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. 77-71-475

Westinghouse Air Brake Company
Wilmerding, Pennsylvania

March 1978

I. TOXICITY DETERMINATION

The following determinations have been made based upon environmental air samples collected on May 18, 1977 and November 15, 1977, confidential employee interviews, patch tests, observation of work practices and available toxicity information:

1. Measured airborne concentrations of triethylamine (TEA) and methylene chloride did not exceed the recommended criteria on an 8-hour time-weighted average concentration basis within the worksite at the time of this evaluation. However, the TEA results are suspect (sampling/analytical methods under development and questionable) as results of employee interviews indicated employees are experiencing numerous symptoms which can be associated with exposure to TEA. Measurements of the ventilation system at the site of release of TEA showed little air movement. Therefore on the basis of employee health complaints and the ineffectiveness of the present ventilation system, it is recommended that the ventilation system be upgraded.

2. Patch testing revealed no allergic dermatitis among employees. However, examinations and medical histories revealed several employees who had contact dermatitis or other skin problems, such as severe defatting of the skin, which were felt to be work related. This was also supported by the observation of poor work practices among the employees. Recommendations are provided in Section V to help eliminate these problems.

3. Observations in the Pattern Shop indicated a need for repositioning of an exhaust fan, putting in some additional ventilation and an improvement in work practices. These recommendations are also listed in Section V.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Service, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publication Office, at the Cincinnati address. Copies of this report have been sent to:

a) Westinghouse Air Brake Company, Wilmerding, Pennsylvania
b) Authorized representative of employees - Local 610, United Electrical, Radio and Machine Workers of America
c) United Electrical, Radio and Machine Worker of America - New York
d) U.S. Department of Labor - Region III
e) NIOSH - Region III

For the purpose of informing the approximately "100" affected employees, the employer shall promptly "post" for a period of 30 calendar days, the Determination Report in a prominent place(s) near where exposed employees work.

.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 an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health received such a request from an authorized representative of Local 610 of the United Electrical, Radio and Machine Workers of America regarding employees exposure to resins, Shamrock Core Paste and dimethylethylamine (DMEA). Reported symptoms included dry throat, nausea, headaches, shortness of breath and dermatitis.

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

The survey conducted at Westinghouse Air Brake was concerned with the core production areas. Two separate areas dealt with this process. The process involves mixing two parts of an organic resin (Isocure I and II) with sand. This mixture is blown into core molds where the catalyst, triethylamine (TEA), is injected through the sand mixture. The core machines are provided with local ventilation but due to location, the ventilation is not effective.

The Isocure Area contains three large core making machines and eleven small core machines. The second area, the coreroom, contains one new core machine. This machine is provided with a system to scavenge waste gas. Initially the machine was set up to operate using dimethylethylamine (DMEA) as the catalyst. Due to the complaints from employees on the odor as well as reported symptoms of headache, nausea and eye and throat irritation, the machine was modified to use TEA. Approximately twenty individuals are also employed in this area washing cores and assembling core parts. The rough edges and ridges are smoothed off the cores (washing cores) and the various components are assembled. (The Shamrock Core Paste is used, on an experimental bases, to bind core components together.)

Several employees involved in the study worked in the Pattern Shop. The Pattern Shop is located in a separate building from the Isocure and Coreroom Areas. In the Pattern Shop, the various patterns used in the core machines are built, modified and repaired. Work consists of using casting plastics and wood to build or repair the patterns. In the process various types of woodworking and machining operations are used. This work varies depending on the pattern being made or repaired. If a pattern is being repaired, it first must be cleaned. The patterns contain varying quantities of the sand mixture when they arrive at the Pattern Shop. This must first be removed and the pattern then cleaned using mineral spirits. A tank containing mineral spirits is located at one end of the shop. An exhaust fan is located on the wall above the tank. The frequency of use varies from day to day and individual to individual.

B. Evaluation Methods

An initial environmental survey was conducted at Westinghouse Air Brake on May 17-18, 1977. Air samples for triethylamine were obtained in the breathing zone of thirteen workers and in selected areas of potential maximum concentrations. Samples were collected in impingers containing 0.05 M sulfuric acid at a flow rate of 1 liter per minute. A personal and area sample were also taken for the methylene chloride in the Shamrock core paste. Samples were collected on charcoal tubes at a flowrate of 50 cc/min. Both sets of samples were analyzed by gas chromatographic procedures. Brief medical interviews were also conducted with twelve employees to determine if they were experiencing any health problems.

A follow-up environmental-medical survey was conducted on November 14-17, 1977. Personal breathing zone sample for triethylamine were collected on silica gel tubes at 50 cc/min. and analyzed by gas chromatographic procedures. Thirty-three employees were interviewed, examined and patch tested. The questionnaire obtained personal identification data, occupational history and past and present medical history. (Table 1) An examination of the chest, back, arms and legs was performed to determine the presence of any skin problems. The patch tests were applied to the upper left quarter of the back. Patch tests were applied

for Isocure I, Isocure II, water, triethylamine and acetone, the diluent for the Isocures. The patches were removed from the back of the employees in 48 hours and the first readings were made and recorded. Final readings were made in 72 hours. Photographs were taken of the affected areas of the skin so that they could later be reviewed by a dermatologist. The health records of those employees who were patch tested were screened for treatment of skin problems.

C. Evaluation Criteria

Epoxy Resins - Epoxy resin systems are capable of producing both primary irritation 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.

The components of the Isocures are confidential, but potential effects from exposure will be discussed. Isocure I contains a material, which on repeated exposure, may cause dermatitis either from irritation or allergy. A sudden eczematous reaction may occur after a few days of exposure on the face, neck, arms and eyelids. Another ecematous type of reaction, which may not appear for a number of years, starts on the back of the hands, wrists, forearms and other parts of the body exposed to friction from clothing. Isocure II contains a substance which causes irritation of the skin.

Triethylamine - Triethylamine vapor is a primary irritant to the mucous membranes and eyes. Exposure can cause lung irritation, kidney and liver damage, heart muscle degeneration, edema and corneal erosion. The American Conference of Governmental Industrial Hygienist (ACGIH)(1976) recommended threshold limit value (TLV) and the current OSHA standard for triethylamine is 25 ppm.

Mineral Spirits - Mineral spirits are a petroleum distillate fraction composed primarily of paraffins and naphthenes. The vapors are mildly irritating to the mucous membranes. Repeated or prolonged skin contact will dry and defat the skin, resulting in irritation and dermatitis.

Methylene Chloride - Methylene chloride is a mild narcotic. In the human body, methylene chloride is metabolized to carbon monoxide and may produce effects similiar to those resulting from exposure to carbon monoxide. Effects from intoxication include headache, giddiness, stupor, irritability, numbness and tingling in the limbs. Irritation to the eyes and respiratory tract occurs at higher concentrations. Repeated skin contact with methylene chloride may cause a dry, scaly, and fissued dermatitis. NIOSH recommends a time-weighted average limit of 75 ppm.

D. Evaluation Results and Discussion

During the preliminary investigation by NIOSH, interviews with employees revealed that the majority of problems, other than dermatitis, occurred when DMEA was being used. Because DMEA was no longer in use at the time of this study, problems associated with its use will not be discussed. A few individuals did, however, report experiencing upper respiratory irritation, burning eyes, and headaches while working in the areas where TEA was present or from cores made with TEA if they were not sufficiently cured or handled immediately upon completion. Eight employees reported having dermatitis or having had experienced it in the past. Four individuals were presently under the care of a dermatologist. Most individuals believed their skin problems were work related. Based on the information collected, 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 the triethylamine were supplied to the Experimental Toxicology Branch, NIOSH. To determine the concentrations to be used for human patch testing, part of each sample was diluted in either acetone or water at concentration of 50%, 25%, 10% 1% and 0.1%. A 0.1 ml amount of each concentration, including a nondiluted (100%) concentration, was applied to separate 20 mm^2 shaved intact and abraded skin test sites on each of 6 male albino rabbits. The test sites were covered by patches for 24 hours, then they and the materials were removed. The test sites were observed at 24 and 48 hours with the following results:

Material	Solvent	Primary Irritation Index	
		Intact Skin	Abraded skin
Isocure I	Acetone	5%	0.5%
Isocure II	Acetone	5%	0.5%
Triethylamine	Water	10%	5.0%

Concentrations 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. Prior to being tested on employees, the materials were also tested on five control individuals to gage concentrations of the test materials that would not likely cause skin irritation.

Of the thirty-three employees who volunteered to participate in the study, four were found to have various types of occupational dermatitis (defatting of the hands or scaling type lesions of the hand). In most instances the problems were mild and the employees were under the care of the company physician and using medications to control the problem. Several instances of non-occupational dermatitis were also encountered and these employees were also under a physician's care or using medication to control the problem. (See Table II)

The review of the medical records of the participating individuals revealed that four employees were being treated by the company physician for contact dermatitis of the hands. The health records also revealed that employees have been treated for a high number of work related injuries in the past.

The material placed on the test patch prior to application to the employees back were: patch one-water; patch two-triethylamine; patch three-Isocure I; patch four-Isocure II; and patch five-acetone. The results of the patch test revealed that two employees had a reaction to Isocure I, one employee had a reaction to Isocure II and one employee had a reaction to Isocure I, Isocure II and triethylamine. (Table III) Of the four employees who had a reaction to the chemicals used in the patch tests, three employees also reacted to acetone, the solvent used to dilute the Isocures. Based on the mild reactions to the test substances and the reaction to acetone, it is the opinion of the NIOSH medical investigator and of the consulting dermatologist that all of the reactions were most likely irritation rather than an allergic reaction. This is also supported by the fact that of the four employees who had reactions to the chemicals, none were under the care of a physician for work related or non-worked related skin problems nor had they been treated for any skin problems in the past.

Although the patch tests were negative and revealed no allergic reactions, work related skin problems are present. Defatting of the hands, scaling type lesions of the hands and in general dry and cracked skin are prevalent. It was also found that a large majority of the employees participating in the survey were unable to state the harmful effects of the materials they were working with or knew what types of precautions to follow to prevent skin

irritation. It also appeared that if they did know, they did not practice the precautions for one reason or another. Observation of the work habits of the employees revealed that many were following very poor work practices. In addition to this, the shower, locker room and restroom facilities were found to be in very poor sanitary condition and some employees stated that they refused to use the facilities because of their condition. Recommendations concerning these problems will be outlined in the following section of this report.

Environmental samples for triethylamine were collected on the initial survey, May 18, 1977. No detectable levels of TEA were found. On the same date, a personal and an area sample for methylene chloride were collected while Shamrock Core Paste was being used. The sample showed concentrations of 59 ppm and 21 ppm, respectively. This is below the current recommended level of 75 ppm. On the follow-up survey, additional sampling for TEA was conducted. Concentrations ranged from 0.003 ppm to 0.039 ppm. (Table VI) All samples were well below the 25 ppm standard. However, the sampling and analytical methods are developmental and on the samples significant amounts of TEA (greater than 1/3 of the reported values) were found on the reference portions of the sampling tubes. It should be assumed that the values reported are suspect and that the saturation limit of the silica gel may have been exceeded. Therefore the values should be considered minimum exposure, at best.

Although the measured levels of triethylamine were well below the standard, employees reported experiencing upper respiratory and eye irritation when the core machines were filled with TEA, a leak in the system developed or when it was necessary for them to work between the machines. (Such symptoms were also experienced by the NIOSH investigators during the follow-up survey.) The reported time-weighted average concentrations for TEA are well below existing standards, yet employees are reporting symptoms associated with TEA exposure. The standard of 25 ppm for triethylamine should be sufficiently low to prevent eye and mucous membrane irritation. This indicates that the reported TEA values may be greatly in error. The presence of symptoms without the apparent presence of excessive TEA levels also may be explained in the following manner. Employees may be exposed to high TEA concentrations for brief periods of time. The remainder of their workday may be spent where the TEA level is very low. As a result, the TWA concentrations are well below the recommended criteria. However, during the employees high exposure times, levels of TEA may be great enough to produce the reported symptoms. Based on employee complaints and the fact that the present ventilation system is ineffective, a change in the ventilation system, on all but the new core machine, appears advisable. Changes in the location of the present duct work may be enough in many cases to make the system effective.

V. RECOMMENDATIONS

A. General

1. A safety and health program should be implemented to educate all employees on the health hazards associated with the substances they are working with.

2. Employees should be encouraged to follow good work practices and good personal hygiene practices.

3. Work clothes should be changed and washed frequently. Care should be taken to prevent clothing from becoming contaminated with resins, solvents, etc, as this will lengthen the time of contact with the skin.

4. The restrooms, locker room and shower facilities should be upgraded and maintained in good condition.

5. Before work, employees should wash and thoroughly dry all exposed skin and apply a bland barrier cream, such as one consisting of equal parts of an anhydrous lanolin and vegetable oil. This practice provides a barrier against the material being handled and facilitates its removal after work. This practice should be repeated after a break and washed off thoroughly at the end of the shift. This practice should be followed by all employees exposed to the sand mixture and those handling the cores. Where the job permits, gloves should be used in place of the barrier creams.

6. After work, employees should wash thoroughly with soap and water and rinse the skin repeatedly with water until clean. The skin should be dried carefully and a barrier cream applied to counter defatting of the skin.

B. Core Areas

1. Ventilation on the core machines should be improved. The present ventilation is too far from the site of the release of the TEA to be effective. Once positioned correctly, the system should be checked to assure that the capture velocities are adequate.

2. The cores should be allowed to cure out as long as possible before being brought into the coreroom and handled by employees. This will allow the residual resin and TEA to dissipate before being handled by the workers.

C. Pattern Shop

1. The exhaust fan above the mineral spirits cleaning tank should be moved so that the mineral spirits are not drawn past the employees breathing zone while cleaning parts.

2. Employees should wear gloves when removing sand from the patterns and when working with the casting plastic. If gloves cannot be worn, barrier cream should be used.

3. Employees should wear gloves when cleaning parts in mineral spirits. Mineral spirits or other types of solvents should not be used to remove resin, plastic, etc. from the skin. Solvents defat the skin making it dry, cracked and sore.

4. An exhaust system should be supplied for operations where drilling or cutting is performed on molded plastic parts to prevent irritation which result from this procedure.

VI. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Dawn Gilles
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Raymond Stroman
Physician Assistant
Medical Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch
Acting Chief
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Acknowledgements

Environmental-Medical Evaluation:

Clifford Moseley
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Charles Wisseman, M.D.
Medical Officer
Medical Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

James Lucas, M.D.
Consulting Dermatologist
Environmental Protection Agency
Cincinnati, Ohio

Animal Skin Studies:

Vernon B. Perone
Research Industrial Hygienist
Experimental Toxicology Branch
Cincinnati, Ohio

Analytical Laboratory Services:

Utah Biomedical Test Laboratory
Salt Lake City, Utah

Report Typed By:

Linda Morris
Clerk-Typist
Industrial Hygiene Section
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Westinghouse Air Brake Company
Wilmerding, Pennsylavnia
November 1977

Demographic Data
HHE 77-71

Table I

Section	Number Assigned	Number of Volunteers	Percent	Age of Volunteers			Years at Current Position		
				Range	Median	Mean	Range	Median	Mean
COREROOM									
First Shift	79	12	.15	20-59	46	42.8	6-25	13	14.4
Second Shift	44	3	.07	28-52	34	38.0	4-32	14	16.6
ISOCURE MACHINE OPERATORS									
First Shift	16	5	3	30-50	37	38.6	11-13	12	12.0
Second Shift	15	2	1	27-56	-	41.5	1-15	-	8.0
PATTERN SHOP									
First Shift	30	11	3	28-61	54	48.0	5-36	30	26.1
Second Shift	-	-	-	-	-	-	-	-	-
TOTAL	184	33	18	20-61	41.5	35	4-36	16	20

Westinghouse Air Brake Company
Wilmerding, Pennsylvania
November 1977

Complaints
HHE 77-71

Table II

Section	Known Allergic	Skin Problems		Receiving Treatment for Skin Problems	
		Work Related	Non-Work Related	Work Related	Non-Work Related
Coreroom	2	3	1	3	1
Isocure Machine Operators	1	0	0	0	0
Pattern Shop	3	1	1	1	1
TOTAL	6	4	2	4	2

Westinghouse Air Brake Company
Wilmerding, Pennsylvania
November 1977

Patch Testing Results
HHE 77-71

Table III

	1		2		3		4		5	
	Water		TEA		Isocure I		Isocure II		Acetone	
	48 hrs	72 hrs	48 hrs	72 hrs	48 hrs	72 hrs	48 hrs	72 hrs	48 hrs	72 hrs
101	-	-	-	-	-	-	-	-	-	-
102	-	-	-	-	-	-	-	-	-	-
103	-	-	-	-	-	-	+	+	-	+
104	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	?+	+	-	-	-	+
106	-	-	-	-	-	-	-	-	-	-
107	-	-	-	-	?+	+	-	-	-	-
108	-	-	-	-	-	-	-	-	-	-
109	-	-	-	-	-	-	-	-	-	-
110	-	-	-	-	-	-	-	-	-	-
111	-	-	+	+	+	+	+	+	-	+
112	-	-	-	?+	-	-	-	-	-	-
113	-	-	-	-	-	-	-	-	-	-
114	-	-	-	-	-	-	-	-	-	-
115	-	-	-	-	-	-	-	-	-	-
116	-	-	-	-	-	-	-	-	-	-
117	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
119	-	-	-	-	-	-	-	-	-	-

Table III (con't)

	1		2		3		4		5	
	Water		TEA		Isocure I		Isocure II		Acetone	
	48 hrs	72 hrs	48 hrs	72 hrs	48 hrs	72 hrs	48 hrs	72 hrs	48 hrs	72 hrs
120	-	0	-	0	-	0	-	0	-	0
121	-	-	-	-	-	-	-	-	-	-
122	-	-	-	-	-	-	?+	-	-	-
123	-	-	-	-	-	-	-	-	-	-
124	-	-	-	-	-	-	-	-	-	-
125	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
127	-	-	-	-	-	-	-	-	-	-
128	-	-	-	-	?+	-	-	-	-	-
129	-	-	-	-	-	-	-	-	-	-
130	-	-	-	-	-	-	-	-	-	-
131	-	-	-	-	-	-	-	-	-	-
132	-	-	-	-	-	-	?+	-	-	-
133	-	-	-	-	-	-	-	-	-	-
C - 134	-	0	-	0	-	0	-	0	-	0
C - 135	-	-	-	-	-	-	-	-	-	-
C - 136	-	-	-	-	-	-	-	-	-	-
C - 137	-	-	-	-	-	-	-	-	-	-
C - 138	-	-	-	-	-	-	-	-	-	-

0 not read
- negative reaction
? doubtful reaction
+ weak (nonvesicular) reaction
++ strong (edematous or vesicular) reaction
+++ extreme reaction, e.g., markedy bullous or ulcerative

Table IV

Westinghouse Air Brake
Wilmerding, Pennsylvania

November 15, 1977

Results of Airborne Concentrations of Triethylamine
HHE 77-71

Sample Location	Sample Number	Sampling Period	Sample Volume (liters)	Triethylamine (ppm)
Millwright A	SG-1	7:26 - 13:45	22.6	0.005
Millwright B	SG-2	7:27 - 13:35	18.7	0.039
No. 2 Core Machine Oper.	SG-3	7:30 - 13:43	23.8	N.D.
No. 315 Demmler Oper.	SG-4	7:33 - 13:46	20.4	0.003
No. 4 Core Machine Oper.	SG-5	7:37 - 13:45	18.9	N.D.
Sand Mixer	SG-6	7:45 - 13:47	18.0	0.008
CB22 Core Oerator	SG-7	7:52 - 13:37	19.2	0.004
\. 1 Core Machine Oper.	SG-8	7:50 - 13:44	23.3	0.003
reroom Machine Operator	SG-9	8:03 - 14:00	18.9	N.D.
Core Washer	SG-10	8:10 - 14:05	19.4	N.D.

Limit of detection - 0.05 ug/tube