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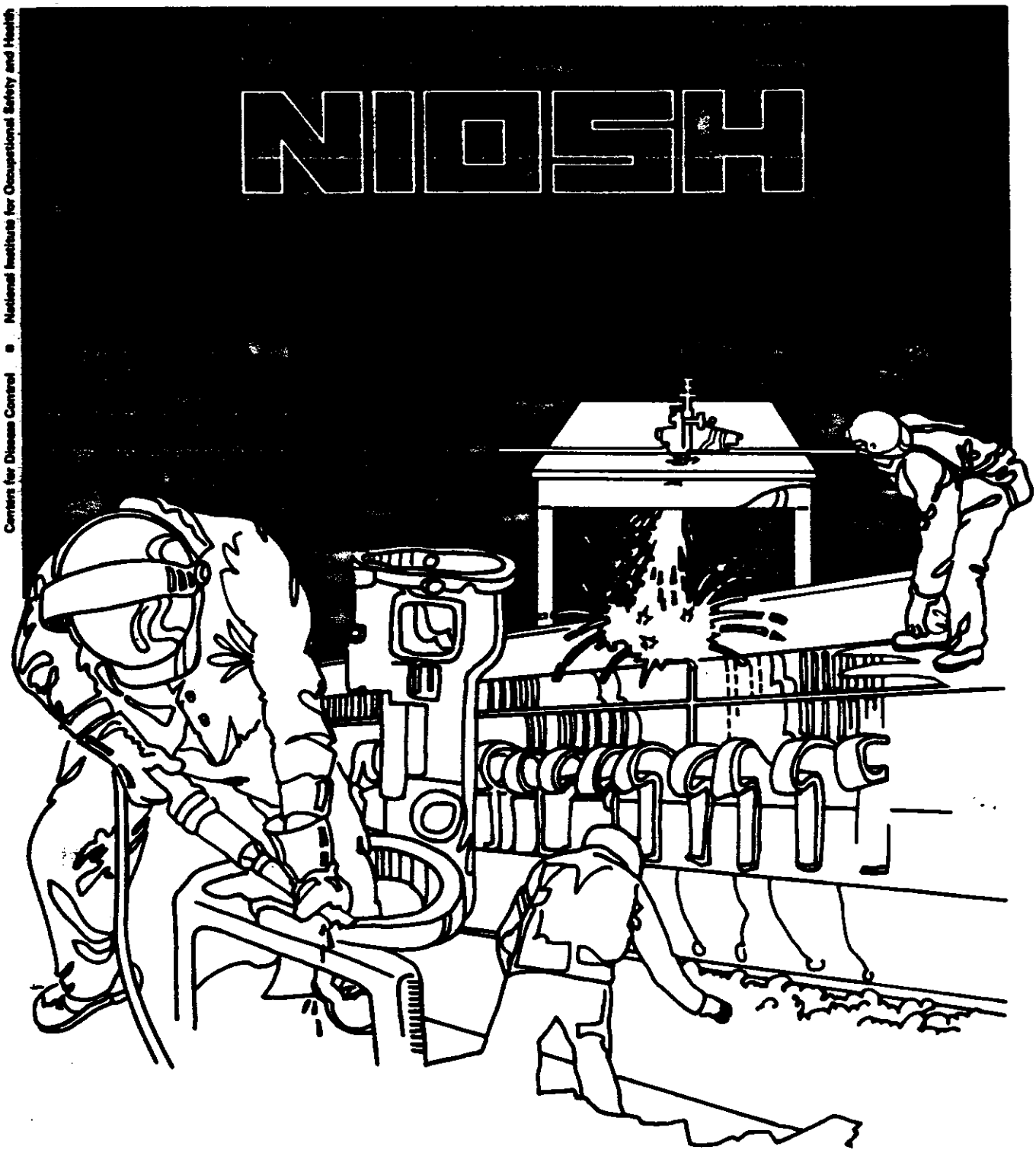

Health Hazard Evaluation Report

HETA 88-122-1912
COMPUTER PRODUCTS CORPORATION
BOULDER, COLORADO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

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COMPUTER PRODUCTS CORPORATION
BOULDER, COLORADO

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I. SUMMARY

In January 1988, the National Institute for Occupational Safety and Health (NIOSH) received a request from Computer Products, Tecnetics Subsidiary, Boulder, Colorado, for an evaluation of solvent exposures during the cleaning of small electrical components. The request was submitted after several workers complained of headaches and nausea. At the time of the study, there were about 10 workers in the Assembly and Potting Departments who worked with solvents.

On February 2, 1988, a NIOSH investigator collected personal breathing-zone air samples from seven workers to evaluate exposure to isopropanol, 1,1,1-trichloroethane, acetone, xylene, toluene, and trichlorotrifluoroethane (freon).

Isopropanol and freon were the major components of exposure to solvent mixtures among Assembly workers while Potting workers were primarily exposed to acetone and 1,1,1-trichloroethane. Exposure to solvent mixtures among four Assembly workers and two Potting workers using small amounts of solvents for routine daily cleaning tasks ranged from 7 to 15% with a mean of 10% of the combined evaluation criteria, based on the most recent NIOSH recommended exposure limits (RELs) or American Conference of Governmental Industrial Hygienists Threshold Limit Values for the individual solvents. One Potting worker using an open bowl of 1,1,1-trichloroethane and larger amounts of acetone than other workers was found to be exposed to 66% of the evaluation criteria. The use of local exhaust ventilation during this procedure was recommended.

It was also noted that Potting Room workers handle small amounts of epoxy catalysts and resins that are potential skin sensitizers. The use of protective gloves and careful work practices was recommended in order to prevent allergic contact dermatitis.

On the basis of the data obtained in this evaluation, it was determined that there were no exposures to organic solvents in excess of recommended standards at the time of the NIOSH visit. The use of local exhaust ventilation was recommended for one cleaning task in the Potting Room.

Keywords: SIC 3571 (Electronic Computers) acetone, 1,1,1-trichloroethane, 1,1,2-trichloro-1,2,2-trifluoroethane, isopropanol.

II. INTRODUCTION

In January 1988, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Computer Products, Tecnetics Subsidiary, for a health hazard evaluation of solvent exposures during the cleaning of small electrical components. The request was submitted after several workers complained of headaches and nausea.

On February 2, 1988, a NIOSH investigator conducted an industrial hygiene evaluation of the Assembly and Potting Departments.

III. BACKGROUND

The Assembly Department employs about 12 workers to assemble circuit boards. Small components are manually cleaned by 4-6 workers using cotton swabs wetted with small amounts of isopropyl alcohol from 8-ounce top-dispensing bottles. One worker occasionally cleans whole circuit boards in a 6 in. x 10 in. open pan of isopropyl alcohol for about one hour.

Some components are cleaned by several workers with trichlorotrifluoroethane (freon) in a Cyclo-Tronics Model 330 Vapor Degreaser located in the center of the Assembly Room. The component is placed at the top of the degreaser in a small wire basket which is automatically lowered. degreased, and raised, such that the worker does not have to stand near the degreaser while it's operating.

Circuit components are also cleaned by three workers in the nearby Potting Department using cotton swabs wetted with acetone or 1,1,1-trichloroethane. One worker occasionally (usually twice per week) uses a 10-inch diameter open bowl of 1,1,1-trichloroethane to clean whole components for about one hour. These components are then cleaned with tissue paper wetted with acetone.

An additional source of potential solvent exposure in the Potting Room is an 18 gallon tank of Humiseal Acrylic Coating which contains mostly toluene and xylene. Circuit boards are dipped in the tank and placed in a 4 ft. x 6 ft. exhaust booth to dry.

IV. METHODS

On February 2, 1988, the NIOSH investigator collected full-shift personal breathing-zone air samples from four Assembly workers and three Potting workers. The samples were collected on charcoal tubes using battery-powered sampling pumps at a flow rate of 50 cc/min. The samples were analyzed for isopropanol, 1,1,1-trichloroethane, acetone, xylene, toluene, and 1,1,2-trichloro-1,2,2-trifluoroethane by gas chromatography according to NIOSH Methods 1400, 1003, 1300, and 1501.[1]

Ventilation measurements of the Potting Room exhaust booth were obtained with an Alnor Model 8100 air velocity meter.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assesment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits (RELs), by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures. Table 1 shows the evaluation criteria used for the substances evaluated in this investigation.

B. Organic Solvent Toxicity

Each of the solvents measured during this evaluation may cause irritation of the eyes, nose, and throat. Effects of direct skin contact with solvents range from dry skin or mild rash to a dry, scaly, fissured dermatitis. These chemicals can also affect the central nervous system (CNS) such that exposed workers may complain of headache, nausea, lightheadedness, dizziness, and uncoordination.

Simultaneous exposure to substances, such as solvents, which affect the body in a similar fashion may have an additive effect. To evaluate these additive effects, the exposure level of each substance is computed as a percentage of the evaluation criterion for that substance. If the sum of these percentages exceeds 100%, the worker is considered to be overexposed to that mixture of substances.

Recent research on the effects of multiple solvent mixtures has focused on behavioral and psycological effects which may indicate nervous system damage or deviations from normal CNS function.[2] For example, an epidemiologic study was conducted on Finnish car painters exposed to a mixture of toluene, xylene, butyl acetate, and white spirits for a mean duration of 15 years. Average combined exposures were less than 32% of ACGIH TLV's; however, researchers found more memory disturbances, decreased vigilance, and more absent-mindedness among car painters than among railroad engineers. Visual intelligence and verbal memory were the most affected. The authors concluded that car painters, although not ill in the clinical sense, showed clear signs of central and peripheral nervous system lesions more often than members of the comparison group.[3,4]

VI. RESULTS

Full-shift TWA exposures to solvent mixtures among seven workers ranged from 7 to 66% of the combined evaluation criteria, based on the most recent NIOSH RELs or ACGIH TLVs for the individual solvents (Table I).

In the Assembly Department, exposure to isopropanol ranged from 25 to 37 mg/M^3 among three workers cleaning with cotton swabs. The worker who used the open pan of alcohol was exposed to 110 mg/M^3. NIOSH recommends an 8-hr. TWA exposure limit of 980 mg/M^3 for isopropanol. Four Assembly workers were exposed to trichlorotrifluoroethane concentrations ranging from 210 to 220 mg/M^3. ACGIH recommends an exposure limit of 7600 mg/M^3 for trichlorotrifluoroethane.

In the Potting Department, two workers were exposed to 11 and 38 mg/M^3 of 1,1,1-trichloroethane, and 48 and 68 mg/M^3 of acetone, when using small amounts of these compounds on cotton swabs. One worker was exposed to 180 mg/M^3 of 1,1,1-trichloroethane that was used in an open pan and 320 mg/M^3 of acetone when cleaning whole circuit components with tissue paper. ACGIH recommends that exposure to 1,1,1-trichloroethane be limited to an 8-hour TWA concentration of 1900 mg/M^3. The NIOSH REL for acetone is 590 mg/M^3.

Negligible amounts (Table I) of toluene and xylene were detected in the Potting Room, due to the use of an effective exhaust booth for the drying of dipped components. Similar in design to a large laboratory-type hood, this exhaust booth had linear air velocities

ranging from 100 to 150 fpm over the entire 4 ft. x 6 ft. face of the hood. ACGIH recommends a minimum face velocity of 100 fpm to prevent contaminants from escaping into the room.[5]

VII. CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

There were no exposures to organic solvents in excess of recommended standards among Assembly or Potting workers at the time of the NIOSH evaluation. Exposure to solvent mixtures among workers using small amounts of solvents and an open pan of isopropanol for routine daily cleaning tasks ranged from 7 to 15% with a mean of 10% of the combined evaluation criteria.

The worker using the open bowl of 1,1,1-trichloroethane and the larger amounts of acetone was exposed to a solvent mixture concentration of 66% of the evaluation criteria. Although no overexposure was found during the NIOSH visit, the use of open containers of most solvents without local exhaust ventilation should be discouraged, due to variable conditions that can affect exposure, such as duration of the cleaning task, changes in temperature or humidity, or accidental spills. Therefore, cleaning of the "70924" component with 1,1,1-trichloroethane and acetone should be conducted in the Potting Room exhaust booth.

Due primarily to the lower volatility of isopropanol, the Assembly worker's use of an open container resulted in an isopropanol exposure that was only 11% of the REL. Isopropanol is one third as volatile as 1,1,1-trichloroethane, and one eighth as volatile as acetone. This means that it evaporates much slower and therefore, emits less vapor in the breathing-zone of the worker. Nevertheless, the possibility of high exposures resulting from accidental spills should be avoided by minimizing the use of open containers as much as possible.

The workers' symptoms that prompted this request cannot be explained on the basis of their exposure levels when compared with the RELs. One possible explanation is that currently "accepted" exposure limits may not be adequate indicators of potential health hazards. Many studies conducted by NIOSH and others have found that symptoms, such as headaches and nausea, can occur during exposure to organic solvents at concentrations well below RELs. Also, the previously discussed study of Finnish car painters shows that behavioral and psychological effects indicative of nervous system damage may occur after chronic exposure to organic solvent concentrations below the RELs. Therefore, exposure to all organic solvents should be reduced as far below the RELs as possible.[2]

It was also noted that Potting Room workers handle small amounts of epoxy catalysts that contain various aromatic and polyglycol diamines, and bisphenol A/epichlorohydrin-based epoxy resins. Due primarily to their low volatility, these compounds are not likely to pose inhalation hazards among Potting Room workers. However, these compounds are capable of sensitizing the skin. Generally, if a worker becomes sensitized (or "allergic") to a substance, then any future exposure causes skin reactions that may be serious enough to require the worker to permanently avoid any jobs where exposure to that substance is possible. Therefore, any skin contact with these materials should be strictly avoided by careful work practices and protective gloves in order to prevent allergic contact dermatitis.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods. 3rd. ed. Cincinnati, OH: National Institute for Occupational Safety and Health, 1984. (DHHS (NIOSH) Publication No. 84-100).

2. National Institute for Occupational Safety and Health. Current Intelligence Bulletin 48 -- Organic Solvent Neurotoxicity, Cincinnati, OH: National Institute for Occupational Safety and Health, 1987. (DHHS (NIOSH) Publication No. 87-104).

3. Husman K. 1980, "Symptoms of Car Painters with Long-Term Exposure to a Mixture of Organic Solvents", Scand. J. Work Environ. and Health, V. 6. pp 19-32.

4. Husman K. and Karli P. 1980, "Clinical Neurological Findings Among Car Painters Exposed to a Mixture of Organic Solvents", Scan. J. Work Environ. and Health, V. 6. pp 33-39.

5. American Conference of Governmental Industrial Hygienists. ACGIH industrial ventilation: A Manual of Recommended Practice. ACGIH Committee of Industrial Ventilation: Lansing, Michigan, 1984.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Copies of this report have been sent to:

1. Computer Products Corp.
2. U.S. Dept. of Labor/OSHA - Region VIII
3. NIOSH - Denver Region
4. Colorado Department of Health

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Table I

Solvent Vapor Exposures

Computer Products, Inc.
HETA 88-122
February 2, 1988

Job/Location	Sample Time	Concentration (mg/M^3) Isopropanol	1,1,1-trichloroethane	acetone	xylene	toluene	freon*	% of Combined RELS+
Assembler # 9	0730 - 1400	110	trace**	7.4	N.D.***	N.D.	210	15
Assembler # 8	0735 - 1430	25	trace	8.4	N.D.	N.D.	220	7
Assembler # 6	0740 - 1430	37	trace	8.8	N.D.	N.D.	210	8
Assembler #14	0745 - 1430	33	trace	7.4	N.D.	N.D.	220	7
Potting # 6	0755 - 1430	-	38	48	trace	4.4	52	12
Potting # 7	0750 - 1430	-	11	68	N.D.	N.D.	36	13
Potting 70924	0755 - 1430	-	180	320	trace	6.1	51	66
Evaluation Criteria Source		980 NIOSH	1900 ACGIH	590 NIOSH	435 NIOSH	375 NIOSH	7600 ACGIH	100%

* freon = 1,1,2-trichloro - 1,2,2-trichloroethane
** trace = above the limit of detection but below the limit of quantitation
*** N.D. = below the limit of detection
\+ To evaluate additive effects, the exposure level of each substance is computed as a percentage of the evaluation criterion for that substance. If the sum of these percentages exceeds 100%, the worker is considered to be overexposed to that mixture of substances.