FINAL REPORT

MERCURY CONTROL TECHNOLOGY ASSESSMENT STUDY

Partlow Corporation
New Hartford, New York

Preliminary Survey Report
for the Site Visit of
June 16, 1981

Contract No. 210-81-7107

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Submitted to:

Alfred A. Amendola, Project Officer
National Institute for Occupational
Safety and Health
Division of Physical Sciences and Engineering
4676 Columbia Parkway
Cincinnati, Ohio 45226

Submitted by:

Donato R. Telesca, Manager
Engineering Department
Dynamac Corporation
Enviro Control Division
11140 Rockville Pike
Rockville, Maryland 20852

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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 Enviro Control, Inc. (ECI) met with representatives of the Partlow Corporation in New Hartford, New York on June 16, 1981 to conduct a preliminary survey on the techniques used to control worker exposure to mercury. Participants in the survey were:

Enviro Control, Inc.

Donato Telesca, Program Manager
Robert Reisdorf, Industrial Hygienist
David D'Orlando, Engineer

National Institute for Occupational Safety and Health

Alfred Amendola, Project Officer

Partlow Corporation

Frank Stagliano, Industrial Relations Manager
Homer Goodier, Engineering Manager
John Kieler, Shop Operations Manager
William House, Manufacturing Manager

The preliminary CTA survey was completed in one day. The study included air sampling, detailed inspections of control equipment, and review of monitoring programs.

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1. INTRODUCTION

A. Contract Background

The Mercury Control Technology Assessment Study has been initiated to assess the current technology used to protect the worker from exposure to hazardous levels of mercury. The objective is to identify and evaluate the exemplary 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 which handle mercury to transfer technology within the major mercury using industries. The study will also identify directions where additional research is necessary.

B. Justification for Preliminary Survey

Preliminary surveys are intended to generate information about the control strategies used at various facilities and they will be used to determine where in-depth surveys will be conducted. The Partlow Corporation (Partlow) Industrial Temperature Control Manufacturing Plant was selected for a preliminary survey because of the proactive measures which the company has taken to protect its employees from exposure to mercury. The mercury filling operation at Partlow has been completely refurbished in an effort to reduce mercury vapor levels below the Occupational Safety and Health Administration's (OSHA) standard of 0.1 mg/m^3 as a time weighted average (TWA).

C. Summary of Information Obtained

An opening conference was held during which the objectives of the program were discussed with the Partlow representatives. The survey team toured the plant and reviewed the operations involving the use of mercury. Information on work practices and the ventilation systems was obtained during brief meetings. The department slide presentation used to train new employees in the use of mercury was shown to the survey team.

II. PLANT DESCRIPTION

The Partlow Corporation manufactures mechanical and electronic industrial temperature control instruments. The only manufacturing process involving the use of mercury is the fabrication of the mercury-filled Piston-Pak thermal sensing element. The Piston-Pak is a heavy duty hermetically sealed devise which is used in almost all of Partlow's mechanical temperature control units. Principal uses include temperature control for container shipment, industrial heating and cooling processes, and concrete curing. The Piston-Pak element is manufactured in a separate building (Element Fabrication Building; Figure 1) from the rest of the plant. This building, formerly a super market, was bought and renovated in 1974, and the entire Partlow mercury operation was moved into it. Renovations included the installation of new machinery and ventilation equipment. The building is constructed of concrete block.

The production floor (10,000 sq. ft.) is one large room consisting of 4 major work areas:

1. capillary/bulb preparation
2. mercury filling
3. pushing, sealing and element assembly
4. element repair

Element production operates one shift per day, 5 days per week. There are 13 production workers; one supervisor, four welders, and eight workers rotating in degreaser, grinder, coiler, and sealing and filler job classifications.

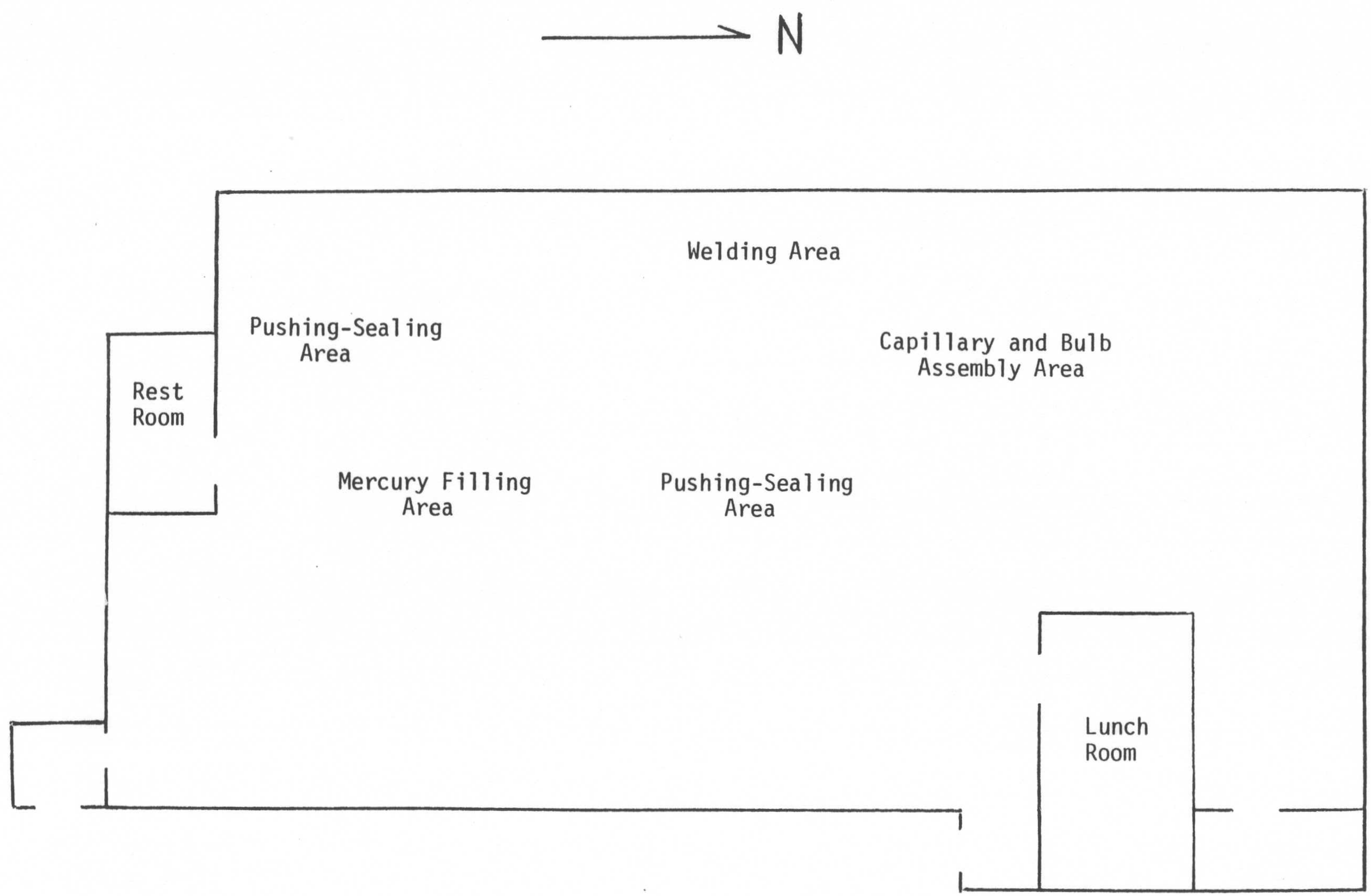

Figure 1. Element Fabrication Building

III. PROCESS DESCRIPTION

The Piston-Pak element is a bulb and capillary temperature sensing device (Figure 2) which uses the force of an expanding liquid (mercury) to operate external controls and indicators.

Bulb and Capillary Assembly

Bulbs and capillaries are made of either 1010 carbon steel or 316 stainless steel. Bulb size determines the temperature range of each sensor. Bulbs are made by cutting metal tubing to size, welding a machine plug to one end of the tube, and a coupling to the other (open) end of the tube.

The rolled capillary is straightened by drawing it through a guide pipe. It is cut to a specified length and is heliarc welded to the coupling at the open end of the bulb. The other end of the capillary is welded to a "head" which houses the mechanical section of the sensor. Completed assemblies are grouped in job lots.

Mercury Filling

Mercury filling of the bulb and capillary assembly is performed in a ventilated and enclosed multi-station mercury filling machine. Each station consists of a fitting attached to a central manifold through which the mercury is introduced to the capillary bulb assemblies. Elemental mercury, which is received at the plant in boxes of twelve 30-pound plastic bottles, is stored in a separate room. The bottles are used to fill a mercury reservoir on the fill machine. The mercury filling operation is a proprietary process.

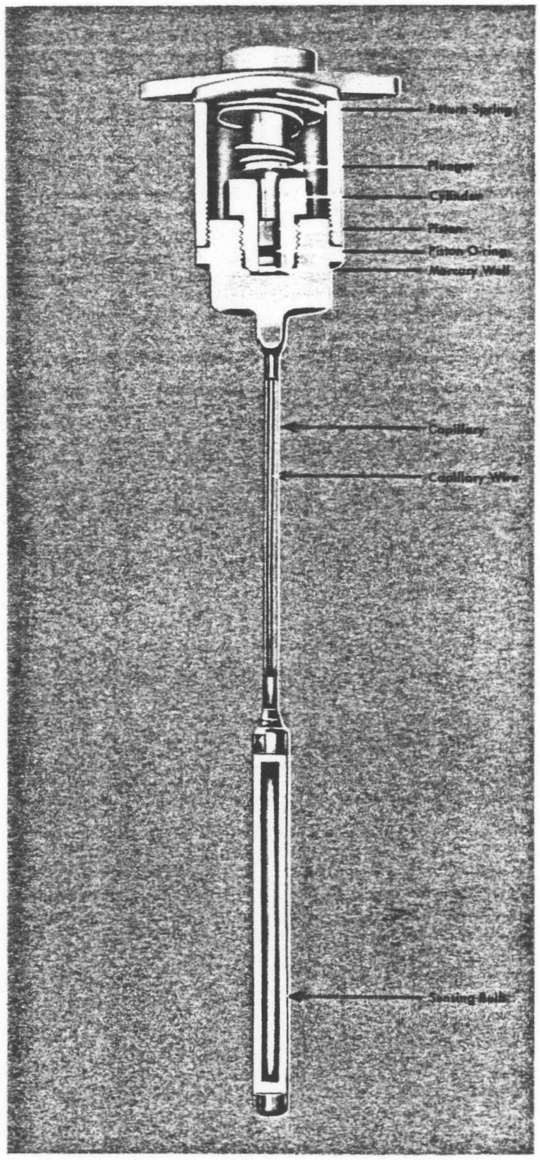

Figure 2. Piston-Pak Thermal Sensing Element

U.S. Patent No. 3,103,818

Wire Pushing and Sealing

A wire is inserted the length of the capillary so that the volume of mercury in the capillary is reduced. This improves the performance of the sensing element because a greater mechanical movement in the head results from small volume changes in mercury. The procedure for inserting the wire is proprietary information.

Final Assembly

The sensor assembly is transferred from the wire pushing station to the final assembly station where a return spring and plunger are set into a temporary housing. The housing which is placed over the head, keeps the head clean, holds the piston in the cylinder, and protects the completed sensor from damage during transport.

The complete sensors with temporary housings are transferred to a calibration station in a different building of the plant. Mercury is contained in the unit at this point. The Piston-Pak sensor is attached to a controller and/or indicating device and is shipped as a complete temperature instrument.

IV. MERCURY CONTROL STRATEGY

A. Engineering Controls

1. Mercury Fill Station

The Mercury Fill Station is an enclosed work bench with a manifold designed to fill twelve capillary-bulb assemblies at one time. The station enclosure is a 3-sided stainless steel hood (Figure 3) with a cable lift, windowed-door (Figure 4) which is kept closed during the fill process. Air is exhausted through a 6-inch duct on the top of the unit.

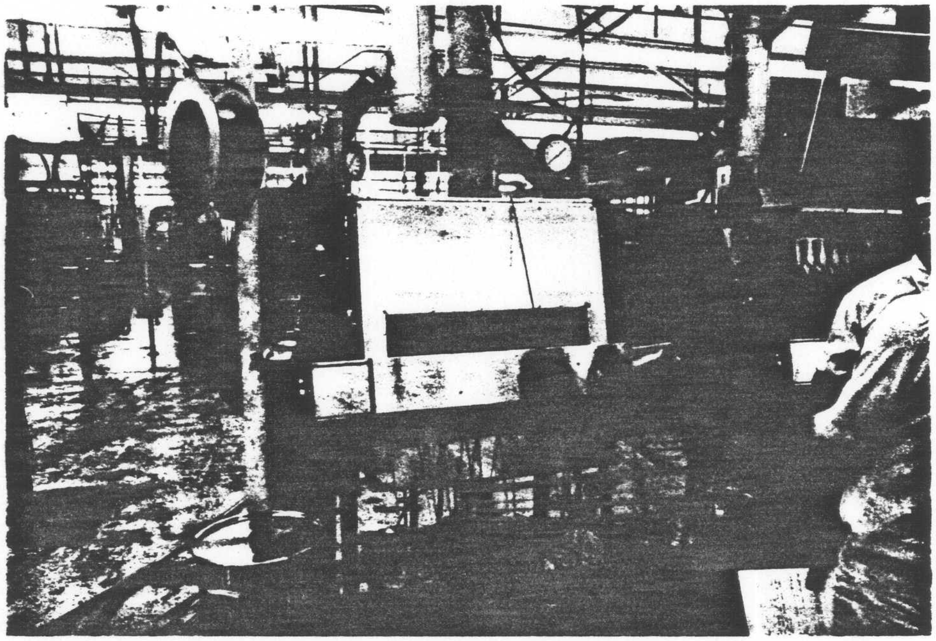

Figure 3. Mercury Fill Station Hood

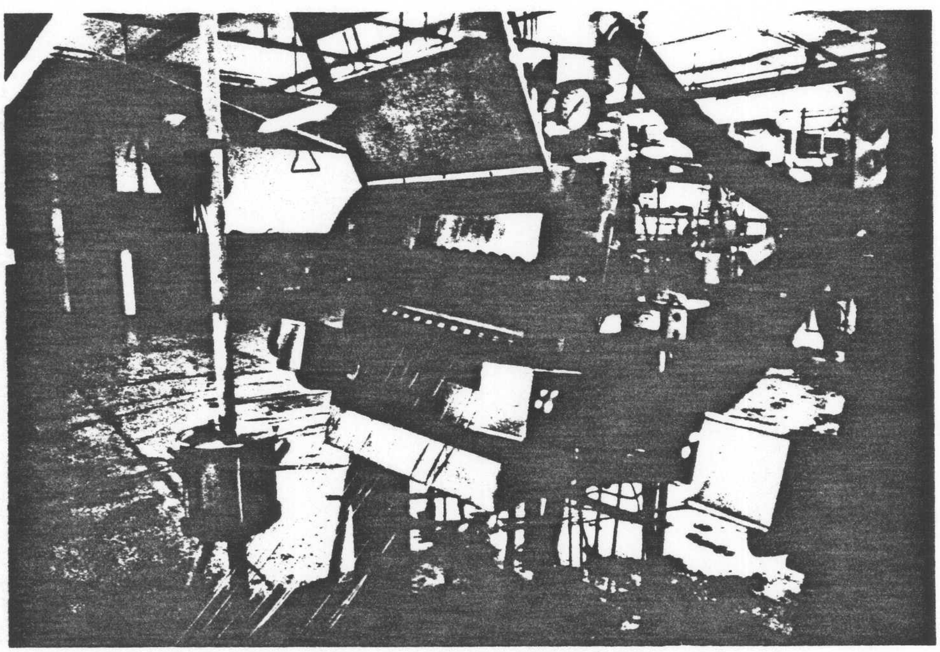

Figure 4. Mercury Fill Station With Door Opened
Showing the Manifold

Outside air is supplied to the enclosure through two 4" flexible ducts located adjacent to the base of the door. When the door is in the closed position, a conduit (built into the door), equipped with specially positioned distribution baffles (Figure 5) is used to provide a uniform air flow across the face of the station. A stainless steel-sloped tray containing 3 inches of water is mounted below the manifold to hold mercury droplets which may fall during the filling process (Figure 6). The water reduces mercury vapor emitted from the droplets. Mercury is periodically drained from this tray through a trap in the bottom.

2. Wire Pushing and Sealing Station

Wire insertion is conducted at a work station (Figure 7) which is designed to contain mercury displaced from the capillary and exhaust the mercury vapor which may escape. The station consists of a stainless steel box containing approximately 3 inches of water. A 6-inch exhaust air take-off is located in a hooded section at the back of the box. Outside air is supplied to the front of the box through an 8-inch supply duct. The resulting flow of air in the unit is from the front of the box to the hooded section at the back of the box.

The mercury displaced during the wire and piston insertion is contained in a plastic bottle on the inside of the work station (Figure 8), or is held in a spill tray surrounding the chuck and is vacuumed off. A tool rack mounted inside the box (Figure 8) stores the tools in the path of the exhaust air flow. This reduces worker exposure to mercury vapor which may be emitted from residual mercury on the tools.

3. Sensor Repair Station

Repair of Piston-Pak sensors is done in the Element Fabrication Building. Before any welding repairs are made, mercury is removed from the capillary and bulb. This is done by drilling out the heads of the sensors and pouring the mercury out. The operation is performed inside of a three

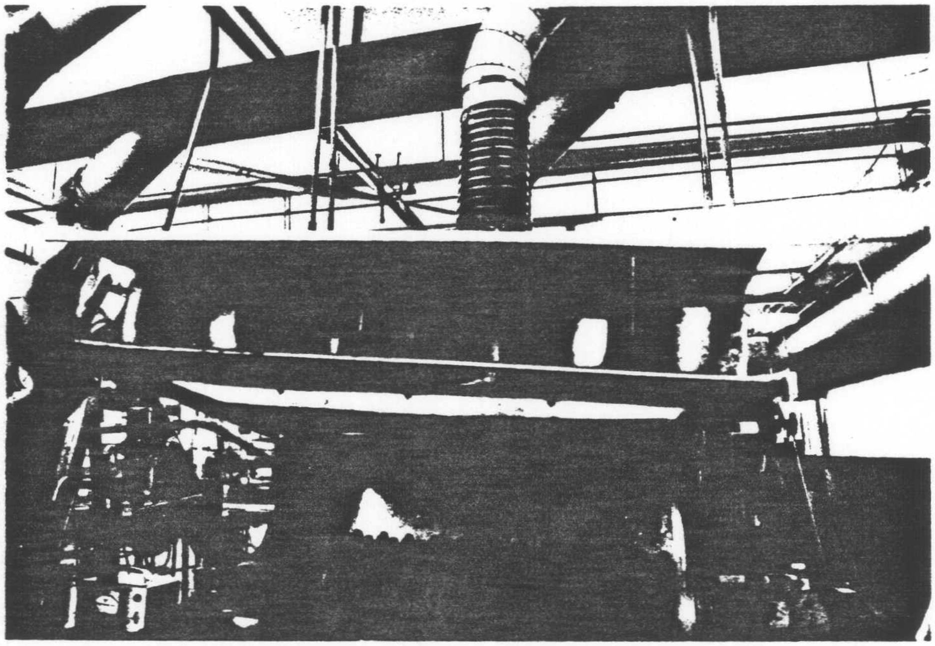

Figure 5. Distribution Baffles on Door

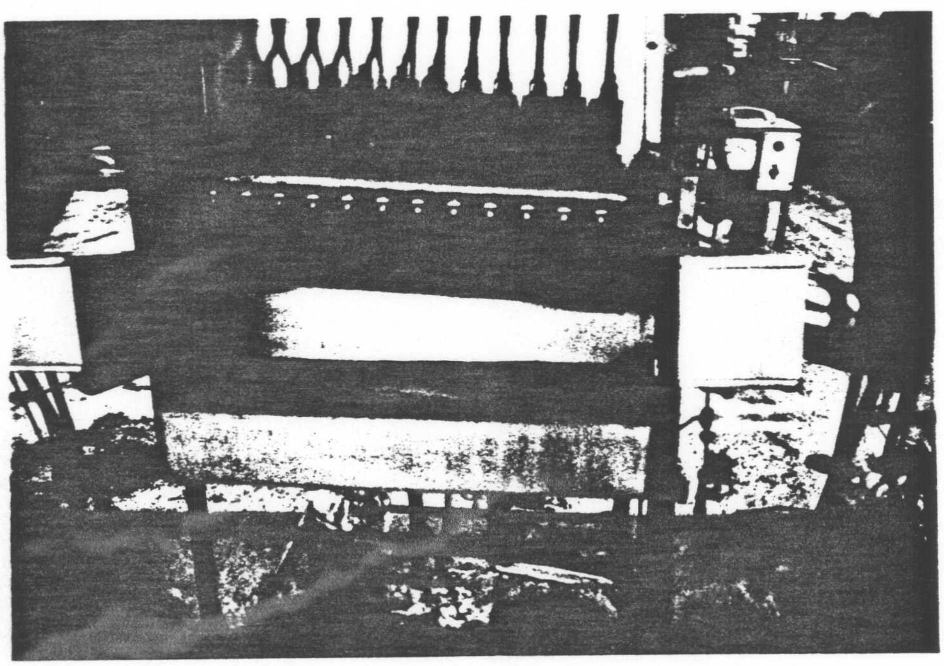

Figure 6. Mercury Spill Tray

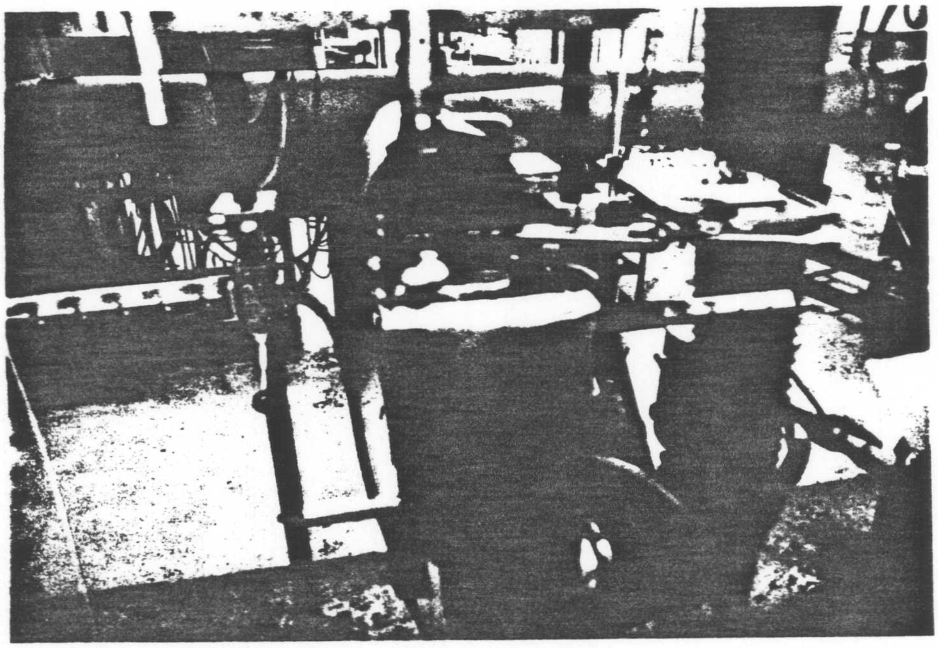

Figure 7. Pushing and Sealing Station

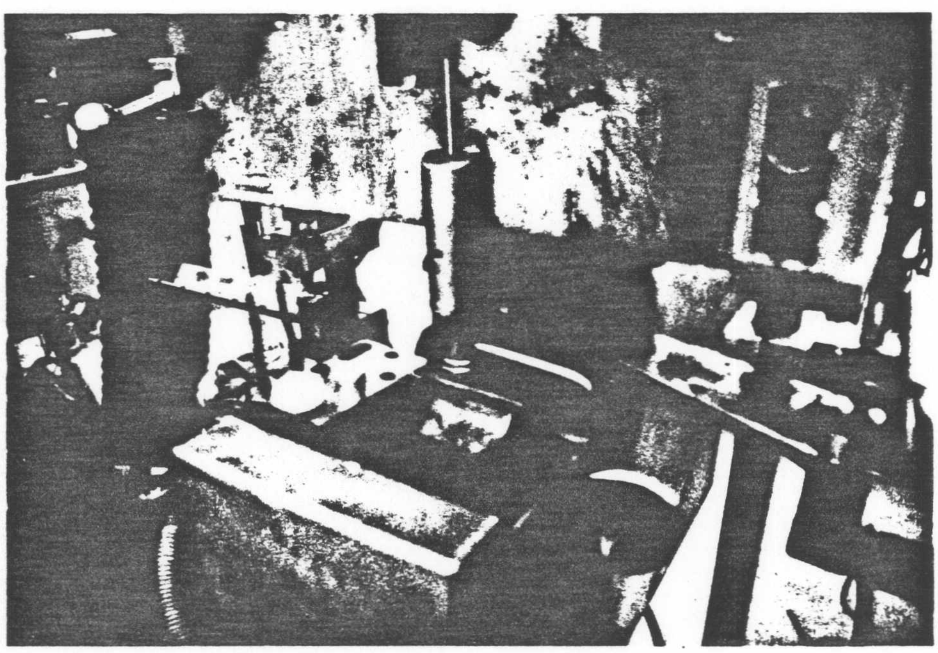

Figure 8. Mercury Overflow Bottle and Tool Rack
Mounted Inside the Box

sided exhaust hood. Outside air is supplied to the top front of the hood.

4. House Vacuum System

The Element Fabrication Building has a central vacuum system consisting of a dust separator and a 720 cubic feet per minute (CFM) Multi-Stage Centrifugal Turbo Air Exhauster, operating at 5.5 inches of mercury. The exhauster is driven by a 20 H.P. motor. The system has eight vacuum inlets in the building, each of which has a cylindrical mercury trap (Figure 9) with an internal baffle. The baffle prevents elemental mercury from being drawn into the vacuum system.

5. Air Exhaust System

The Element Fabrication Building has eleven separate local exhaust systems to remove air from work stations. These systems are listed in Table 1 with their design air flow capabilities and are referenced on Figure 10.

TABLE 1

Exhaust Fan Number	Number of Exhaust Air Take-offs in System	Air Flow/Take-Off CFM	Total System Airflow CFM
EP-100	6	388	2328
EP-200	3	388	1164
EP-300 (vacuum system)	8	-	720
EP-400	4	400	1600
EP-500	2	400	800
EP-600	1	1125	1125
EP-700	1	1125	1125
EP-800	1	1125	1125
EP-900	1	400	400
EP-950	1	400	400
EP-951	1	1445	1445

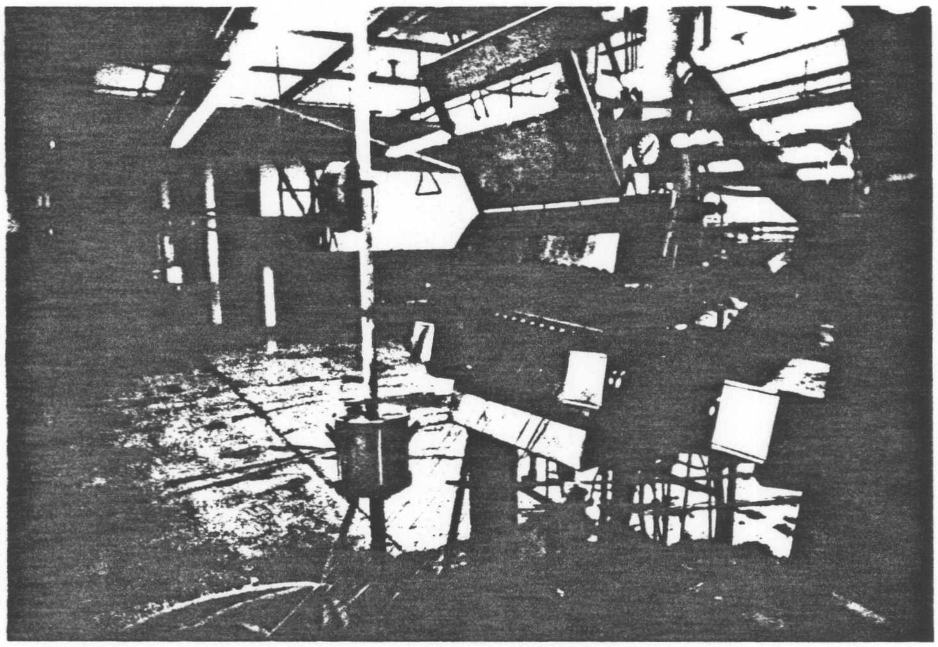

Figure 9. Mercury Vacuum Trap

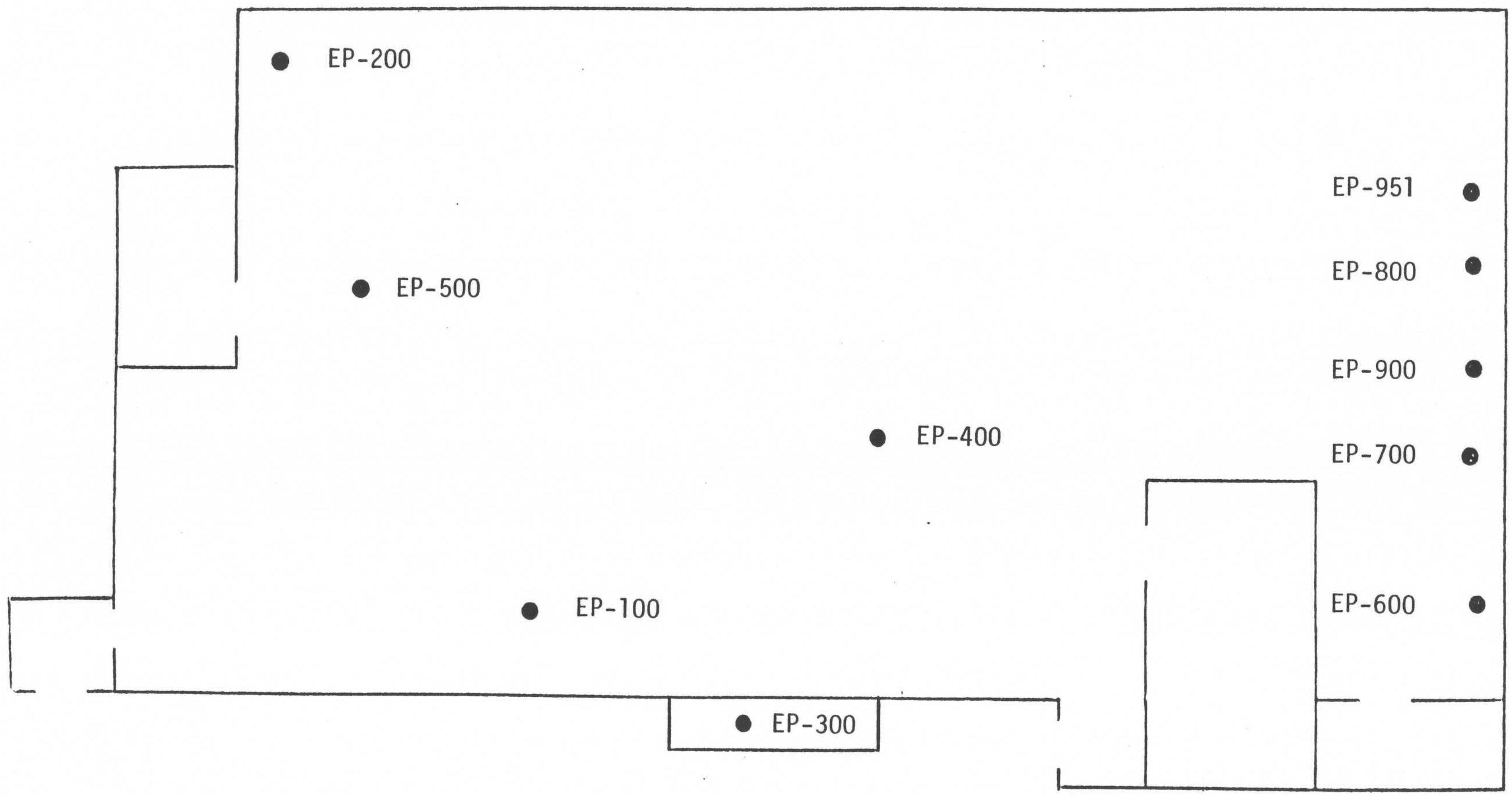

Figure 10. Air Exhaust System Layout

B. Personal Protective Equipment

Workers wear rubber aprons during activities which have a potential for contact with liquid mercury. No other protective clothing (designed to reduce exposure to mercury) is used at this facility. A skin barrier cream (Calgon Co.) has been used intermittently by some workers to reduce dermal exposure to mercury. This product was not in use during the survey. Respirators or other protective equipment are not used at this plant. Work clothes are provided by the employer. Employees are not required to change clothes at the end of the work day.

C. Work Practices

Procedures and practices have been implemented to control exposure to mercury. The following is a summary of the work practices in effect:

- smoking is not permitted on the production floor. Smoking is allowed in the lunchroom located adjacent to the production area.
- food or beverages are not permitted in production areas.
- employees are required to wash hands before breaks and at end of day.
- beards and/or long-hair are not permitted.
- workers are on a rotating schedule in which 3 months are spent on a "high exposure" job (e.g. sealing and filling operations), and 3 months are spent in another job within the Element Fabrication Department.

The job rotation program was initiated in January 1978. Plant representatives and the consulting physician feel that this has resulted in reduced worker exposure as indicated by the results of the biological monitoring program.

D. Housekeeping

The following housekeeping procedures have been implemented to control exposure to mercury:

- floors are washed daily with HgX.
- production equipment is washed every 6 months with HgX as part of a major plant washdown. A soap solution is used on metal parts.
- floors are vacuumed using an industrial vacuum sweeper.
- production equipment and work stations are cleaned once per week with soap.
- floors are repainted once a year with a urethane based floor sealant.

E. Monitoring Programs

1. Biological Monitoring

Biological monitoring is an important part of this company's medical program. The monitoring consists of urine and blood tests to determine levels of mercury. Monitoring is conducted once per year in conjunction with a physical examination. Monitoring was conducted on a more frequent basis (every 6 months) in the past, however, based on the judgement of the consulting Occupational Health Physician, monitoring was changed to a yearly basis.

The current acceptable level at this facility for mercury in biological sample is 10 μg/100 ml of blood and 0.30 Mg/l of urine. When a urine or blood level is at or above this level, the worker is retested in 3 months. If the level remains in excess of the acceptable level, the worker is placed in an area where the potential for exposure to mercury is low, or based on the physician's recommendation, the employee may be placed in a "no exposure" area. When retesting indicates a mercury level below the acceptable level, the worker will be reinstated. Although both urine and blood monitoring is routinely performed, the plant physician considers blood levels to be a more reliable indicator of exposure. Consequently, worker relocation may be based solely on blood-mercury levels; relocation may not occur based on a high urine-mercury level alone.

2. Air Contaminant Monitoring

Periodic monitoring is conducted to determine the levels of mercury vapor associated with various jobs and locations within the Element Fabrication Department. This involves weekly monitoring with a direct reading instrument (Bacharach MV-2) at selected locations at or near the breathing zone of certain workers.

F. Other Programs

1. Education and Training

Each new employee in the Element Fabrication Department takes part in a training program which includes a slide presentation on the handling and potential hazards of mercury. Additional information on the handling of mercury is posted or distributed to each employee. Continued on-the-job training is provided through immediate supervision.

V. SURVEY DATA

Air monitoring using a mercury vapor detector (Jerome Model No. 401) was conducted during the survey. Many of the sample locations were the same as those selected for weekly monitoring by plant personnel. The results of sampling are shown in Table 2. Mercury vapor was detected in all environments sampled. The highest sample concentration detected was 0.096 Mg/m^3.

TABLE 2

Location	Mercury Vapor Concentration (Mg/m^3)
Repair area	0.076
Degreasing	0.080
Locker area	0.090
Fill machine	0.092
Long element fill	0.092
Welder	0.096
Lunchroom	0.066
Near sealing unit	0.092

VI. CONCLUSION AND RECOMMENDATIONS

Plant air sampling and biological monitoring suggest that existing control strategies associated with the manufacturing of temperature control instruments at this facility are effective in controlling worker exposure to mercury. Based on general observations and information supplied by the plant representatives, workplace control of mercury is achieved by:

- use of local exhaust ventilation at fill stations and pushing-sealing stations.
- good housekeeping practices.
- effective employee training
- equipment, machinery and procedures specially designed to contain and control mercury.

The work stations used for mercury operations were uniquely designed by Partlow for operating efficiency and mercury vapor control. An in-depth survey is recommended to measure air flow through the units and determine the effectiveness of mercury vapor control.