

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. HE 78-111-588

WESTERN ELECTRIC COMPANY
DENVER, COLORADO

April 1979

I. TOXICITY DETERMINATION

Based on environmental and medical evidence, a hazard to the health of the workers exposed to Instapak[®] urethane foam packaging system did not exist at the Western Electric Company in Denver, Colorado during the period of the Health Hazard Evaluation on August 22-24, 1978.

Medical questionnaires revealed a history of "shortness of breath" and "perceived disagreeable odors" associated with the foaming process in five of 21 respondents and perceptions of "foul tastes" in the mouth in four workers.

Environmental air sampling indicated levels of both toluene diisocyanate (TDI) and diphenylmethane diisocyanate (MDI) below the limits of detection in seven area samples and nine personal samples. Small amounts of tetrachloroethylene (Perchloroethylene) and methyldicyclohexylamine were detected in the environmental samples below hygienically significant levels.

The medical and environmental findings together suggest, but do not prove prior sensitization of workers to diisocyanates. The OSHA and NIOSH hygienic standards will not protect sensitized workers from symptoms if sensitization to TDI and MDI has already occurred (Table 2).

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

Copies of this report have been sent to:

- a) Western Electric, 1200 W. 120th Avenue, Denver, Colorado 80234.
- b) IBEW Local 2300, 10465 Melody Drive, Suite 312, Northglenn, Colorado 80234.
- c) International Brotherhood of Electrical Workers, 1125 15th Street NW, Washington, DC 20005.
- d) U.S. Department of Labor - Region VIII.
- e) NIOSH - Region VIII.

For the purpose of informing the approximately 18 "affected employees" the employer shall promptly "post" for a period of 30 calendar days this determination Report in a prominent place(s) near where the exposed employees work.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative regarding worker exposures to Instapak[®], a urethane foam packaging system. The request stated that workers were experiencing headache and sore throats from exposure to this system.

The only substance identified on the June 1978 request for Health Hazard Evaluation was ethylene glycol monoethyl ether and only technical information was solicited. Following initial contacts with IBEW local representatives in July 1978, diisocyanates were identified as the probable health hazard in the Instapak[®] operation and an on-site evaluation was planned. An opening conference and walk through was held on the plant August 22, 1978. Air sampling and ventilation system measurements were conducted August 23 and 24. A closing conference was held with representatives of Western Electric and of IBEW Local 2300 on August 24, 1978. At this conference laboratory analysis report procedures and the prospects for further evaluations was explained. On October 3, 1978, an Interim Report was distributed to representatives of Western Electric and Local 2300. This report contained a summary of actions taken to date.

IV. HEALTH HAZARD EVALUATION

A. Plant Process

The product made in the manufacturing area, Building 30, is PBX electronic communications switching equipment. There are three areas within Building 30 where the Instapak[®] system is used to package units for shipment. The

three areas are essentially identical. Approximately 12 full and part-time packers and six supervisors are employed in this area.

Fiberboard boxes are assembled and foam is introduced into the bottom of the container with a gun. The unit to be shipped as well as protective material to separate it from the foam is added and foam introduced at each side of the container. After the foam has cured the lid is closed and secured. The operator position is above the box. The operator may remain above the box while the foam cures. The operation is not continuous. The estimated gun time is about 20% of the shift.

The foaming gun is attached by hoses to two 55 gallon barrels which contain urethane resin (component B) and polymeric isocyanates (component A). The Product Data Sheet furnished during the evaluation indicated that component A contained only diphenyl methane diisocyanate (MDI). However, laboratory analysis of a bulk sample revealed 400 mg/ml of toluene diisocyanate (TDI) in addition to 320 mg/ml of MDI in component A.

Air pressure is used to convey the components to the gun and to achieve mixing. The operator is required to attach the gun connections to newly opened drums, to clean the gun, as needed, with ethylene glycol monoethyl ether (cellusolve), and to maintain the work area in a clean and orderly condition.

Ventilation is provided by a general vent system with supply diffusers at ceiling height. The base of a typical diffuser is 17 feet above the floor. Pedestal fans are available to blow room air past the operator.

Operators are provided with gloves.

B. Evaluation Design

Free isocyanates and organic vapors from the Instapak[®] and aromatic amines which could be expected to interfere with the Marcali method for measuring isocyanate exposure were the substances of interest.

Long term (3-5 hour) area samples for diisocyanates as well as short term personal samples during actual Instapak[®] spraying were collected.

Long term (5-6 hour) personal and area samples were collected on charcoal tubes and silica gel tubes to identify organic vapors and aromatic amines present.

Smoke tubes and a thermo anemometer were used to evaluate local ventilation conditions in the foaming areas.

The company physician was interviewed and 21 confidential medical questionnaires completed by the industrial hygienist and environmental investigator on workers to determine adverse health effects which might be related to their work.

C. Evaluation Methods

The air sampling and analytical methodology for the different types of samples is shown in Table 1. Included in Table 1 are, for each substance evaluated, the collection device, the range of sample durations, the pump flow rate, the analytical method, the analytical detection limit and, where applicable, the reference for the detailed sampling and analytical method. The personal air samples are those for which the subject actually wears the air sampler with the collection device pinned to the shirt or collar so as to obtain an air sample representative of the air in the breathing zone. The area samples are obtained by placing the sampling device in general work areas thought to have air quality similar to that of the subject exposed. MSA Model D pumps were used to collect the samples analyzed for diisocyanates. Sipin pumps were used to collect the samples analyzed for amines and organic vapors.

D. Environmental Limits, Criteria, and Health Effects

The environmental evaluation criteria used for this study are presented in Table 2. Listed in Table 2 for each substance are the recommended environmental limit, the source of the recommended limit, the principal or primary health effects underlying each recommended limit and the current OSHA standard. There is no recommended exposure limit for N-methyldicyclohexylamine or dicyclohexylamine.

E. Evaluation Results

There was no TDI or MDI in the seven area and nine personal samples analyzed above the lower limit of detection. MDI was identified in component A at a concentration of 320 mg/ml and TDI at a concentration of 400 mg/ml. The area silica gel and charcoal tube samples were analyzed by NIOSH Measurement Support Services Branch. Four silica gel tubes held N-methyldicyclohexylamine at concentrations of approximately 280, 520, 650, and 270 $\mu\text{g}/\text{m}^3$ as determined by a semi-quantative method. Cyclic amines do not interfere with the Marcali method for diisocyanates, three silica gel tubes and eight charcoal tubes contained no identifiable organic compounds at a limit of detection of 50 ng/tube, one charcoal tube from each Instapak[®] area contained perchloroethylene at concentrations of approximately 344, 714, and 662 $\mu\text{g}/\text{m}^3$ well below the NIOSH recommended TWA concentration. The perchloroethylene apparently represents low level leakage from the enclosed and automated soldering operation located nearby. Since the level of detection required to analyze the remaining samples was below that available at the contract laboratory where the balance of the samples were sent and since the reported values were well below the level of hygienic significance, they were not analyzed. There was no cellusolve, ethylene glycol monoethyl ether, the compound of concern named in the request for evaluation, found.

There was no local exhaust ventilation in the Instapak[®] areas. Smoke tube tests showed air rising upward from the floor at two locations and generally minimal air velocities, less than 50 fpm except in the vicinity of pedestal fans or directly below operating diffusers. While this is satisfactory, under conditions observed, except for control of perceived odors, the

ventilation would be inadequate in the event of a spill and respirators for clean-up personnel and evacuation of adjacent personnel pending measurement of diisocyanates in the ambient air would be necessary.

Three case histories involving company medical surveillance, and restriction of exposure to Instapak[®] were discussed with the company physician. Twenty one medical questionnaires were administered to regular and substitute workers in the Instapak[®] areas. Five of the 21 interviewees reported shortness of breath associated with Instapak[®] and four perceived a foul taste in the mouths. Five reported the odor to be disagreeable. Three mentioned getting the uncured foam on their skin and the difficulty of removing it. All questionnaires and medical field notes were reviewed by a NIOSH medical officer.

Read together the environmental and medical data suggest prior sensitization of some employees to diisocyanates. The resultant complaints are triggered by minimal exposures. One interview suggested the problem intensified about a year ago when the formulation of the Instapak[®] was said to have changed. This may have corresponded to the addition of TDI which was not noted in the Product Data Sheet available at the plant. Sensitization during a spill and cleanup remains a possibility. Recommendations: in any event goggles and hand and arm protection from possible contact with liquid diisocyanates is recommended. Details are available in the NIOSH Diisocyanate Criteria Document, Reference 1. (2) A spill evacuation and clean-up plan is needed.

V. REFERENCES

1. Criteria for a Recommended Standard . . . Occupational Exposure to Diisocyanates, U.S. Department of Health, Education, and Welfare, PHS, CDC, NIOSH, September 1978.
2. Criteria for a Recommended Standard . . . Occupational Exposure to Tetrachloroethylene (Perchloroethylene), U.S. Department of Health, Education, and Welfare, PHS, CDC, NIOSH, July 1976.
3. Registry of Toxic Effects of Chemical Substances, Department of Health, Education, and Welfare, PHS, CDC, NIOSH, Volume 2, September 1977.
4. Windholz, Martha, E.D., The Merck Index, Ninth Edition, Merck and Company, Inc., Rahway 1976.
5. U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1910.1000, Table 1 and Table 2.
6. U.S. Department of Health, Education, and Welfare, PHS, CDC, NIOSH, Manual of Analytical Methods, Second Edition - Volume 1, April 1977.

7. Deichmann, William B., Toxicology of Drugs and Chemicals, New York, Academic Press 1969.
8. American Conference of Governmental Industrial Hygienists, Documentation of Threshold Limit Values for Chemical Substances in Workroom Air, Third Edition, 1971.
9. Patty, F.A. ed., Industrial Hygiene and Toxicology, Second Edition, Interscience Publishers, New York 1963, Pg. 2037-2050.
10. Ibid, Pg. 2058-2059.
11. Gleason, M.H., Gosselin, R.E., Hodge H.C. and Smith, R.P. Clinical Toxicology of Commercial Products: Acute Poisoning, Third Edition, Williams and Wilkins Company, Baltimore 1969, Pg. 51.
12. Patty, op. cit., Pg. 1547-1550.
13. Gleason, et. al., op. cit., Pg 65.

VI. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Table I

NIOSH Sampling and Analysis Methodology

Western Electric Company
Denver, Colorado

HE 78-111

<u>Substance</u>	<u>Collection Device</u>	<u>Flow Rate</u>	<u>Duration</u>	<u>Analysis</u>	<u>Limit Of Detection</u>	<u>Reference</u>
Toluene diisocyanate	(TDI) 1-Midget Impinger 15 ml of collecting solution	1.5 lpm	2.5-5.0 hours - area 8-31 minutes personal	colormatic NIOSH P&CAM 141	0.2 µg/ml	6
Diphenyl methane diisocyanate	(MDI) 1-Midget Impinger 15 ml of collecting solution	1.5 lpm	2.5-5.0 hours area 8-31 minutes personal	colormatic NIOSH P&CAM 142	0.3 µg/ml	6
Perchloroethylene (Tetrachloroethylene)	Charcoal tube (150 mg)	50 cc/min	6-7.5 hours	Gas Chromatography Mass Spectroscopy	-	6
N-methyldicyclohexylamine	Silica gel tube	50 cc/min	30-70 hours	Gas Chromatography	-	6

Note 1: The results for both Perchloroethylene and N-methyldicyclohexylamine are reported on a semi-quantative basis since they were present at levels below the usual detection limits available.

Table II
 Environmental Evaluation Criteria
 Western Electric Company
 Denver, Colorado
 August 22-24, 1978

<u>Substance</u>	<u>Recommended Environmental Health Limit</u>	<u>HE 78-111 Source</u>	<u>Primary Health Effects</u>	<u>OSHA Standards</u>
Toluene diisocyanate	35 $\mu\text{g}/\text{m}^3$ - TWA 140 $\mu\text{g}/\text{m}^3$ - ten minute ceiling	Reference 1	Direct irritation, sensitization of respiratory tract, temporary or permanent decrease in pulmonary function	(Reference 5) 0.14 mg/m^3 - ceiling
Diphenyl methane diisocyanate	50 $\mu\text{g}/\text{m}^3$ - TWA 200 $\mu\text{g}/\text{m}^3$ - ten minute ceiling	Reference 1	Direct irritation, sensitization of respiratory tract, chronic decrease in pulmonary function	0.2 mg/m^3 - ceiling
Perchloroethylene	50 ppm^3 - TWA	Reference 2	Central nervous system depression, peripheral neuropathy, mild eye, nose, and throat irritation	100 ppm - TWA 200 ppm - ceiling
Ethylene glycol monoethyl ether (2 ethox ethanol)	370 mg/m^3 - TWA 560 mg/m^3 - STEL	Reference 8 Reference 12 Reference 13	Central nervous system depressant with mild eye, nose, and throat irritation; skin absorption is a factor; can cause kidney damage	740 mg/m^3 - skin
N-methyldicyclohexylamine	_____	Reference 3,7,9	Alkaline irritant for mucous membranes and respiratory tract, and to some extent for skin, may cause halos about lights with eye exposure	
Dicyclohexylamine *	_____	Reference 3,7,9 and 10	Alkaline irritant for mucous membranes and respiratory tract, and to some extent for skin; may cause halos about lights with eye exposure; skin absorption possible. Systemic effects include headaches, nausea, faintness and anxiety; possibly may be a skin sensitizer	

* This substance was identified in component B but was not present in any air sample