard solvent and toluene than the Federal Standards. They are listed below for the reason that the more restrictive limits may eventually be adopted as Federal Standards.

ACGIH Threshold Limit Values

Substance	ppm*	mg/m^3**
Cellosolve Acetate-Skin	100	540
Stoddard Solvent	200	1150
Toluene	100	375

* ppm - Parts of vapor or gas per million parts of contaminated air by volume.
**mg/m^3 - Approximate milligrams of substance per cubic meter of air.

The biological parameters observed during this investigation were confined to the results of our skin testing. Criteria for evaluating patch testing followed acceptable medical protocol for performing and interpreting such tests as described by Fisher.[2]

E. Evaluation Results and Discussion

1. Skin Testing - Animals

In animals, the epoxidized linseed oil was non-irritating at a concentration of 10% and below in the closed patch test series of evaluation (see Table II). On uncovered skin it was non-irritating at all concentrations. Epoxidized soya oil was non-irritating at 0.1% only in closed patch tests, and on the uncovered skin this compound was non-irritating at 10% and below. The Alkyd Resin was non-irritating at 1% and below in the closed patch tests and results were similar for the uncovered tests. Acetone (the vehicle) was non-irritating at all concentrations under closed patches and on uncovered skin. The criteria used for interpretation of the animal results are listed in Table III. On the basis of these findings, study subjects (workers) were patch tested with each material at the highest non-irritating concentrations determined from the animal work.

2. Skin Testing - Workers

The results of the closed patch tests performed on the five control subjects and four of the painters revealed no evidence of skin sensitization (i.e. allergy) in any individual (see Table IV).

3. Medical Questionnaires

Neither the control population nor the workers had any previous history of exposure to epoxy compounds prior to January 1972. As might be expected there were no symptoms of a significant nature described by the control group, however, one of the controls (E.S.) had a childhood history of atopy. The incidence of symptoms in the workers prior to this evaluation has been listed in Table V. All workers described some reaction that had occurred during the various epoxy paint assignments. There were no reactions described to any of the conventional paints used at other times during the period in question.

4. Management Interviews and Medical Records

Prior to this investigation there had been three different assignments involving the use of "Pitt-Glaze." A lavatory, an acid resistant room and a corridor has been painted. Each job was conducted in relatively close quarters and the only make-up ventilation was provided by an area or window fan. Workers complained of adverse effects during the first job and an investigation by the management revealed a cross-circuiting of ventilation in the lavatory. While the cause of the first incident was thought to be understood by the management, similar complaints were reported by the workers on the latter jobs but no causal mechanism to explain the workers complaints could be identified.

In all three episodes the workers described the onset of headache, dizziness, burning eyes, nose and throat and in some cases nausea one to three hours after the assignment had begun. Insomnia seemed to plague two of the workers while they were on an epoxy paint assignment. While there had been no skin ailments reported on the first job, at least one worker developed a skin eruption on each of the next two jobs. Dispensary records in the plant described one of the cases as follows, "....a skin condition involving both eyelids...a blister rash which is noted on the forearms, neck and face of the patient." The other worker's skin eruption was described as an erythematous, eczematous reaction in the intertriginous region between the third and fourth fingers bilaterally. In each case the worker was taken off the job and eruptions cleared in 72 hours without specific medication. Neither worker had been reassigned to an epoxy paint job and in fact, the management made a ruling that painting assignments would be rotated so that no painter would be on an epoxy job for more than one week out of every month.

5. Environmental Survey

A total of 15 samples were collected during the environmental survey. All but two samples were taken from the breathing zone of the painters during the painting operations. The concentration of contaminants is listed in Table VI. The more stringent ACGIH Limits have been used to determine the fractional contribution of each contaminant (i.e. a fraction of its ACGIH TLV). These latter values have been used to report the TLV of the mixture.

Cellosolve acetate and stoddard solvent were detected in all samples, however, the concentration of these individual contaminants did not exceed even the more stringent standards in any instance. Toluene exceeded the more restrictive standards in two instances but if one uses the Federal Standard only the higher of these values would exceed the Federal Standard. The higher level was measured at a time when toluene was poured on the floor of the rest room during the cleaning process after painting. This process is to be discouraged.

The TLV for the mixture was exceeded in three samples(i.e. #2, 8 and 10). Again, when Federal Standards are applied the mixture was above the Standard in only one instance(#10) and equaled the Standard in another instance(#8). Toluene was the most prominent contaminant in this mixture. The average concentration of all fifteen breathing zone samples was 0.82 of the TLV for the mixture.

6. Discussion

The inhalatory and cutaneous hazards associated with the use of epoxy resins have been recognized for many years. Key,[3] Birmingham,[4] and many others have written about this subject and have reported the high sensitization capacity of these compounds in their uncured state. As far back as 1963 the Federal Government published a pamphlet[5] stating ways of preventing dermititis if working with epoxy resins. In addition, the pamphlet also addresses the hazard of vapor exposure which undoubtedly played a part in the illness described by the workers at this facility.

It is clear that the epoxy resins being used were being handled improperly from the outset. None of the workers were supplied with protective appliances, painting took place in confined quarters with a probable lack of adequate ventilation and the workers were never advised of the potential hazards of the materials with which they were working. While none of the workers had become sensitized (allergic) to the components of the epoxy paint, it is likely that the skin ailments described in the painters were the result of exposure to irritant concentrations of one or more of these agents. Other symptoms described, such as headaches, nausea, dizziness, burning of the eyes, nose and throat were probably caused by excessive solvent exposures.

The manifestations of solvent toxicity for compounds such as cellosolve acetate, stoddard solvent and toluene assume a pattern similar to that described by the workers. Patty[7,8,9] has outlined these symptoms for each of the volatiles under consideration. Although the concentrations of ambient contaminants were generally below the accepted standards during this investigation, the conditions at the time of our survey were not really analogous to those described during painting jobs when worker illness was reported. There is no way of arriving at the levels that developed on previous occasions. We can only conclude in our best judgement that based on circumstances such as poor ventilation in confined quarters and inadequate protective gear for workers, there was most likely a cause-effect relationship between the sickness described by the workers and exposure to solvents contained in the paint.

It is strongly recommended that the guidelines for the safe use of epoxy resins, as outlined in the U.S. Public Health Service Publication "Preventing Dermatitis If You Work With Epoxy Resins," be

strictly enforced to prevent the recurrence of conditions similar to those that precipitated this hazard evaluation.

V. REFERENCES

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4. Birmingham, DJ: Clinical Observations on the Cutaneous Effects Associated with Curing Epoxy Resins, AMA Arch Indus Health, 19:365 (1959).

5. Preventing Dermatitis If You Work With Epoxy Resins, USPHS Publication No. 1040 (1971), US Government Printing Office, Washington, D.C.

6. Patty, FA: Industrial Hygiene and Toxicology, V II, 2nd ed., p. 1195-1201, Van Nostrand Reingold, New York, 1963.

7. Ibid, p. 1588-89.

8. Ibid. p. 1226-29.

VI. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Steven R. Cohen, M.D.
Principal Medical Officer
Medical Services Branch
Division of Technical Services

Albert A. Maier
Project Officer
Region I-II, Industrial Hygienist

Originating Office:

Jerome P. Flesch, Chief
Hazard Evaluation Services Branch

Acknowledgements :(Medical)

James B. Lucas, M.D.
Medical Officer-Dermatologist
Medical Services Branch
Division of Technical Services

Vernon B. Perone
Research Industrial Hygienist
Toxicology Branch
Div. of Laboratories and Criteria Development

TABLE I

COMPONENTS OF "PITT-GLAZE"*

Epoxy Component (16-630)		Concentration (%)
Pigment		42.9
Titanium Dioxide (Class 3)	81.5%	
Silica and Silicates	18.5%	
	100.0%	
Vehicle		57.1
Non-Volatile	67.8%	
Epoxidized Linseed Oil	67.7%	
Epoxidized Soya Oil	32.3%	
	100.0%	
Volatile	32.2%	
Ethylene Glycol Monoethyl Ether Acetate	67.8%	
Aliphatic Hydrocarbons	18.6%	
Alcohols	13.6%	
	100.0%	100.0% 100.0%

Polyester Component (16-610)		Concentration (%)
Pigment		14.2
Non-Volatile (Polyester Resin)	70.1%	
Volatile	29.9%	
Ethylene Glycol Monoethyl Ether Acetate	69.9%	
Aliphatic Hydrocarbons	30.1%	
	100.0%	100.0% 100.0%

*Components as listed on commercial label.

TABLE II

ANIMAL SKIN TEST RESULTS OF "PITT-GLAZE" COMPONENTS*

Material	Rabbit Skin (Covered) 24-Hour Readings				Guinea Pig Skin (Uncovered) 24-Hour Readings			
	100%	10%	1%	0.1%	100%	10%	1%	0.1%
Epoxidized Linseed Oil	1	0	0	0	0	0	0	0
Epoxidized Soya Oil	2	1	1	0	1	0	0	0
Alkyd Resin	2	1	0	0	1	0	0	0
Acetone (Control)	0	0	0	0	0	0	0	0

*Prepared by Vernon B. Perone, Research Industrial Hygienist, Toxicology Branch.

TABLE III

SCORING SYSTEM USED TO GRADE ANIMAL SKIN TEST RESULTS

Reaction	Grade
No irritation	0(non-irritant)
Erythema(regardless of degree)	1(mild-irritant)
Erythema and edema confined to test area	2(irritant)
Erythema and edema beyond test area	3(strong irritant)
Eschar	4(corrosive)

TABLE IV

WORKER SKIN TEST RESULTS OF "PITT-GLAZE" COMPONENTS

Office Controls*	Epoxidized Linseed Oil /Soya Oil	Alkyd Resin	Acetone
#101(K.R.)	0	0	0
#102(J.L.)	0	0	0
#103(S.C.)	0	0	0
#104(R.L.)	0	0	0
#105(E.S.)	0	0	0
Workers(Painters)*			
#201(W.S.)	0	0	0
#202(F.S.)	0	0	0
#203(M.G.)	0	0	0
#204(G.F.)	0	0	0

*All patch tests were read at 48 hours.

TABLE V

INCIDENCE OF WORKER SYMPTOMS REPORTED DURING PITT-GLAZE PAINT JOBS

Nausea	4/4*
Dizziness	2/4
Eyes burning or itching	3/4
Dryness of nose and/or throat	3/4
Insomnia	2/4
Headache	2/4
Skin Eruption	3/4

*Number of workers reporting symptom/Total number workers exposed.

No.	SAMPLE VOLUME* Liters	CONTAMINANT WEIGHT (mg) Cell Acet	Stod Solv	Toluene	CONTAMINANT CONCENTRATION (mg/M^3) Cell Acet	Stod Solv	Toluene	TLV** (Fraction of) Cell Acet	Stod Solv	Toluene	TLV OF MIXTURE (Fraction of)
1	10.92L	1.64	2.87	N.S.	150	263		0.28	0.23		.51
2	6.58	2.91	5.01	N.S.	442	761		.82	.66		1.48
3	26.52	0.25	16.7	N.S.	9.43	630		.02	.55		.57
4	10.53	3.11	4.45	N.S.	295	423		.55	.37		.92
5	120		Bulk	Sample							
6	10.92	1.40	3.10	N.S.	128	284		.24	.25		.49
7	15.0	2.15	5.27	N.S.	143	351		.26	.31		.57
8	14.0	1.89	5.34	6.11	135	381	436	.250	.33	1.16	1.74
9	15.0	1.31	3.17	N.S.	87	211		.16	.18		.34
10	6.02	0.77	2.20	7.44	128	365	1236	.240	.32	3.3	3.86
11	0		Blank	Sample							
12	11.5	0.33	0.38	N.S.	29	33		.05	.03		0.08
13	10.0	1.11	1.36	N.S.	111	136		.21	.12		.33
14	11.0	2.12	2.85	N.S.	193	259		.36	.23		.59
15	11.17	2.01	3.71	N.S.	180	332		.33	.29		.62
16	11.33	0.77	0.55	N.S.	68	49		.13	.04		.17
17	10L	0	0	N.S.	0	0					0

Average 0.82

*Samples Nos. 1 thru 10 taken 4/11/73 in Woman's Rest Room with fair ventilation
Samples Nos. 12 thru 17 taken 4/12/73 in Fire Tower with good ventilation

**ACGIH Threshold Limit Value

N.S. - Not sampled.