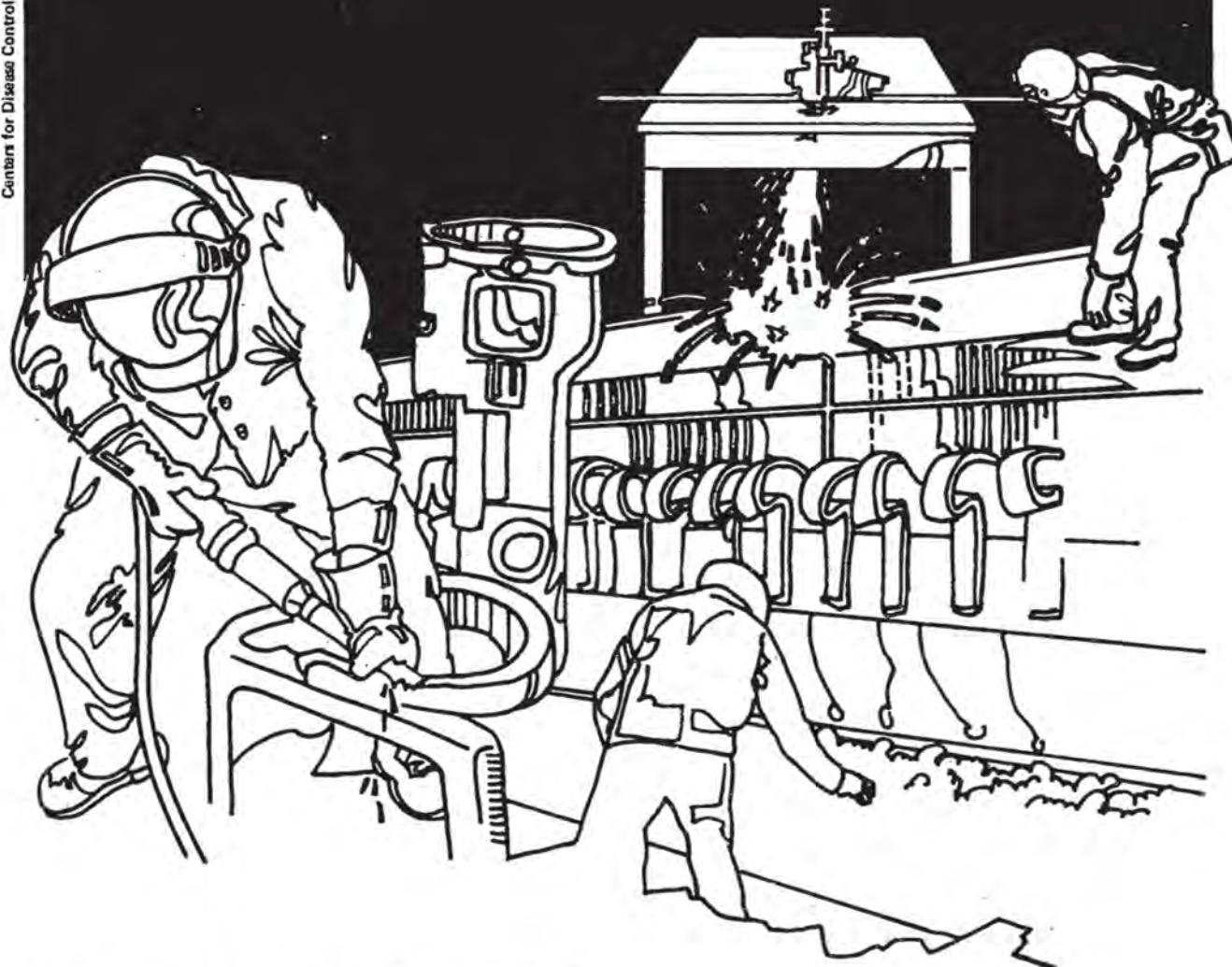


NIOSH



Health Hazard Evaluation Report

HETA 82-364-1243
OHIO THERMOMETER COMPANY
SPRINGFIELD, OHIO

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.

HETA 82-364-1243
DECEMBER 1982
OHIO THERMOMETER COMPANY
SPRINGFIELD, OHIO

NIOSH INVESTIGATOR:
Kenneth M. Wallingford, I.H.

I. SUMMARY

On August 23, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a Health Hazard Evaluation at the Ohio Thermometer Company, Springfield, Ohio. NIOSH was asked to evaluate workers' exposure to inorganic mercury in the small thermometer department.

On September 15, 1982, NIOSH investigators conducted an environmental investigation. They collected direct-reading mercury vapor measurements, obtained ventilation measurements, and observed existing conditions and work practices. Inorganic mercury vapor concentrations were found to range from 4 to 145 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) at 18 work stations in the small thermometer department and were highest near the floor and work tables. NIOSH recommends that exposures to inorganic mercury be limited to 50 $\mu\text{g}/\text{m}^3$ as an 8-hour time-weighted average (TWA). The current Occupational Safety and Health Administration (OSHA) standard for inorganic mercury is a ceiling level of 100 $\mu\text{g}/\text{m}^3$. Exposures may occur not only through inhalation, but also due to skin absorption and ingestion resulting from the visible mercury contamination in the cracks of the floor and work tables throughout the small thermometer department. This residual mercury contamination remains even though the company discontinued the use of mercury for the in-plant manufacture of thermometer tubes over one year ago.

Based on these results, NIOSH determined that a health hazard from overexposure to inorganic mercury existed at the Ohio Thermometer Company. Recommendations to protect the workers and to effect a thorough cleanup of this department are presented in Section VIII of this report.

KEYWORDS: SIC 3820 (Instruments for measuring, controlling, and indicating physical characteristics), inorganic mercury, thermometer manufacturing

II. INTRODUCTION

On August 23, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from an employer representative of the Ohio Thermometer Company in Springfield, Ohio, for a health hazard evaluation. NIOSH was asked to evaluate mercury exposures in the small thermometer department located on the second floor of the main plant building.

On September 15, 1982, two NIOSH industrial hygienists conducted an environmental investigation at the plant. On October 12, 1982, a letter was sent to the employer and employee representatives which summarized the work done on September 15 and included five recommendations to minimize the workers' exposure to mercury.

III. BACKGROUND

The Ohio Thermometer Company was established in 1934 and manufactures thermometers, inclinometers, and clocks. The company employs approximately 100 workers, 60 of whom are represented by the International Association of Machinists and Aerospace Workers (IAM). About 15 employees are involved in the manufacture of small thermometers. Approximately 2500 small thermometers are produced each week in the small thermometer department which occupies the entire 18,000 ft.² second floor of the plant.

Several operations are involved in the process of manufacturing small thermometers. In brief, reservoir bulbs are blown at one end of cut glass tubes which are then filled with an indicating liquid. Any excess liquid is driven out with heat and the tubes are flame-sealed to a specified length. The sealed tubes are calibrated, mounted on a scale, assembled on or in a holder as necessary, and packaged. Brooder (#739) and candy (#6980) thermometers are the two predominate types of small thermometers manufactured at the Ohio Thermometer Company.

In 1979, two compliance inspections were conducted at the Ohio Thermometer Company by the Occupational Safety and Health Administration (OSHA). These inspections were followed in 1980 by a consultative survey performed by the Ohio Department of Industrial Relations (ODIR). As a result of these on-site investigations, the company discontinued the use of mercury in late 1980, and substituted less hazardous indicating liquids for the manufacture of small thermometers. A limited number of pre-manufactured mercury tubes, however, are still purchased for further assembly. After the in-plant use of mercury was discontinued, a follow-up consultative survey was conducted in 1981 by ODIR which indicated that residual mercury vapor levels existed throughout the small thermometer department. ODIR recommended that a more thorough evaluation be performed and that the company initiate the use of HgX on the floor and work surfaces as an interim measure to minimize the workers' exposure to inorganic mercury.

IV. METHODS AND MATERIALS

During the NIOSH environmental investigation, direct-reading mercury vapor measurements were obtained using a calibrated JW (Bacharach) Model MV2 mercury sniffer. Measurements were collected at 18 separate work stations and one lunch station in the small thermometer department on the second floor and at one lunch station on the first floor. At each work station, three separate measurements were made: one at floor level, another at work table height, and a third at the breathing zone.

Ventilation measurements were collected using a Kurz Model 441 air velocity meter at the work stations in the small thermometer department utilizing local exhaust ventilation systems.

V. EVALUATION CRITERIA

A. Toxic Effects of Inorganic Mercury:

Mercury can enter the body through the lungs by inhalation, through the skin by direct contact, or through the digestive system.¹

Acute or short-term exposure to high concentrations of mercury vapor causes tightness and pain in the chest, difficulty in breathing, coughing, inflammation of the mouth and gums, headaches, and fever.^{1,2} Acute mercury poisoning is, however, relatively rare in industry.

Chronic or long-term exposure to lower concentrations of mercury is more common. Chronic mercury poisoning is known to cause tremors and shaking (usually of the hands), inflammation of the mouth and gums, metallic taste, increase in saliva, weakness, fatigue, insomnia, allergic skin rash, loss of appetite and weight, kidney disease, and impaired memory. These symptoms generally occur gradually and may be associated with personality changes such as irritability, temper outbursts, excitability, shyness, and indecision.^{1,2}

NIOSH currently recommends that exposure to inorganic mercury be limited to 50 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) as an 8-hour time-weighted average (TWA).³ The American Conference of Governmental Industrial Hygienists (ACGIH) also recommends that inorganic mercury exposure be limited to 50 $\mu\text{g}/\text{m}^3$ as an 8-hour TWA.⁴ The current OSHA standard for inorganic mercury is a ceiling level of 100 $\mu\text{g}/\text{m}^3$.⁵

VI. RESULTS

The direct-reading measurements collected during the environmental investigation (Table I) indicated that inorganic mercury vapor concentrations ranged from 4 to 145 $\mu\text{g}/\text{m}^3$ at the 18 work stations in the small thermometer department. At the floor, the mercury concentrations ranged from 4 to 145 $\mu\text{g}/\text{m}^3$ with a mean of 38 $\mu\text{g}/\text{m}^3$.

At worktable height, the concentrations ranged from 4 to 95 ug/m³ with a mean of 16 ug/m³. At the breathing zone, the mercury concentrations ranged from 4 to 15 ug/m³ with a mean of 6 ug/m³. Measurements collected at the two lunch stations indicated mercury concentrations ranging from 5 to 20 ug/m³ at the second floor lunch station and concentrations ranging from 1 to 4 ug/m³ at the first floor lunch station. NIOSH's observations indicated that these elevated concentrations were the result of residual mercury remaining in the cracks and recesses of the wood floor and work tables. Some of this residual mercury may be the result of spills due to the breakage of pre-manufactured mercury tubes purchased by the company for further assembly.

Ventilation measurements were obtained at the three work stations in the small thermometer department that utilized ventilating systems. At the tube filling station, the air velocities at the 1 x 62" slot hood ranged from 240 to 500 feet per minute (fpm) with an average of 385 fpm. At the No. 739 heat out station, the air velocities of the 5.5 x 51" (effective dimensions) overhead hood ranged from 50 to 65 fpm with an average of 60 fpm. The air velocities at the No. 6980 marking station ranged from 5 to 90 fpm with an average of 60 fpm through a 25.5 x 41" rectangular hood. Smoke tube measurements taken in the capture plane at these three work stations indicated that smoke was effectively removed by the hoods at the tube filling and No. 6980 marking stations, but not by the hood at the No. 739 heat out station.

VII. DISCUSSION AND CONCLUSIONS

The individual direct-reading mercury measurements were collected in one minute or less and cannot be used to estimate precise TWA exposures for the employees in the small thermometer department. However, even though the in-plant use of mercury was discontinued over one year ago, these results indicate elevated mercury concentrations still exist throughout the small thermometer manufacturing area, especially near the floor and work station tables when compared to the current NIOSH recommended TWA for inorganic mercury of 50 ug/m³.

The ventilation measurements indicated that the ventilation system in place at the tube filling and No. 6980 marking stations were adequate. However, the system in place at the No. 739 heat out station was not adequate. If this station is to be used in the manufacture of thermometers, even without mercury as the indicating liquid, the ventilation system should be upgraded so that the vapors released during the heating operation can be effectively removed.

Based on the results of this investigation, a thorough clean-up of residual mercury in the small thermometer department is necessary to protect the workers from the risk of excessive exposure to inorganic mercury through not only the inhalation of vapor, but also skin absorption and ingestion. Additionally, an emergency clean-up procedure should be implemented to deal with future mercury contamination due to breakage of mercury tubes purchased for assembly at the Ohio Thermometer Company.

VII. RECOMMENDATIONS

Recommendations one through five were presented to the Ohio Thermometer Company in a letter dated October 12, 1982. They will be repeated here for reference, along with three additional recommendations to effect a thorough clean-up of the small thermometer department.

1. The consumption of food and beverages and the practice of smoking on the second floor should be discontinued.
2. The practice of storing lunches in the refrigerator that contains chemicals and solvents should be discontinued.
3. Encourage good personal hygiene practices such as washing before breaks.
4. Remove the mercury tube filling station and the cans of unsealed mercury thermometers from the second floor as soon as practicable.
5. Continue the use of HgX on the floor and work tables.
6. Remove all the residual mercury currently contaminating the floor and work tables in the small thermometer Department with a vacuum system designed specifically for mercury.
7. Once all visible contamination is removed, coat the floor and work tables with an epoxy-type paint that will form a seamless, non-porous covering. Repeat this application as necessary to counteract normal wear.
8. Initiate an emergency procedure to immediately cleanup future mercury spills due to breakage of pre-manufactured mercury tubes purchased by the company for further assembly. This can be accomplished using either the vacuum system described in recommendation No. 6 or a commercially available mercury cleanup kit to prevent the unnecessary migration of mercury to other areas of the plant.

IX. REFERENCES

1. Occupational Safety and Health Administration. Mercury. Occupational Safety and Health Administration, 1975. (DOL (OSHA) publication no. 2234).
2. National Institute for Occupational Safety and Health. NIOSH/OSHA occupational health guidelines for chemical hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 81-123).
3. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to inorganic mercury. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW (NIOSH) publication no. 73-11024).

4. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment with intended changes for 1982. Cincinnati, Ohio: ACGIH, 1982.
5. Occupational Safety and Health Administration. OSHA safety and health standards. 29 CFR 1910.1000. Occupational Safety and Health Administration, revised 1980.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. Ohio Thermometer Company, Springfield, Ohio
2. Authorized Representative of Employees, Local 148, International Association of Machinists and Aerospace Workers
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

Inorganic Mercury Vapor Concentrations
In The Small Thermometer Department

Ohio Thermometer Company
Springfield, Ohio
HETA 82-364

October 15, 1982

Work Station	Concentration ($\mu\text{g}/\text{m}^3$)		
	Floor	Work Table	Breathing Zone
Tube Blowing	20	-	4
Tube Filling	30	4	4
Tube Measuring	80	8	15
Tube Stretching	50	20	10
No. 6980 Heat Out	32	11	4
No. 739 Heat Out/Sealing	30	5	4
No. 739 Marking	70	25	5
No. 6980 Marking	22	12	4
No. 6980 Scaling	25	8	5
Tube Storage	8	-	8
No. 739 Stitch Mounting	15	10	8
No. 6980 Stitch Mounting	62	95	10
No. 739 Glue/Assembly/Packing	18	8	5
No. 6980 Glue	30	12	8
No. 6980 Assembly	20	8	5
No. 6980 Top Off	15	4	5
No. 6980 Case Blowing	145	2	4
No. 4560 Case Blowing	4	4	4
Lunch Table (2nd Floor)	20	12	5
Lunch Table (1st Floor)	4	2	1

All measurements were collected with a Calibrated Direct-Reading JW (Bacharach) Model MV2 Mercury Sniffer

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