FINAL REPORT

MERCURY CONTROL TECHNOLOGY ASSESSMENT STUDY

GTE Products Corporation
Chemical and Metallurgical Division
Towanda, Pennsylvania

Preliminary Survey Report
for the Site Visit of
June 9, 1981

Contract No. 210-81-7107

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Submitted to:

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FOREWORD

A Control Technology Assessment (CTA) team consisting of members of the National Institute for Occupational Safety and Health (NIOSH) and Dynamac Corporation, Enviro Control Division, met with representatives of the GTE Products Corporation Chemical and Metallurgical Division plant in Towanda, Pennsylvania, on June 9, 1981, to conduct a preliminary survey on the techniques used to control worker exposure to mercury. Participants in the survey were:

Dynamac Corporation

David D'Orlando, Engineer
Robert Reisdorf, Industrial Hygienist

National Institute for Occupational Safety and Health

Alfred Amendola, Project Officer

GTE Products Corporation

Carmen Venezia, Industrial Hygienist
Frederick Mower, Engineer
Raymond Newman, Project Engineer
J.B. Kreischer, Loss Prevention Manager
Walter Smith, Manufacturing Superintendent

The preliminary CTA survey was completed in 1 day. The study included a process tour and a review of mercury controls.

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INTRODUCTION

CONTRACT BACKGROUND

The Mercury Control Technology Assessment Study has been initiated to assess the current technology used to protect workers from exposure to mercury. The objective is to identify the methods employed by industries in controlling worker exposure to elemental mercury and mercury compounds. A result of the study will be the publication of a comprehensive document describing the most effective means to control emissions and exposures. This report will be available to companies that handle mercury in order to transfer technology within the major mercury-using industries. The study will also identify areas where additional research is necessary.

JUSTIFICATION FOR SURVEY

Preliminary surveys are intended to generate information about the control strategies used at various facilities and are used to determine where indepth surveys will be conducted.

The GTE Products Corporation was selected for a preliminary survey because it was identified as a plant that used control techniques to successfully maintain mercury vapor levels below the 0.1 milligrams per cubic meter (mg/m^3) Permissible Exposure Limit (PEL), as a time-weighted average (TWA), set by the Occupational Safety and Health Administration (OSHA). This has been achieved through the implementation of several controls designed to limit mercury vapor that can escape from elemental mercury pools used in the tungsten bar pressing and treating operation.

SUMMARY OF INFORMATION OBTAINED

An opening conference was held during which the objectives of the program were discussed with GTE Products Corporation representatives. A description of the tungsten bar pressing and treating operation was given by the process

engineer, followed by a tour of the production facility. The controls in use were observed, and additional information on the mercury control strategy was obtained through discussions with engineers and the industrial hygienist.

PLANT DESCRIPTION

The GTE plant manufactures numerous high-technology, chemical, metal, and ceramic products including aperture masks, phosphors for television screens, fabricated parts, and forms of tungsten and molybdenum. The tungsten bar pressing and treating operation is the only process at the plant that uses mercury. This operation occupies a 2,400-square-foot room in one of the buildings at the plant. The building is a block wall structure with poured concrete floors and corrugated steel roof. Renovations of the building, made in 1967, included the installation of controls to maintain mercury vapor levels below the OSHA PEL.

Ten workers may be exposed to mercury in the Press and Treat Room. This includes three shifts of three operators each, plus one group leader. Of the three operators on each shift, two are Press Operators and one is a Treat Operator. The tungsten bar production process is run periodically according to demand for the product.

PROCESS DESCRIPTION

The tungsten bar pressing and treating process, a typical tungsten sintering operation, has been used at the plant since 1941. Minor changes have been implemented to improve product quality and to reduce worker exposure to mercury.

The process begins with the pressing of tungsten powder into long, thin bars of specified weights. The bars must then be strengthened and densified thrcugh presintering in a muffle furnace and sintering with a high amperage electrical current. These processes are both proprietary in nature. Mercury is used as a continuous electrical contact in the sintering process. It is contained in pools called mercury cups. Each sintering unit (treating bottle) is located in a ventilated enclosure.

After sintering, the bars are cooled to room temperature and the tungsten density is determined. Mercury is used for density measurements because of its high specific gravity. The bars are immersed in a pool of mercury, and the weight of the displaced mercury is determined. The volume of the bar is calculated by dividing the weight of the displaced mercury by the density of mercury. The density of the tungsten bar can be determined by dividing the mass of the bar by the volume. When the bar is removed from the mercury pool, the mercury is brushed off into a tray of water located in front of the pool.

MERCURY CONTROL TECHNIQUES

ENGINEERING CONTROLS

Treating Bottles

Each set of treating bottles consists of a ventilated enclosure with a separate vertically sliding door for each bottle. The doors are kept closed except when a bar is being loaded or unloaded from a bottle. When the bars are being heated, the bottles are kept sealed over the mercury cups. Vaporization of mercury from the cup is reduced by using water-cooled treating bottles and contacts. Water trays are situated below each set of bottles to collect mercury droplets that may fall from a bar when it is removed from a bottle. The 1- to 2-inch water level in these trays reduces mercury vapor emitted from the droplets.

Air Supply System

Air supply to the Press and Treat Room is provided by one 10,000 cubic feet per minute (cfm) unit (Figure 1). The unit draws 100 percent outside air through a dome roof intake. Three duct heaters in parallel provide the heat for the air. The air-conditioning cooling coils are used to maintain a temperature below 20 C (70 F) during the warmer months. Supply air is distributed in the room through four 48-inch by 20-inch supply registers.

Air Exhaust System

Air is exhausted from the Press and Treat (Sintering) Room by two separate exhaust ventilation systems (Figure 2).

Sintering Exhaust System--
The sintering exhaust system consists of four 12-inch by 12-inch exhaust air ducts that come off of both sides of each of the sets of treating bottle

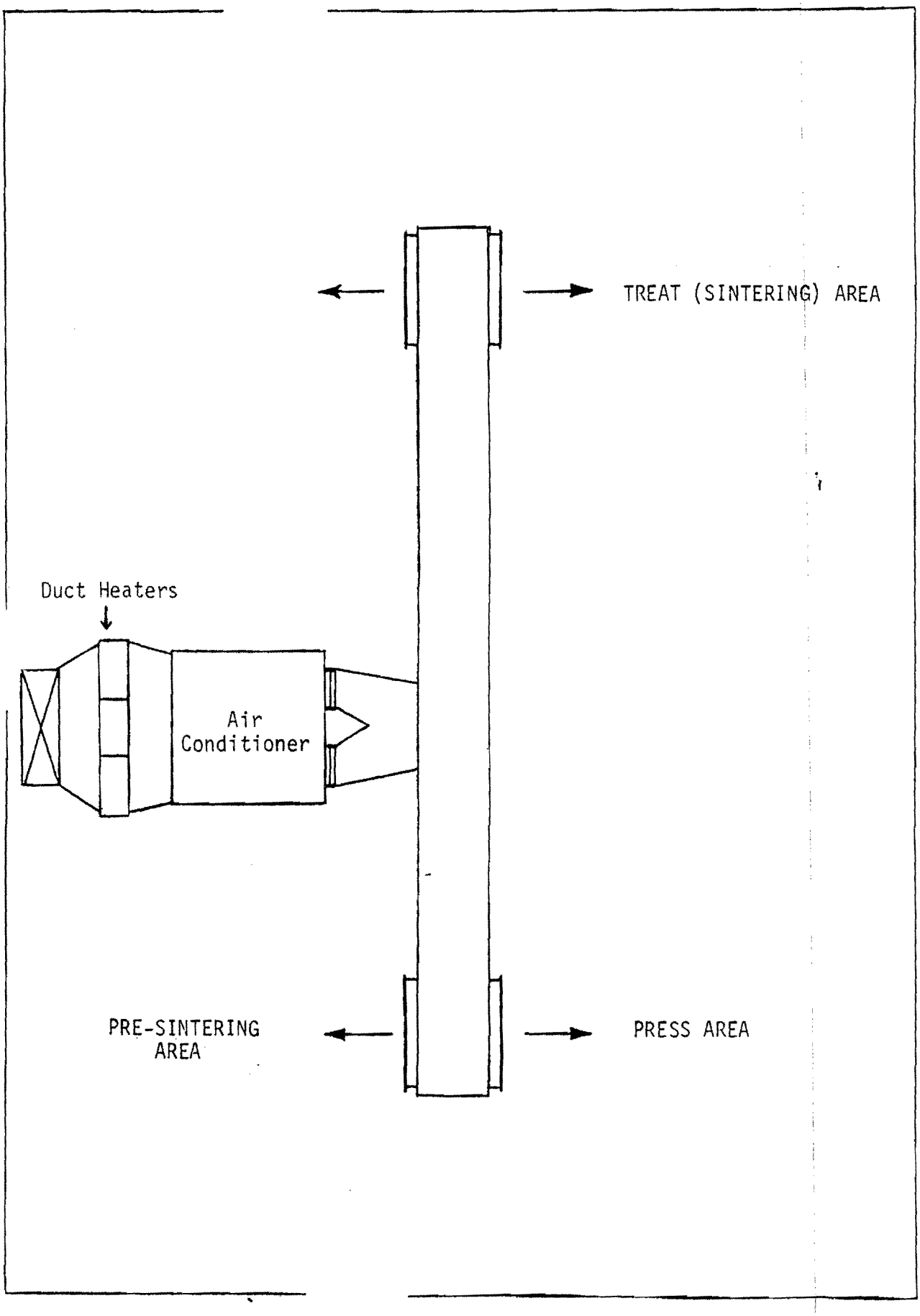

Figure 1. Press and Treat Room - Air Supply System.

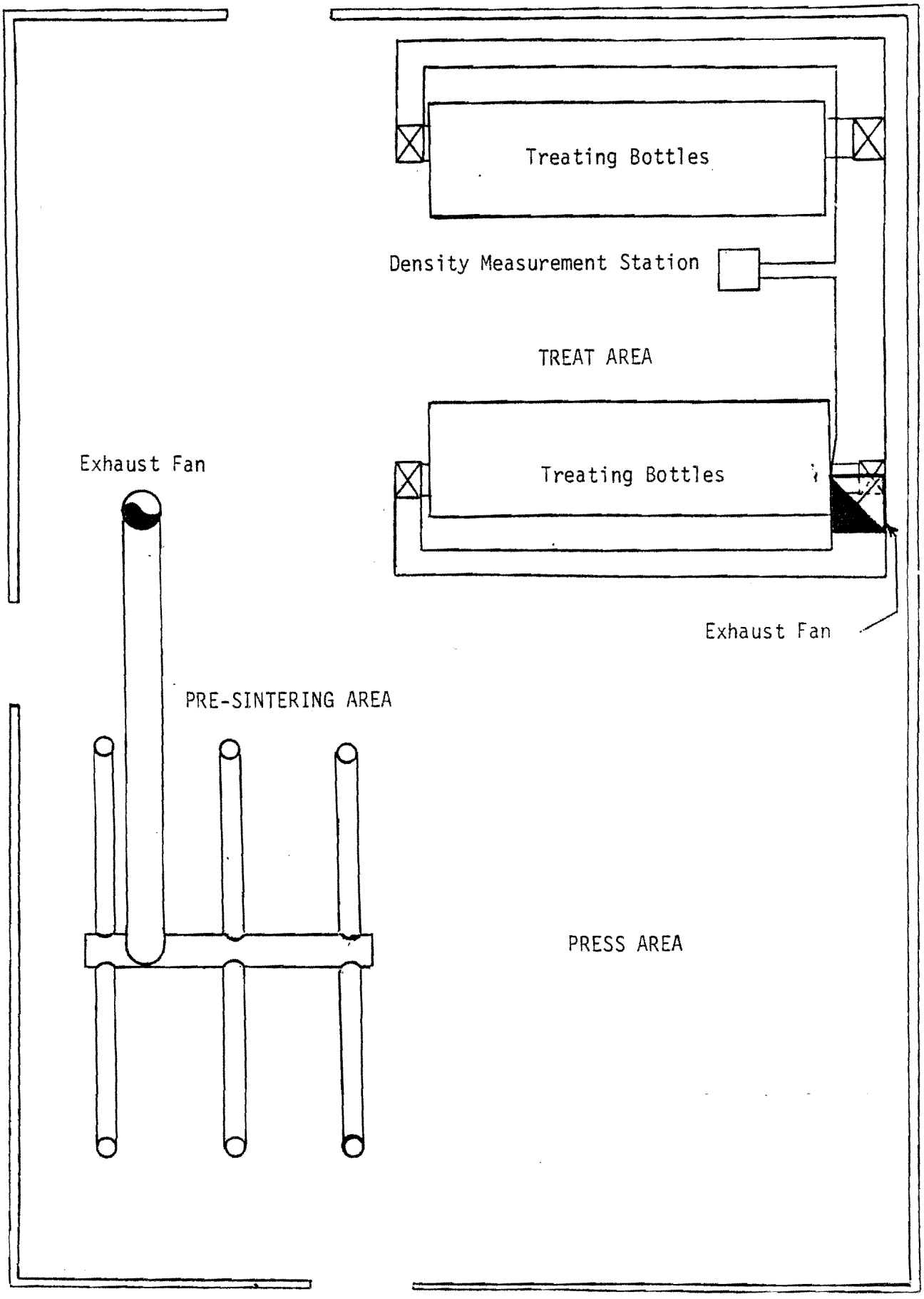

Figure 2. Press and Treat Room - Air Exhaust System.

enclosures. The ducts combine into a 22-inch by 22-inch central duct that leads to a 600 cfm roof exhaust fan. This system was installed to draw air through the faces of the treating bottle enclosures and to remove the mercury vapor given off from the mercury cups.

Density Measurement Station Local Exhaust--
A separate local exhaust ventilation unit is located at the density measurement station. This unit is a backdraft slot hood. It draws air across the mercury pool, through a 4-inch duct to a 6-inch duct, into the sintering exhaust system. The mercury pool is covered while not in use for density check. There is a tray in front of the mercury pool to contain droplets of mercury that have been brushed off the bars. A level of water is maintained in the tray to reduce mercury vaporization.

Presintering Exhaust System--
This system was installed primarily to remove local heat, hydrogen, and metal fumes from the presintering area. However, it may contribute to the removal of air contaminated with mercury that may be present. The presintering exhaust system has six local exhaust ventilation (LEV) units mounted above the openings at either end of the presintering furnaces. Each unit is a small exhaust hood with a 6-inch duct leading to a central 14-inch duct. The 14-inch duct leads to a 1,500 cfm roof exhaust fan.

Central Vacuum System

The Press and Treat Room has a separate central vacuum system that is exhausted to the roof. There are eight 2-inch-diameter capped vacuum inlets throughout the room. Each inlet has a particulate trap that is emptied when full. There is no filter in the system.

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment used at this facility to control worker exposure to mercury consists of the following:

- Sheepskin gloves are worn when handling materials that may be contaminated with mercury. These are changed at the discretion of the worker. The gloves are worn for general cleanliness as well as for control of dermal exposure to mercury. The gloves are disposed of when worn out.

- Tyvek^{R} disposable smocks are worn by the Treat (Oven) Operators. These are usually changed once per week.

- An air-line respirator (Mine Safety Appliance, Comfo-II, facepiece with a positive-pressure, continuous-flow regulator using house air) is used while cleaning the sintering units. The cleaning operation generally takes 15 minutes for each set of sintering units and is conducted once per shift.

WORK PRACTICES

The practices in effect to reduce worker exposure to mercury in the Press and Treat Room are as follows:

- Consumption of food or beverages is not permitted.

- Smoking is not permitted.

- Workers are required to wash their hands before breaks.

- Workers are requested to inspect all areas for visible amounts of mercury.

- Job rotation is implemented whenever urine-mercury levels indicate a high level of exposure to mercury.

- Skin cuts, cracks, or abrasions must be covered.

- Pliers or tongs must be used to recover material from the mercury "cup."

- Only one enclosure door at a time should be opened. This allows for better exhaust ventilation.

- All materials and equipment must be thoroughly brushed free of mercury before removal from the oven enclosure.

- Maintenance work within the bottle enclosures is not permitted until a thorough cleanup has been completed by the Treat Operator.

- Doors to the room must be kept closed.

- Respirators must not be stored in the Treat Area.

- Contaminated equipment must be stored in ventilated cabinets.
- The designated sink must always be used for rinsing mops and dumping mop water.
- Waste materials must be placed in an orange-colored, 24-gallon drum that is kept covered.
- Heat gloves (used for changing bars) should be stored in plastic bags. These gloves should not be worn except when needed.
- Water levels under the treating bottles and the density measurement station must be maintained to reduce mercury vaporization.
- The mercury tank used for density measurement must be kept covered when not in use.

HOUSEKEEPING

Housekeeping practices in effect include the following:

- Floors are washed with HgX^R, a mercury decontaminant, once per shift.
- Routine equipment cleaning is conducted using the house vacuum system.
- Mercury spills are cleaned using a portable mercury trap connected to the house vacuum system. The trap consists of a 3-1/2 gallon can with inlet and outlet connections and serves to collect liquid mercury during the vacuuming process. Operators are responsible for the cleanup of spills. In addition, operators are responsible for routine cleanup and HgX^R washing.
- Floors are painted once a year with red epoxy paint to help minimize absorption of mercury into the floor and make liquid mercury droplets more visible.

MONITORING PROGRAMS

Biological Monitoring

Biological monitoring is an important part of the plant's medical program. This involves monthly monitoring of workers' urine for mercury. Usually only the Press and Treat workers and the Group Leader are monitored. Spot urine samples, rather than 24-hour composites, are collected. Biological monitoring has been conducted since the early 1960's.

If a worker's urine-mercury level exceeds 0.10 milligrams per liter (mg/L), the worker may be moved to an area where the potential for exposure is lower. For example, a Treat Operator may be relocated to the Rotary Press operation, which is still inside the Press and Treat Room. When the urine-mercury level of two samples is 0.25 mg/L or higher, or when the level of one sample is 0.30 mg/L or higher, the worker is removed from the mercury use area. Workers may be reinstated to their former jobs when their urine-mercury levels drop below 0.10 mg/L. Urine samples are analyzed at the facility. The analytical method used is an adaptation of NIOSH Method P&CAM 165. The results of urine-mercury analyses were reviewed. Most worker levels were below 0.10 mg/L; the most recent monitoring data (April 1981) ranged from 0.03 to 0.10 mg/L for the seven workers sampled.

Air Contaminant Monitoring

Monitoring to determine the levels of mercury vapor is not conducted on a routine basis at this facility. However, periodic sampling to determine both the level of mercury vapor and the time-weighted average (TWA) exposure of workers to mercury vapor has been conducted. Mercury vapor levels have been monitored using a direct reading instrument (Hg Mercometer - Anti Pollution Technology Corp., Div. of Thermotron Corp.); however, this instrument is not currently used at this facility. Personal sampling to determine TWA exposure is conducted by collecting samples on Hopcalite solid sorbent tubes. This sampling and analytical method is similar to NIOSH Method P&CAM 176. Usually, only the Treat Operator is selected for monitoring purposes. The results of the five samples taken between 1974 and 1981 ranged from 0.03 to 0.09 mg/m^3 of mercury.

Continuous monitors for the detection or control of mercury vapor are not in use at this facility.

OTHER PROGRAMS

Medical Program

The medical program at this facility is administered by a consulting physician at the plant's clinic. Part of the medical program involves a program

for employees working with mercury. The elements of the program are summarized below.

SCHEDULE FOR EXAMINATIONS

Employee Age	Routine Physical Exam	Nurse's Check
Under 35	Pre-employment	3 years
35 to 45	5 years	2-1/2 years
45 to 60	3 years	1-1/2 years
60 to 65	1 year	--

PRE-EMPLOYMENT AND ROUTINE EXAMS INCLUDE:

- Complete physical and medical history
- Eye examination
- Hearing test
- Urinalysis (albumin, sugar--does not include determination of mercury)
- Chest X-ray
- Spirometry
- EKG
- Blood work

NURSE'S CHECKS INCLUDE:

Height and weight	Eyes
Appearance	Hemoglobin
Teeth, throat	Urinalysis
Temperature and pulse	Medical history
Blood pressure	Comments (employee)
Skin	Comments (nurse)

Education and Training

Each new operator in the Press and Treat Room undergoes a 2-week training period. This involves on-the-job training while working with the Group Leader. A training progress sheet is filled out for each employee after one month by the Group Leader. Included is an evaluation of the employee's knowledge of mercury handling and safety procedures.

SURVEY DATA

Sampling to determine the level of mercury vapor was not conducted during this survey.

CONCLUSIONS AND RECOMMENDATIONS

Limited plant monitoring data reviewed during the survey suggest that existing control strategies associated with the manufacture of tungsten rods are effective in controlling worker exposure to mercury.

Based on general observations and information supplied by plant representatives, workplace control of mercury is achieved primarily by:

- Use of enclosed, ventilated sintering units
- Good housekeeping practices including spill cleanup procedures
- Sound work practices
- Medical monitoring.

It is recommended that the plant adopt a regular air monitoring program to determine mercury vapor levels in the ambient air.

The control most worthy of additional study is the exhaust air enclosure for the treating bottles.