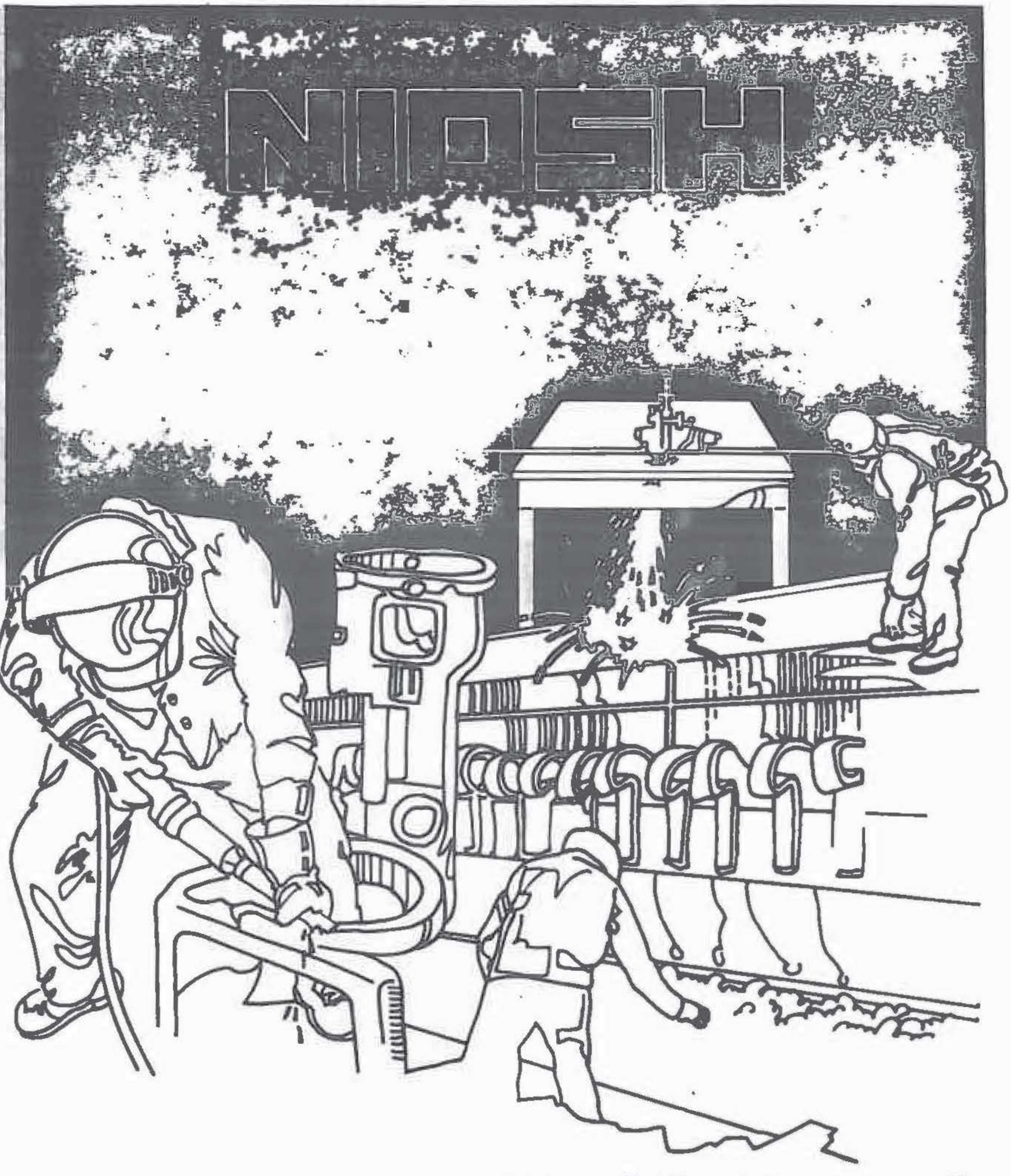
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

79-075-784

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. 699(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.

HE 79-075-784
DECEMBER 1980
ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN

NIOSH INVESTIGATORS:
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I. SUMMARY

On April 5, 1979, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate dust exposures in the compounding area and mill room of the St. Clair Rubber Company, Marysville, Michigan. The company had recently installed or modified existing ventilation systems in these areas and requested this evaluation in order to determine how effective these systems controlled dust concentrations.

The processes evaluated included the compounding of raw materials, mixing, milling, and calendering of synthetic rubber products. Ten to 16 people worked in this area each shift. Jobs with the highest potential for dust exposure were the No. 1 and No. 2 Compounders and the Banbury Operator. Atmospheric samples for total particulates, lead, antimony, and carbon black were collected as both general area and personal exposure samples during simulated and actual work conditions. Ventilation systems were tested by measuring exhaust hood capture and face velocities.

Analysis of air samples taken at the main plant detected dust concentrations (as total particulates) from 0.03-6.9 milligrams per cubic meter of air (mg/M^3). The mean dust concentration was 1.4 mg/M^3. No overexposures to lead, antimony, or carbon black were found for the jobs sampled when evaluated as full shift time weighted averages(TWA). However, one lead sample taken from the No. 1 Compounder inside the "hazardous materials" room was 42 micrograms (μg)/M^3 calculated as an 8-hour TWA which is above the action limit of 30 μg/M^3 established by OSHA under the new lead standard (CFR 1910.1025). An air sample for this same job taken by NIOSH 7 months later was 9.7 μg/M^3 as an 8-hour TWA. At the adhesives plant, one mill operator was exposed for 67 minutes to 1.34 mg/M^3 antimony during a milling operation. If this job had been performed for more than 3 hours the NIOSH recommended full shift TWA limit of 0.5 mg/M^3 would have been exceeded.

On the basis of the data obtained in this investigation, it has been determined that no hazardous exposures were found to dusts containing carbon black, lead, and antimony under current conditions and work schedules as evaluated during this survey. However, lead exposures inside the hazardous materials room could be excessive if lead containing materials were handled several hours a day on a daily basis. Also, dusts containing antimony oxide are a potential health hazard for mill operators working at the Adhesives Plant. It is recommended the company closely monitor and supervise the work practices of the No. 1 and No. 2 Compounder to minimize exposure to the many toxic materials handled. Suggestions for further reducing these exposures are provided within the body of this report. An appendix to this report provides basic toxicity data for most of the chemicals used by the compounders.

KEYWORDS: SIC 3069 (Fabricated Rubber Products), compounding, milling, lead, carbon black, antimony oxide, ventilation

II. INTRODUCTION

On April 2, 1979, the Vice President for Administration, St. Clair Rubber Company, Marysville, Michigan, submitted a request for a NIOSH health hazard evaluation of dust exposure in their compounding area and mill room. NIOSH had previously conducted a health hazard evaluation of this plant in 1977 (HE 77-67). At that time, NIOSH investigators had recommended that the local exhaust systems in the compounding area be replaced or modified to improve dust control near the compounding weighing scales. Subsequent to that first NIOSH survey, the company completely overhauled the compounding ventilation system and changed the compounding procedures. In order to evaluate the effectiveness of these controls, the company asked NIOSH to conduct a follow-up evaluation of worker exposures to dusts from chemical substances used in the compounding area. An environmental survey was conducted by NIOSH on May 14-16, 1979. NIOSH investigators elected to monitor worker exposures to the most hazardous substances used in the compounding area, e.g., lead, antimony oxide, and carbon black, as an indicator of the effectiveness of environmental controls used by the company.

Environmental and personal breathing zone samples were collected and analyzed for total dust, lead, antimony oxide and carbon black. Results of the air sampling were summarized in an interim report to management and local union officials in September, 1979. Additional environmental samples for airborne lead were collected by NIOSH investigators during a subsequent NIOSH health hazard evaluation (HE 79-126) on November 19-20, 1979. This delayed sampling for airborne lead was necessary because the lead containing rubber compound was not being formulated and processed through the compounding area and mill room at the time of the NIOSH survey in May, 1979.

III. BACKGROUND

The St. Clair Rubber Company manufactures moulded rubber products including gaskets, motor mounts, radiator pads, and bumper strips; rubber coated fabrics, and rubber adhesives. Total plant operations employ approximately 160 workers on a 2 shift schedule, 8 hours per day 5 days per week. Ten to 16 workers are assigned to the compounding area where raw materials, which include polymer rubbers, activators, catalysts, fillers, and linkers are batched, mixed, milled and calendered. Two workers per shift, (No. 1 and No. 2 Compounder) are assigned to perform batch compounding of raw materials. The three major synthetic rubber systems which accounted for the bulk of the company's production are ethylene propylene diene modified rubber (EPDM), styrene butadiene rubber (SB), and butyl (a copolymer of isobutylene) rubber. Approximately 500 distinct rubber formulations were utilized.

During the first NIOSH evaluation in 1977, compounders were scooping chemical additives directly from bags and drums. The compounding scales were local exhaust ventilated, but dust collection efficiency was poor. The compounding jobs were dusty and compounders were exposed to many differrent chemicals. Although compounders were not likely exposed to airborne dust concentrations above recommended limits for any one compound, the potential for adverse health effects from the combined exposures to dust from all of the compounding additives was of concern to NIOSH.

In order to better control the dusts generated during compounding, many of the additives were placed in special exhaust ventilated storage bins (see Figure 1). Two rows of bins, 14 bins each, faced a track mounted batch cart which held 4 or 5 tote boxes. A small scale, one for each row of bins, was mounted on a rail which ran the full length of the bin line. The scale and batch cart could be moved up or down the line to the appropriate bin. The No. 1 Compounder opened the bin, scooped out and weighed the material on the scale, then dumped the materials from the scale pan into the tote boxes.

After adding the materials, the batch cart was pushed down to the end of the track and the tote boxes were slid onto a roller conveyer leading to the Banbury mixer. The scales were local exhaust ventilated by using the lateral draft slot exhaust located in the bottom of each storage bin. An overhead canopy exhaust hood attached to a 10 inch flexible duct was mounted above the batch cart. The configuration of the storage bins in relation to the scales and batch cart is shown in Figure II. The code numbers assigned by the company to each chemical additive are identified on the bin where each chemical was stored.

A hazardous materials room had been built to isolate compounding of the more toxic chemicals such as, lead chromate, lead oxide (litharge), and antimony oxide. Inside the hazardous materials room, chemicals were weighed and handled inside an exhaust ventilated glove box (see Figure III). Air was also exhausted from a plain-end duct in the ceiling of the room through a separate fan which discharged air through a bag dust collector into the compounding area. This discharge was subsequently vented to the outside following this NIOSH survey.

The No. 1 Compounder, wearing disposable coveralls and dust mask, weighed out the chemicals using glove ports in the front of the box. After weighing, the compounds were dumped into a tote box. A coverlid was placed on the tote box and the box was removed from the glove box and placed on the floor of the hazardous materials room until needed by the Banbury Operator.

The No. 2 Compounder handled larger quanitities of materials including carbon blacks. The materials were weighed and placed on a carrousel which fed a conveyer belt leading to the Banbury. The exhaust ventilation hood for the No. 2 Compounder's scale had been modified since the first NIOSH survey. New exhaust ducts had been installed and a larger fan was added. Branch ducts from this fan also pulled air from the Banbury and the No. 1 Compounder's batchcart (overhead canopy hood). The metal storage bins and the hazardous materials glove box were ventilated using a separate system which was equipped with a fabric dust collector vented to the outside air.

IV. EVALUATION DESIGN AND METHODS

1. First follow-up Environmental Survey (May 15-16, 1979)

The environmental study was deisgned to evaluate dust exposures by sampling the most hazardous materials used in the compounding area. In addition to measuring total dust concentrations, personal and area atmospheric samples for lead, antimony oxide and carbon black were collected.

Personal sampling for airborne lead and total particulates involved the No. 1 and No. 2 Compounders, the Banbury Operator, the Blender Mill Operator and Calender Operators. The samples were collected on 5 micron pre-weighed polyvinyl chloride filters using battery powered sampling pumps operated at 2.0 liters per minute. Total particulates were determined gravemetrically. Lead and antimony oxide analysis was by atomic absorption spectroscopy using NIOSH P&CA Method No. 172.

During the survey, batching with "sublimed litharge" (lead oxide), and antimony oxide was demonstrated by the No. 1 Compounder working inside the hazardous materials room. Only one formula (No. 4317065) contained significant amounts of lead containing material (150 lbs. of lead sulfate and 125 lbs of lead oxide per batch). This formula could not be processed during the airborne lead monitoring of the mill room because the company had depleted its supply of lead sulfate. Therefore, the batches mixed in the hazardous materials room were performed as a demonstration for the NIOSH investigators to simulate the processes that would be required of the No. 1 Compounder in providing materials for formula No. 4317065.

Carbon black samples were taken only from the No. 2 Compounder and Banbury Operator. Filters were reweighed after sample collection to determine gravemetric weight gain on each filter. Each filter was then placed on a pre-weighed aluminum pan and placed in a low temperature asher in order to ash the carbon black and other organics. After ashing was complete, the samples were re-weighed and the weight loss determined. The weight loss was considered to be the maximum amount of carbon black contained on the filter. The actual amount of carbon black may have been less than the value reported since other materials on the filter may also have been lost during ashing.

Total dust and antimony oxide samples were taken for the No. 1 Compounder and Banbury Operator At the request of management, total dust and antimony were also sampled during a milling operation at the adhesive plant.

Swipe samples were taken from the compounding area and lunch room to determine the extent of any lead fallout contamination of work surfaces. Swipe samples were taken from the skin and dust mask of the No. 1 Compounder after handling lead oxide in the hazardous materials room.

A bulk sample of silica flour used in the adhesives plant was sent to the NIOSH laboratory for analysis by X-ray diffraction to determine if the sample contained crystalline silica.

Local exhaust ventilation systems were tested by taking air flow measurement with a Kurz air velocity meter Model 441, which will electronically measure air flow in feet per minute (fpm) from 0 to 6,000 fpm. Systems tested were the ventilated metal storage bins, the canopy exhaust hood on the batch cart in the No. 1 compounding area, the glove box exhaust in the hazardous materials room, the canopy hood above the No. 2 compounding scale, and the exhaust system on the feed hopper of the Banbury mixer.

2. Second Follow-up Environmental Survey (November 19-20, 1979)

A subsequent follow-up survey was conducted in order to determine if workers were exposed to lead during the mixing of "sublimed litharge" (lead oxide) and "blue lead" (lead sulfate) in a specific rubber formula (No. 4317065). On November 14, the No. 1 Compounder's lead exposure was monitored while weighing out and placing in covered bins, 5 batches (25 lbs/batch) of lead oxide. On November 20, the Banbury operator was monitored for lead exposure while mixing 5 batches of "lead containing" rubber, each batch containing 150 lbs of lead sulfate fed directly to the Banbury from 3 each 50 lbs. sacks and 125 lbs. of lead oxide fed to the Banbury from 2 each 50 lbs. sacks and one tote box containing 25 lbs. previously added by the No. 1 Compounder in the hazardous materials room. Two area samples were also placed, one near the Banbury and one in the No. 2 compounding area. The samples were collected on 0.8 micron AA filters using battery powered air sampling pumps operated at 1.5 liters per minute. The samples were analyzed by atomic absorption spectroscopy described in NIOSH P&CA Method No. 172.

V. EVALUATION CRITERIA

1. Lead

Inhalation of lead dust and fumes is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion of lead dust contamination of food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. The absorbed lead can damage the kideys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive distrubances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.

Blood lead levels below 40μg/100ml whole blood are considered to be normal levels which may result from daily environmental exposure. However, fetal damage in pregnant women may occur at blood lead levels as low as 30μg/100ml. Lead levels between 40-60μg/100ml in lead exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60 to 100μg/100ml represent unacceptable elevations which may cause serious adverse health effects. Levels over 100 μg/100ml are considered dangerous and often require hospitalization and medical treatment.

The new OSHA standard for lead in air is 50μg/M^3 on an eight hour time-weighted average for daily exposure. The standard also dictates that in four years workers with blood lead levels greater than 50μg/100ml must be immediately removed from further lead exposure and in some circumstances workers with lead levels less than 50μg/100ml must also be removed. At present, medical removal of workers is necessary at blood lead levels of 70μg/100ml or greater. Removed workers have protection for wage, benefits, and seniority for up to eighteen months until their blood levels adequately decline and they can return to lead exposure areas.[1]

2. Antimony Oxide

NIOSH recommends that employee exposure to antimony and its compounds be controlled so that employees are not exposed to antimony at a concentration greater than 0.5 milligrams per cubic meter of air (0.5 mg/m^3) determined as a time-weighted average (TWA) concentration for up to a 10-hour work shift in a 40-hour work week.[2] This level is also the current Occupational Safety and Health (OSHA) permissible exposure limit (PEL).

The major hazards associated with occupational exposure to antimony are cardiac changes, respiratory changes including pneumoconiosis, and irritation of the skin and mucous membranes. One study suggested that antimony exposure may increase the risk of lung cancer. The carcinogenic, mutagenic, and teratogenic potentials of antimony compounds, along with possible effects of antimony on reproduction, remain to be determined.

3. Carbon Black

NIOSH recommends that occupational exposure to carbon black be controlled so that employees are not exposed to carbon black at a concentration greater than 3.5 mg/M^3, or to polycyclic aromatic hydrocarbons (PAHs) at a concentration greater than 0.1 milligrams measured as the cyclohexane-extractable fraction, per cubic meter of air (0.1 mg/M^3), determined as a time weighted averaged (TWA) concentration for up to a 10-hour workshift in a 40-hour work week.[3] The present OSHA PEL is also 3.5 mg/M^3 TWA, measured as total dust over an 8-hour work shift.

The recommended occuptional exposure limits are based on data indicating that carbon black may cause both temporary and permanent lung damage and skin irritation. Particulate polycylic organic material (PPOM), polynuclear aromatic hydrocarbons (PNAs) and PAHs are terms frequently encountered in the literature and often used interchangeably. Some of these PAHs such as 3, 4-benzpyrene, pyrene, and 1.2-benzpyrene are formed during carbon black manufacture. Their adsorption on the carbon black could pose a risk of cancer after exposure to the carbon black.

The carbon blacks used by St. Clair Rubber are primarily furnace blacks which typically contain only 0.06% PAHs by weight as the benzene extractable fraction. Thermal blacks contain a greater amount of benzene extractable PAHs, depending on the particle size. Medium thermal blacks (MT) with particles 400-500 nanometers (nm) and five thermal blacks (FT) with particles 120-150 nm in diameter, typically contain 0.3% and 0.8% benzene extractable PAHs respectively.[4]

Although not specifically evaluated, toxicity data has been compiled through a computer search of the NIOSH Registry of Toxic Effects of Chemical Substances (RTECS) for many of the compounding chemicals used by the St. Clair Rubber Company. This list was provided as an attachment and was sent directly to the St Clair Rubber Co. and URW Local 47 prior to distribution of this final determination report. The RTECS search found 22 of 43 compounds used in the compounding area were listed in the Registry. However, the absence of a substance from the Registry does not imply that the substance is non-toxic, and thus non-hazardous, any more than the presence of a substance in the Registry indicates that the substance is hazardous in common use.

It must be emphasized that the entry of a substance in the Registry does not automatically mean that it must be avoided. A listing does mean, however, that the substance has the documented potential of being harmful if misused, and care must be exercised to prevent adverse consequences.[5]

VI. RESULTS AND DISCUSSION

Results from atmospheric samples for total particulates and lead inside the hazardous materials room are presented in Table I. Despite the efforts to isolate the No. 1 Compounder from lead exposure, some exposure does exist. Personal exposure to lead has been demonstrated during this investigation. Fortunately, the mixing of lead compounds is of short duration resulting in time-weighted average exposures below the current OSHA Standard of 50 $\mu g/M^3$. It was also noted that the amount respirable dust (dust less than 10 microns in diameter) and total dust collected in the high volume sample were approximtely equal, indicating the airborne dust was primarily of respirable particle size. Results from analysis of samples for total particulates and antimony oxide are presented in Table II. In other words, all samples taken inside the hazardous materials room were within safe limits. However, if compounding of lead oxide were performed for a full work shift, the OSHA PEL for lead exposure would have been exceeded.

Carbon black sample results are presented in Table III. All samples were below the maximum concentration recommended by NIOSH

(3.5 mg/M^3). The highest concentration detected was 2.59 mg/m^3. The estimated concentration of airborne PAHs (as benzene solubles fraction) was also below the NIOSH recommended limit (100 μg/M^3). These estimates were derived as the product of the benzene solubles fraction (typically 0.06% for furnace blacks and 0.3% for MT thermal blacks) of the appropriate carbon black and the airborne carbon black concentration.

Table IV and V depict the sample results for total particulates, lead, and antimony oxide as monitored in the No. 1 and No. 2 compounding area and mill room. All of the samples were within the exposure limits of the evaluation criteria. The Banbury Operator's exposure while mixing 5 batches of lead containing compound (Code No. 4317065) was 81.5 μg/M^3 during the 90 minutes it took to mix the 5 batches plus clean up, or a calculated 15.5 μg/M^3 as an 8-hour TWA by assuming zero lead exposure for the remainder of the work shift. Three open mills were located at the adhesives plant but none were exhaust ventilated. Only one mill operator was using antimony oxide when this sample was collected. The mill operator's exposure over a 1-hour sampling period was 1.35 mg/m^3 antimony oxide (as antimony). The 8-hour TWA would have been exceeded if this task had continued for more than 3 hours. Total dust levels were also excessive (more than 10 mg/M^3). All the mill operators were required to wear dust masks. A considerable amount of talc was used on the mill and is assumed to be a major component of the total dust composition.

Swipe sampling did detect lead contamination in and around the hazardous materials room (Table VI). The greatest amounts were found on top of the glove box and on the shoes of the No. 1 compounder. Lead was also found inside the No. 1 compounder's dust mask. No lead contamination was detected in the lunch room.
A silica flour (trade name Cab-O-Sil) was also used at the Adhesive Plant. This is an amorphous, non-crystalline silica. To confirm that this material contained no free crystalline silica, a bulk sample was sent to the NIOSH laboratory and subjected to X-ray diffraction analysis. The lab report found no evidence of crystalline silica in the sample.

Exhaust air velocities (in fpm) measured at each ventilated storage bin are shown in Table VII. Two measurements were taken on each bin, at the opening of the slot at the rear of the bin (slot velocity) and at the front of the bin (face velocity) as identified in Figure 1. The face velocity is representative of the capture velocity available to control dust generated at the scale. The tests indicated the system was not balanced as would be expected with the design chosen. No expansion joints were used and the exhaust header take off was at the end of the bin line instead of the center. Exhaust velocity was too strong at the top end of the bin line (as shown in Figure II) and inadequate at the low end. Compound 11187, a fine powder had been placed in a bin that exhausted so much air the material had been sucked into the slot exhaust clogging the duct. The same exhaust fan powered both the bin exhaust and hazardous materials room glove box. When closing the glove box slide gate, the air flow was increased in the bin exhaust.

The batch cart overhead canopy hood was equipped with two 10 inch diameter exhaust ducts branched into a 10-inch diameter hose. The face velocity for each duct at the canopy hood termination was 1800 and 2000 fpm (total 3800 fpm). However, at the time of the survey, the flexible hose had partially collapsed restricting air flow to 900 and 1100 fpm respectively. The flexible hose has since been replaced with a more rigid design.

Although the exhaust systems move a considerable amount of air, it appears to be largely ineffective in controlling dust in the No. 1 compounding area. The No. 1 Compounder's exposure to total airborne dust was 6.3 mg/M^3. This concentration is larger than in any other area monitored in the main plant. The major difficiency of the design is that exhaust hoods in this area are not close enough to the points where the dust is generated, i.e., on the scales and in tote boxes on the batch cart.

Tests of the glove box exhaust system indicated the exhaust duct velocity and exhaust volume exceeded the recommendation of the American Conference of Governmental Industrial Hygienists[6] (See Figure III).

The ventilation systems for the Banbury and No. 2 compounding scale were effectively capturing dust generated in these locations. Measured capture velocity at the Banbury Operators breathing zone was 175 fpm. The ACGIH recommends 100-200 fpm. Capture velocity at the No. 2 Compounder's scale was 350 fpm, which falls in the range recommended by the ACGIH (200-500 fpm)[5].

VII OBSERVATIONS AND RECOMMENDATIONS

1. Supervisors and compounders should adopt work practices which will minimize lead exposure. The No. 1 Compounder was observed walking in and out of the hazardous materials room wearing protective clothing after it had been contaminated with lead oxide. The No. 1 Compounder's dust mask was not cleaned before use. Lead was detected on the inside of the mask No shoe coverlets were available to prevent lead from contaminating the Compounder's shoes.

2. The exhaust system in the glove box has adequate exhaust volume, yet exposures continue to occur. Dry sweeping methods were used for clean up in the hazardous materials room which could be a significant source of airborne dust. A vacuum system should be installed. The new OSHA standard permits dry sweeping of lead dust "only where vacuuming or other equally effective methods have been tried and found not to be effective".

3. Empty tote boxes used for lead and antimony compounds are intermixed with other compounding material tote boxes. These boxes should have special markings or colors and should be returned dirctly to the hazardous materials room after use.

4. The company should investigate the possibility of purchasing lead oxide in 25 lb. sacks to eliminate the need for handling this material in the hazardous materials room.

5. Emptied sacks were being tossed over the side of the Banbury into a collecting container "bailer" and packed down by hand prior to removal. Empty sacks should be wrapped up in large plastic bags, bailed, and removed before the container is filled to a point where band packing becomes necessary.

6. Generally, dust exposures have been reduced in the compounding area as a result of the improved ventilation systems on the Banbury mixer and the No. 2 compounding scale. The No. 1 compound area ventilation storage bins, however, should be balanced to provide a uniform air flow through each bin. This could be achieved by installing slide gates or dampers on each bin exhaust duct or by redesigning the system to incorporate an exhaust header with expansion joints and center take off to the main exhaust duct.

7. Although based on the results of only one sample, it appears that dust levels are excessive for workers operating the open mills in the Adhesives Plant. The company should closely monitor this area during a full work shift. If dust levels exceed 10 mg/m^3 as total dust or exceed occupational exposure limits on separate compounds, open mills should be equipped with local exhaust ventilation systems.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

a) The St. Clair Rubber Company
b) Authorized Representative of Employees, United Rubber Workers, Local 47
c) United Rubber Workers International
d) U.S. Department of Labor, Region V
e) NIOSH Region V
f) NIOSH Region IV

For the purpose of informing the approximately 20 "affected employees", the employer will promptly "post" this report for a period of thirty (30) calendar days in a prominent place(s) near where the affected employees work.

X. REFERENCES

1. Occupational Safety and Health Administration Standard for Occupational Exposure to Lead. 29 CFR Part 1910.1025, effective March 1, 1979.

2. Criteria for a Recommended Standard, Occupational Exposure to Antimony. DHEW (NIOSH) Publication No. 78-216, Cincinnati, Ohio: NIOSH; 1978.

3. Criteria for a Recommended Standard, Occupational Exposure to Carbon Black. DHEW (NIOSH) Publication No. 78-204, Cincinnati, Ohio: NIOSH; 1978.

4. Dannenberg, E. M., Carbon Black. In: Kirk - Othmer Encyclopedia of Chemical Technology; 3rd. edition, Vol. 4. New York: John Wiley and Sons; 1978: 631-666.

5. NIOSH Registry of Toxic Effects of Chemical Substances, DHEW (NIOSH) Publication No. 79-100, Cincinnati, Ohio: NIOSH; 1979.

6. American Conference of Governmental Industrial Hygienists. Industrial Ventilation: A Manual of Recommended Practice, 15th. ed. Lansing, Michigan: ACGIH. 1978.

TABLE I
COMPOUNDING DUSTS AND LEAD CONCENTRATIONS
HAZARDOUS MATERIALS ROOM
ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN
HE 79-75
May 15, 1979

Sample No.	Sample Duration	Time	Sample Volume	Total Dust	Lead		Location/Job Description
					Actual	8hr TWA*	
		(min.)	(liters)	(mg/M^3)	(μg/M^3)		
DM2466	3:23pm-5:27pm	124	248	0.8	65	--	Area Sample - inside hazardous materials room during batching of antimony oxide and "sublimed litharge" (lead oxide), lead oxide batched from 4:40pm - 5:00pm.
DM2282	3:22pm-5:23pm	121	242	1.7	165	42	Personal exposure for No. 1 Compounder during weigh-out into covered bins, 10 batches (25 lb./batch) of sublimed litharge which required 40 minutes for batching and clean-up.
DM2325	3:24pm-5:27pm	123	1107	1.0	153	--	High volume area sample in hazardous materials room during batching of antimony oxide and "sublimed litharge" (lead oxide), lead oxide batched from 4:40pm - 5:00pm.
DM2478	3:24pm-5:27pm	123	1107	1.1	189	--	Same as sample 2325 except only respirable dust (<10 microns in diameter) was collected.
				November 19, 1980			
AA1	3:23pm-3:44pm	21	31.5	--	222	9.7	Personal exposure for No. 1 Compounder during weigh-out into covered bins, 5 batches (25 lb./batch) of sublimed litharge. Sample includes batching and clean-up time.

* Assuming no lead exposure during the remainder of the 8-hour shift, this value is the estimated 8-hour time-weighted average (TWA) exposure. The current OSHA standard for lead is 50 micrograms (μg)/M^3, 8-hour TWA. The limits of detection are 0.01 milligrams (mg)/sample for total dust and 8 μg/sample for lead.

TABLE II
COMPOUNDING DUSTS AND ANTIMONY OXIDE CONCENTRATIONS

HAZARDOUS MATERIALS ROOM

ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN
HE 79-75

May 15, 1979

Sample No.	Sample Duration	Time	Sample Volume	Total Dust	Antimony	Location/Job Description
		(min.)	(liters)	(mg/M^3)	(mg/M^3)	
DM2462	3:23pm-5:27pm	124	248	1.0	None Detected	Area Sample - inside hazardous materials room during batching of antimony oxide and "sublimed litharge" (lead oxide), antimony oxide batched from 3:23pm - 4:00pm.
DM2464	3:22pm-5:23pm	121	242	1.3	0.12	Personal exposure for No. 1 Compounder during weigh-out into paper sacks, 10 batches of antimony oxide requiring 37 minutes work time.
DM2325	3:24pm-5:27pm	123	1107	1.0	0.10	High volume area sample in hazardous materials room during batching of antimony oxide and "sublimed litharge" (lead oxide), antimony oxide batched from 3:12pm - 4:00pm.
DM2478	3:24pm-5:27pm	123	1107	1.1	0.15	Same as sample 2325 except only respirable dust (<10 microns in diameter) was collected.
NIOSH Evaluation Criteria				10.0 mg/M^3	0.5 mg/M^3	
Limits of Detection				0.1 mg/sample	0.02 mg/sample	

mg/M^3 = milligrams of substance per cubic meter of air

TABLE III
COMPOUNDING DUSTS AND CARBON BLACK CONCENTRATIONS

ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN

HE 79-75

May 15 - 16, 1979

			Concentration		Est. PAH Conct.*		
Sample No.	Sample Duration	Sample Volume	Total Dust	Carbon Black	Furnace	Thermal	Job/Location - Description
		(liters)	(mg/M^3)		(µg/M^3)		
D-23	7:32am-2:25pm	826	1.85	1.48	.88	.44	No. 2 Compounder - loading compounding chemicals onto "carrousel"
D-17	7:36am-2:44pm	856	0.15	0.11	.07	.33	No. 2 Compounding Area - on column near "Merry-Go-Round"
D-27	3:59pm-6:47pm	336	3.33	2.59	1.77	7.77	No. 2 Compounder - loading compounding chemicals onto "carrousel"
D-25	4:03pm-6:46pm	326	2.66	2.45	1.47	7.35	Banbury Operator - loading compounding batches into Banbury mixer

mg/M^3 = milligrams of substance per cubic meter of air
µg/M^3 = micrograms of substance per cubic meter of air

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* The concentration of polycyclic aromatic hydrocarbons (PAH's), as benzene solubles, is typically 0.06% for furnace blacks and 0.3% for thermal blacks[2]. The estimated PAH concentration, in µg/M^3, was calculated by multiplying the total carbon black concentration for each sample by these percentages.

The NIOSH recommended standard for carbon black is 3.5 mg/M^3, or 100 µg/M^3 PAH's (as cyclohexane solubles) determined as time-weighted average (TWA) concentrations for up to a 10-hour workshift in a 40-hour workweek.

TABLE IV
COMPOUNDING DUSTS AND LEAD CONCENTRATIONS
COMPOUNDING AREAS AND MILL ROOM

ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN
HE 79-75

May 15, 1979

Sample No.	Sample Duration	Time	Sample Volume	Total Dust	Actual←Lead	→8hr TWA*	Location/Job Description
		(min.)	(liters)	(mg/M^3)	(µg/M^3)		
				May 15, 1979			
DM2313	7:24am-2:46pm	422	844	6.3	26	23	Personal exposure - No. 1 Compounder
DM2463	7:26am-2:42pm	436	872	1.1	13	--	No. 1 compounding area - on batch cart between metal storage bins
DM2465	7:32am-2:25pm	413	826	1.6	ND	--	Personal exposure - No. 2 Compounder
DM2459	7:36am-2:44pm	428	856	0.3	ND	--	No. 2 compounding area - on column near carrousel
DM2457	7:40am-2:25pm	405	810	0.7	ND	--	Personal exposure - Banbury Operator
DM2468	7:42am-2:46pm	442	844	0.4	ND	--	Banbury operator's station - on control panel to right of Banbury
DM2474	7:57am-2:25pm	388	776	0.6	ND	--	Personal exposure - Calender No. 9 Operator
DM2470	7:59am-2:26pm	387	774	0.4	ND	--	Personal exposure - Blender Mill Operator
DM2475	8:01am-2:27pm	386	772	0.6	ND	--	Personal exposure - Calender No. 5 Operator
DM2471	8:03am-2:47pm	404	808	0.3	ND	--	Mill Room - near Mill No. 2

TABLE IV CONTINUED

Sample No.	Sample Duration	Time	Sample Volume	Total Dust	Lead		Location/Job Description
					Actual	8hr TWA*	
		(min.)	(liters)	(mg/M^3)	($\mu g/M^3$)		
May 16, 1979 (second shift)							
DM2277	3:22pm-7:08pm	214	428	1.4	ND	--	Personal exposure - No. 1 Compounder working with batch cart and working in Mill Room
DM2274	3:55pm-6:54pm	179	858	0.8	ND	--	No. 1 compounding area - on batch cart between metal storage bins
DM2331	3:59pm-6:47pm	168	336	5.1	ND	--	Personal exposure - No. 2 Compounder
DM2324	3:57pm-6:53pm	176	352	0.6	ND	--	No. 2 compounding area - on column near carrousel
DM2326	4:05pm-6:46pm	161	322	1.4	ND	--	Personal exposure - Banbury Operator
DM2281	4:05pm-6:52pm	167	334	1.7	ND	--	Banbury operator's station - on control panel to right of Banbury
DM2267	4:08pm-6:48pm	160	320	0.3	ND	--	Personal exposure - Blender Mill Operator
DM2320	4:10pm-6:49pm	159	319	1.5	ND	--	Personal exposure - Blender Mill Operator
DM2273	4:13pm-6:51pm	158	316	0.5	ND	--	Mill Room - near No. 2 Mill
DM2312	4:11pm-6:51pm	160	320	1.0	ND	--	Mill Room - left side of No. 9 Calender

TABLE IV CONTINUED

Sample No.	Sample Duration	Time	Sample Volume	Total Dust	Actual ←Lead→	8hr TWA*	Location/Job Description
		(min.)	(liters)	(mg/M^3)	(μg/M^3)		
				November 20, 1979 (during production of 5 batches of "lead containing" compound - No. 4317065)			
AA3	9:59am-11:54am	90	135	--	81.5	15.3	Personal exposure - Banbury Operator while mixing 5 batches of rubber compound, each batch containing: 150 lbs. of sublimed blue lead (lead sulfate) fed to Banbury from 3 ea. 50 lb. sacks and 125 lbs. of sublimed litharge (lead oxide) fed from 2 ea. 50 lb. sacks and one tote box containing 25 lbs. previously added by No. 1 Compounder in hazardous materials room.
AA4	9:41am-11:57am	136	204	--	24.5	6.9	No. 2 compounding area - on column 6 ft. above floor near carrousel
AA5	9:42am-11:56am	134	201	--	ND	--	Directly under Banbury - over conveyer from Banbury to calender

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* Assuming no lead exposure during the remainder of the 8-hour shift, this value is the estimated 8-hour time-weighted average (TWA) exposure. The current OSHA standard for lead is 50 μg/M^3, 8-hour TWA. The limits of detection are 0.01 milligrams (mg)/sample for total dust and 3 micrograms (μg)/sample for lead.

ND = Not Detected

TABLE V

COMPOUNDING DUSTS AND ANTIMONY OXIDE CONCENTRATIONS
COMPOUNDING AREA, MILL ROOM, AND ADHESIVES PLANT
ST. CLAIR RUBBER COMPANY

MARYSVILLE, MICHIGAN
HE 79-75

Sample No.	Sample Duration	Time (min.)	Sample Volume (liters)	Total Dust (mg/M^3)	Antimony (mg/M^3)	Location/Job Description
				May 15, 1979		
DM2315	7:24am-11:00am	422	844	6.9	ND	Personal exposure - No. 1 Compounder
DM2458	7:40am-2:25pm	405	810	0.7	ND	Personal exposure - Banbury Operator
DM2477	7:42am-2:46pm	442	884	0.5	ND	Banbury operator's station - on control panel to right of Banbury
				May 16, 1980		
DM2265	10:11am-11:18am	67	134	11.7	1.34	Personal exposure - Mill Operator at Adhesives Plant
DM2473	10:11am-11:19am	68	136	3.5	0.3	Adhesives Plant - mill operator's work table on right side of mill
NIOSH Evaluation Criteria				10.0 mg/M^3	0.5 mg/M^3	
Limits of Detection				0.1 mg/sample	0.02 mg/sample	

mg/M^3 = milligrams of substance per cubic meter of air
ND = Not Detected

TABLE VI
LEAD CONTAMINATION DETECTED FROM SWIPE SAMPLES
ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN
HE 79-75

May 15-16, 1979

Sample No.	Lead Detected (µg/sample)	Location
1	120	Hazardous materials (HM) room door knob - outside
2	430	HM room door knob - inside
3	46	HM room door - outside
4	1900	Top of dry box in HM room
5	10	HM ligIt switch
6	6.8	HM exhaust fan switch
7	220	Front of dry box in HM room
8	6.8	Inside of dust mask worn by No. 1 Compounder
9	3200	Top of shoes worn by No. 1 Compounder
10	6.8	Forehead of No. 1 Compounder
11	<5	Compounding table
12	19	Scale outside HM room
13	<5	Lunch room - from top and sides of 2 coffee machines
14	<5	Lunch room - from top and sides of Coke machine
15	<5	Lunch room door - entrance push plate and exit handle
16	<5	Lunch room water fountain
17	<5	Lunch room - from tops of 4 lunch tables
18	<5	Lunch room microwave oven - handle and buttons

Limit of Detection 5 µg

µg = micrograms

TABLE VII
EXHAUST VELOCITY MEASUREMENTS
VENTILATED METAL STORAGE BINS
NO. 1 COMPOUND AREA

ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN
HE 79-75

May 15-16, 1979

Bin for Compound No.	Slot Velocity		Face Velocity	
(Bin Line No. 1 - starting with bin closest to exhaust fan)				
14023 (flake)	1500		180	
11187 (powder)	0 *	0 *Δ	0 *	0 *Δ
14026 (powder)	1400		125	
11101 (powder)	1400		120	
14100 (pellet)	1800		70	
14124 (powder)	1500	2000 Δ	60	70 Δ
14058 (powder)	1800		55	
11192 (chip)	1150		40	
491 (pellet)	900		40	
418 (pellet)	875	950 Δ	40	50 Δ
435 (powder)	900		35	
424 (pellet)	650		30	
211 (flake)	750		40	
177 (powder)	600	650 Δ	50	60 Δ
000 (empty bin)	800		55	
(Bin Line No. 2 - starting with bin closest to exhaust fan)				
14088 (powder)	1000	1500 Δ	50	80 Δ
14094 (granular)	800		50	
14105 (empty)	700		40	
12182 (flake)	575		30	
12166 (pellet)	600	1100 Δ	35	50 Δ
14008 (flake)	450		25	
12188 (flake)	450		10	
14030 (flake)	375		20	
493 (powder)	375	500 Δ	15	35 Δ
433 (powder)	300		10	
426 (pellet)	250		10	
419 (pellet)	225		15	
178 (powder)	200	375 Δ	10	20 Δ

Δ Velocity when slide gate on glove box exhaust duct in hazardous materials room was closed.

* Bin slot exhaust duct was clogged with compounding material

FIGURE 1

COMPOUNDING CHEMICALS VENTILATED STORAGE BINS

ST. CLAIR RUBBER COMPANY
MARYSVILLE, MICHIGAN
HE 79-75

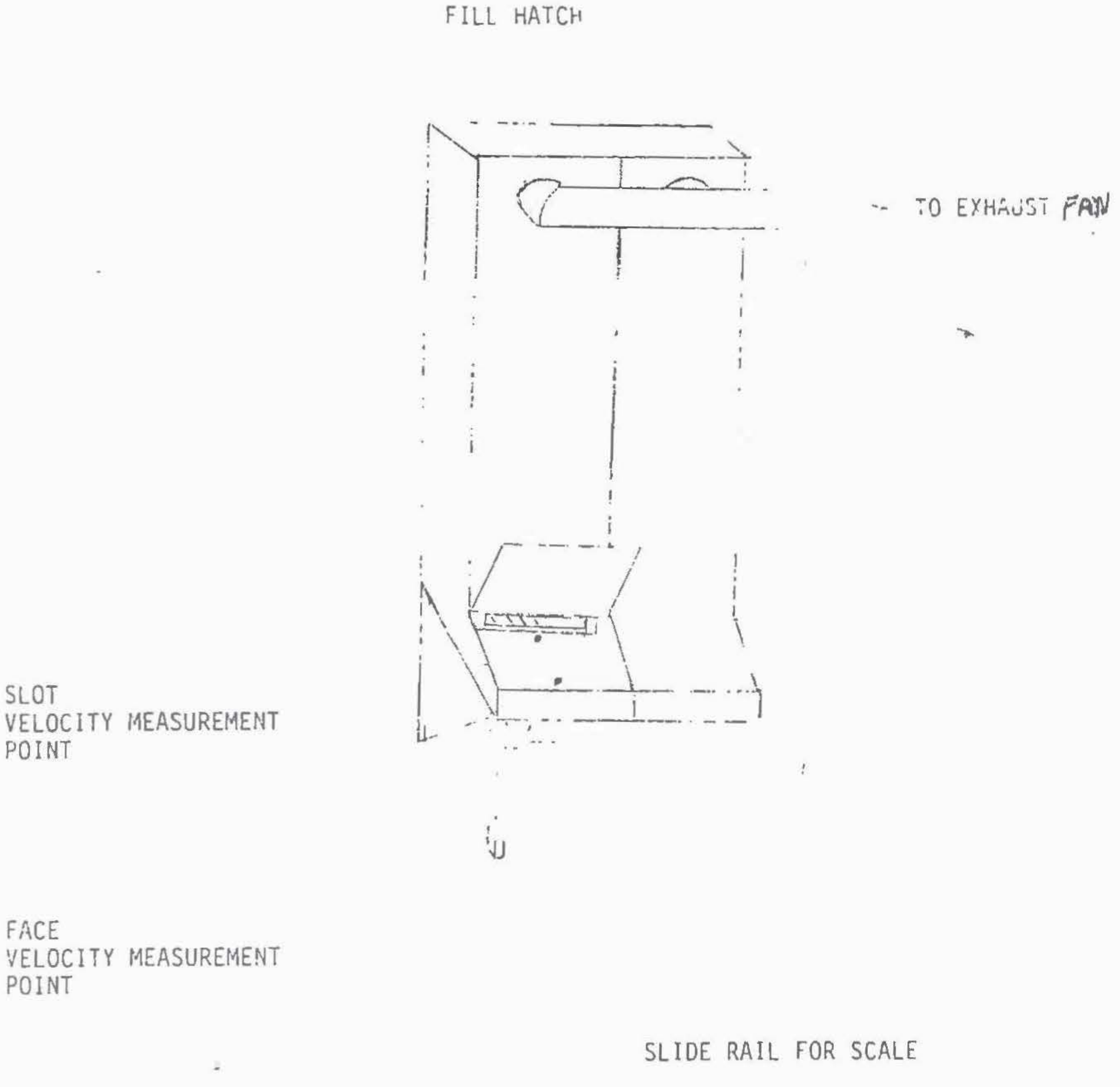


FIGURE II
NO.1 COMPOUNDING AREA
ST. CLAIR RUBBER COMPANY

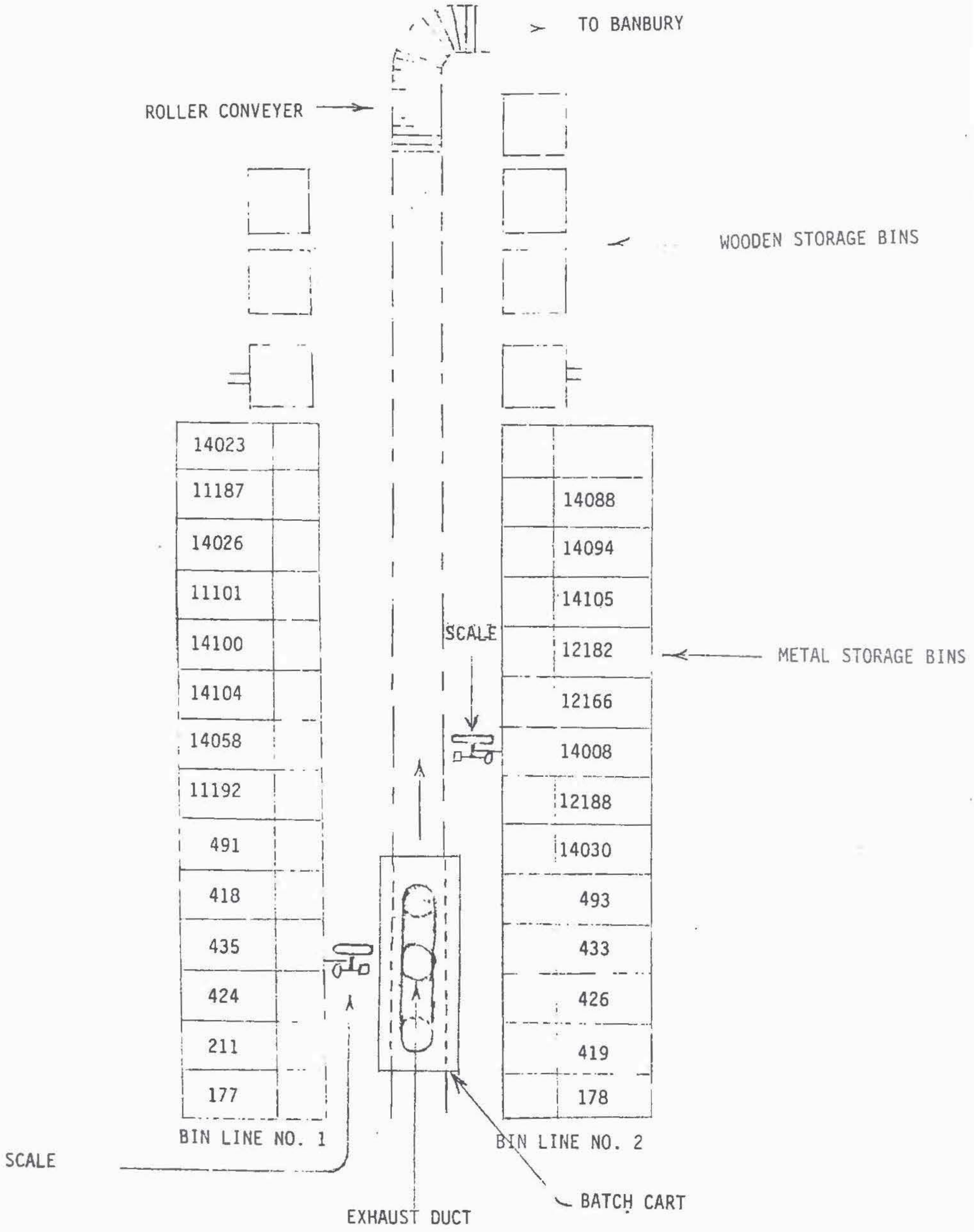


FIGURE III

HAZARDOUS MATERIALS ROOM GLOVE BOX
ST. CLAIR RUBBER CO.
HE 79-75

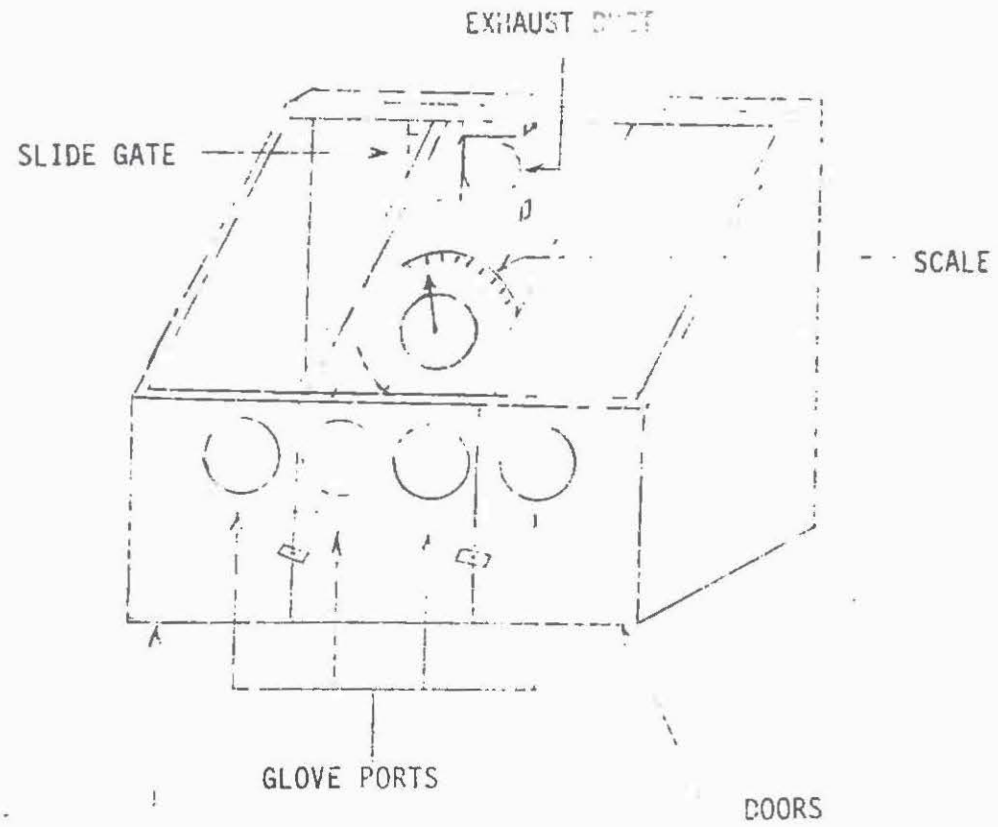
Recommended duct velocity = 2000-4000 fpm[1]

Recommended exhaust volume (Q) = 50 cfm/sq. ft. of open door area[1]
Open door area for glove box shown (1 door) = 4.1 sq. ft.
THEREFORE - recommended Q = 50 x 4.1 = 205 cfm

Measured duct velocity = (V) = 2800 fpm[2]

Actual exhaust volume (Q) = V x A
A = exhaust duct area = πr^2 = 0.196 sq. ft (for 6" dia. duct)
THEREFORE - actual Q = 0.196 x 2800 = 550 cfm

Measured face velocity at the open door = 130 fpm[2]



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1. As recommended by the American Conference of Governmental Industrial Hygienists "Industrial Ventilation Manual", 15th Edition, Fig. VS 202, pg. 5-21.

2. As measured with a velometer during the NIOSH survey on May 15-16, 1979.