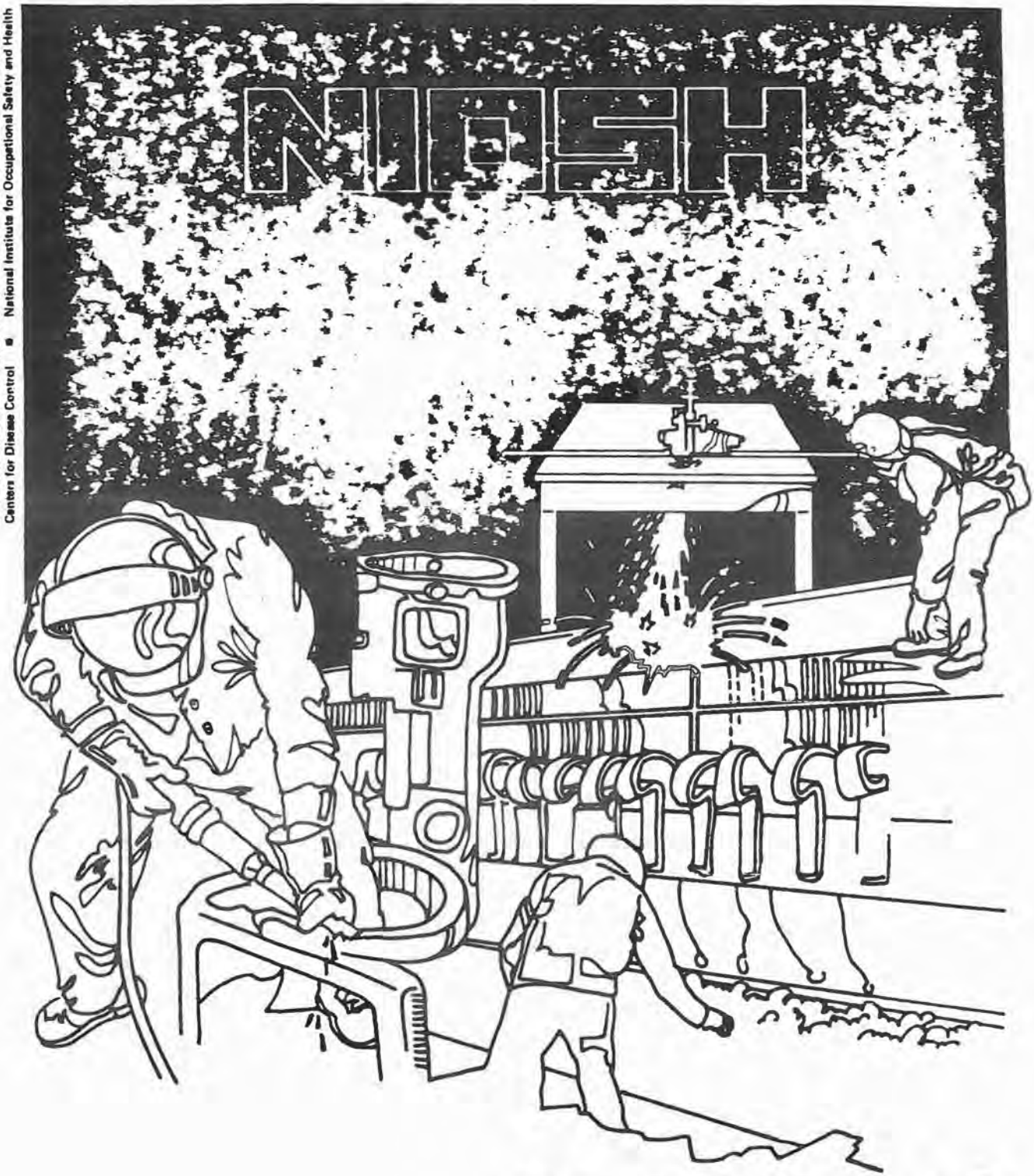
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

80-057-781

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 80-057-781
December 1980
Long Island Rail Road
Richmond Hill, New York

NIOSH INVESTIGATOR:
Richard Hartle

I. SUMMARY

A request for a Health Hazard Evaluation (HHE) was received by the National Institute for Occupational Safety and Health (NIOSH) on January 21, 1980, from an authorized representative of Local 589 of the International Brotherhood of Electrical Workers (IBEW). This request concerned employee exposures to potentially hazardous concentrations of airborne substances in the Battery Shop, Armature Room, and Paint Shop at the Long Island Rail Road (L.I.R.R.), Richmond Hill facility, New York.

Environmental sampling was conducted on June 2-5, 1980, to evaluate airborne contaminants generated from battery re-charging, steam cleaning, welding and soldering, vacuum weather sealing, air-conditioning recharge operations, paint stripping, spray-painting, and paint priming. A respirable dust sample collected during a steam cleaning operation indicated an exposure level of 16 mg/M^3; exceeding the OSHA standard of 5 mg/M^3. During paint stripping operations methylene chloride was detected in workers' breathing zones at time-weighted concentrations ranging from 102 parts per million (ppm) to 127 ppm. The NIOSH recommended exposure limit is 75 ppm. Concentrations of hexamethylene diisocyanate ranging from 0.027-0.054 ppm were detected during spray-painting. NIOSH recommends that time weighted average concentrations be kept below 0.005 ppm.

On the basis of the data obtained during this investigation, NIOSH determined that a potential hazard exists from overexposure to nuisance particulates, methylene chloride, and hexamethylene diisocyanate at the LIRR Maintenance and Repair Shop.

Accordingly, recommendations are made in the body of this report as a guide for the control of these exposures.

KEYWORDS: SIC 4020 Rail Road Maintenance, battery recharging, welding fumes, steam cleaning, spray painting, paint stripping, nuisance particulates, arsine, stibine, sulfuric acid, vinyl toluene, toluene, maleic anhydride, methyl butyl ketone, heptane, 1-nitropropane, 2-nitropropane, xylene, methyl ethyl ketone, cellosolve acetate, butyl acetate, hexamethylene diisocyanate, methylene chloride, methanol, isopropanol, chlorodifluoromethane.

II. INTRODUCTION

On January 21, 1980, a request was received by NIOSH for a hazard evaluation of the Armature Room, Battery Shop, and Paint Shop. An additional HHE request was submitted by an employee, concerning exposures to unknown agents in the Battery Shop. With the agreement of this employee, the requests were combined and treated as a single evaluation.

An industrial hygiene walk-through survey of the facility was conducted by NIOSH officers on February 21, 1980 (Interim report #1; March 1980). Because of contract negotiations within the N.Y.M.T.A. an industrial hygiene follow-up survey was not conducted until June 2-5, 1980. The purpose of the follow-up survey was to document employee exposures to potentially toxic substances at various jobs and locations and to evaluate their hazard potential.

III. BACKGROUND

The L.I.R.R. Richmond Hill facility is one of seven maintenance and repair shops for self-powered electric passenger cars and electric/diesel locomotives. The facility employs approximately 800 hourly and 40 administrative workers.

The L.I.R.R. was initially a series of private railroads which formed a coalition in the 1830's, and was subsequently purchased by the Pennsylvania Rail Road. In 1966 the State of New York purchased the system and delegated its operation to the New York Metropolitan Transit Authority. Because the system is muninicipally operated, the Occupational Safety and Health Administration has no enforcement authority of safety and health standards in the repair and maintenance shops. This situation prompted the request by the IBEW for NIOSH to evaluate current workplace exposures.

As stated earlier, the request for HHE covered the Armature Room, Battery Room, and Paint Shop. Following is a description of each area.

Armature Room:

Activities in this area of the repair shop involve cleaning, tear-down, inspection, and repair of electric motors. Cleaning is conducted out of doors, adjacent to the building, using high-pressure steam containing an industrial strength detergent (Penetone 5). The motors are moved inside and oven dried, then disassembled for inspection. Armatures are stripped and re-wound in an adjacent area. Soldering, arc-welding, and inert gas-shield welding is conducted at various locations in the shop. The final major process involves weather sealing of armatures and casings in a vacuum impregnation vessel containing primarily toluene and vinyl toluene. There are approximately 75 workers in this area over three work shifts.

Battery Shop:

The Battery Shop is located on the second floor, above a segment of the Armature Room. Lead-acid and nickel-cadmium batteries from the L.I.R.R. fleet are water washed and charged in this area at 21 separate charging stations. There are generally two workers in this area, during the day shift only.

Paint Shop:

The Paint Shop is located at one end of a passenger car repair shop, isolated by walls and accessable by four bay doors. In this area, passenger cars and locomotives are stripped of old paint using a methylene chloride based commercial solvent (Pen-Strip G) then primed and spray-painted with polyurethane based paints. During the time of our survey, passenger cars were stripped in the paint shop and painted during the third shift in the adjacent repair shops. The methylene chloride based solvent is sprayed via hand-held nozzle onto the top and side of a passenger car. The dissolved paint is removed by scraping and water washing. Two workers are primarily responsible for stripping, and two with priming and painting.

Incidental evaluations in three other areas were made during the follow-up site visit. These included the air-conditioning repair station, air-brake cleaning, and upholstery shop.

IV. METHODS AND MATERIALS

Armature Room:

Environmental monitoring in the Armature Room was conducted to determine exposure concentrations of dusts evolved during steam cleaning operations, metal dusts and fumes created from welding and soldering and from grinding and cutting copper parts, plus vinyl toluene and maleic anhydride emanating from the vacuum impregnation tank. Bulk samples of armature core-covering material and settled dusts in the core stripping and rewinding areas were collected to determine asbestos content.

Sample collection for metals was on "AA" millipore membrane filters at an air-flow rate of 1.5 liters per minute (lpm). The ICP (Inductively Coupled Argon Plasma) method of analysis was used.

Sampling and analysis for vinyl toluene and maleic anhydride were conducted in accordance with the NIOSH P&CAM method #'s 302, and S25, respectively.

Battery Shop:

Battery recharging area environmental air samples were collected and analyzed for sulfuric acid mist, arsine, and stibine according to NIOSH P&CAM #'s 267, S-229, and S-243, respectively.

Paint Shop:

Breathing zone and general area air samples for methylene chloride, isopropanol, and methanol were collected in the Paint Shop during a paint stripping operation. The samples were collected and analyzed via NIOSH P&CAM Method # S-329 for methylene chloride, S-65 for isopropanol, and S-59 for methanol. Similar air samples were collected during a priming operation for methyl butyl ketone (S-178), heptane (S-89), 1- and 2-nitropropane (272), xylene (S-318), toluene (S-343), isopropanol (S-65), and butanol (S-66), and during a spray painting operation for methyl ethyl ketone (S-3), cellosolve acetate (127), butyl acetate (S-47), and toluene (S-343). Ceiling and average exposure general area sampling for hexamethylene diisocyanate was conducted during spray painting using a nitro reagent sampling medium contained in dual midget impingers, and analyzed via the NIOSH P&CAM # N240 (modified).

Sample collection for "Freon" 11 and 12 in the air-conditioning recharge area was conducted according to P&CAM # S-102.

V. EVALUATION CRITERIA

The environmental evaluation criteria used in this report as related to airborne exposures to toxic substances are 1) NIOSH recommended standards, 2) Federal Occupational Health Standards as propulgated and enforced by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor (29 CFR 1910.1000) and 3) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's).

NIOSH, as formed under the Occupational Safety and Health Act of 1970 was enacted with the express purpose of assuring, so far as possible, safe and healthful working conditions for all working men and women in the Nation. As a means to this end, Congress provided for research in the field of occupational safety and health to explore ways to discover latent disease, to establish causal connections between diseases and environmental conditions in the workplace, and to establish criteria to assure that no employee will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience. As a result of these endeavors, recommendations for new federal standards may be presented to the Department of Labor, OSHA, usually in the form of NIOSH Criteria Documents.

The American Conference of Governmental Industrial Hygienists has developed a system of documentation for upper limits of exposures to chemical and physical agents in the work environment, and publishes this documentation, with annual updates, in the form of Threshold Limit Values or TLV's. Specifically, TLV's refer to "... airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect."

Summary Tables are presented in the "Results and Discussion" section of this report for the environmental samples collected during the HHE with reference to these three sources of evaluation criteria, where applicable.

VI. RESULTS AND DISCUSSION

Armature Room:

An environmental sample for respirable dust was obtained from the individual involved with steam cleaning of electric motors. Motors are cleaned to remove dusts accumulated during normal use and attrition products from the electrical contacts or "brushes", primirely composed of carbon and graphite. A full shift sample could not be obtained, because the worker felt that the sampling device interfered with his job. However, a sample collected for approximately 1.5 hours indicated exposure levels of respirable dust at 16 milligrams per cubic meter (mg/M^3). Because the workload and process does not deviate substantially during the work-shift, this sample is probably representative of an average full-shift exposure. Excessive concentrations of nuisance dusts may seriously reduce visibility, may cause unpleasant deposits in the eyes, ears, and nasal passages, or cause injury to the skin or mucous membranes by chemical or mechanical action. Table 1 presents a summary of results for particulate sampling. Included in the table are results of particulate sampling conducted at the air-brake cleaning station, Paint-Shop grinding, and sand blasting.

Welding and slot grinding operations were evaluated for worker exposures to metal dusts and fumes. Representative breathing zone air samples were collected from appropriate workers for the duration of the work shift. As indicated in Table 2 no overexposures were experienced by these workers for sampled substances.

Workers and union officials expressed concern for the possibility of asbestos products contained in armature core-covering material which must be manually stripped. Bulk samples of the suspected material were obtained along with settled dust or "rafter" samples, which are indicative of past airborne contaminants. No bulk samples were reported as containing any asbestos material.

An assessment of exposures to vinyl toluene and maleic anhydride was made by obtaining full shift personal and general area samples in the vicinity of the vacuum impregnation vessel. As indicated in Table 3, all reported values were well within the limits of the evaluation criteria. Although the weather sealing process was not at normal capacity, recently installed local ventilation seems to be controlling fugitive emissions from the vessel.

Battery Shop:

Because arsine and stibine may be generated through a chemical action between battery electrolyte and contaminants contained in the metal plates, environmental monitoring was conducted for the duration of the work shift in the Battery Shop for these two compounds. Additionally, airborne sulfuric acid was measured during the shift via breathing zone and general area sampling. A summary of results is presented in Table 4 showing the average and range of concentrations for all three compounds. With reference to the evaluation criteria, contaminants were well within safe exposure levels. Conversations with employees in this area indicate that a potential problem exists upon entering the work area at the beginning of the morning work shift, suggesting a build-up of contaminants during the off-shift hours. Also, as with all other areas evaluated, concern was expressed for exposure levels during the winter months when natural ventilation (open door and windows) is minimal.

A poor practice was observed during the survey involving the placement of an exhaust ventilation fan near (overhead) a work bench often used by battery shop workers; thus drawing any contaminants through this work station.

Paint Shop:

Paint stripping operations were conducted by applying a commercial solvent (Pen-Strip G) to the top and one side of a railroad car via a hand-held spraying apparatus. The solvent is contained in 55-gallon drums which are pressurized to facilitate spraying. Two drums are used for each operation (top and side). The primary ingredients of the solvent are methylene chloride (61%), isopropanol (16%), and methanol (3%). Stripping was conducted in the paint shop area which contained two lateral rail tracks, accessible at either end by two bay doors. The area was ventilated by overhead exhaust ventilation and by natural convection (bay door openings).

Scaffolding is used for access to the upper sides of the cars. Access to the top of the car requires a worker to walk on the top for both solvent application and subsequent removal.

Breathing zone and general area environmental air samples were obtained for evaluation of methylene chloride, isopropanol, and methanol exposures.

Sample results indicated no overexposure to isopropanol or methanol. However, results of breathing zone and general area sampling for methylene chloride (MeCl) show excessive exposures. Three consecutive breathing zone samples were collected for a total of greater than six hours for both workers. A time-weighted-average (TWA) exposure value was calculated, with the worker primarily involved with application of solvent averaging 127 ppm MeCl and the worker primarily involved with removing the solvent and dissolved paint averaging 102 ppm MeCl.

Although malfunctioning equipment precluded the aquisition of full-shift general area samples, consecutive area samples were collected for approximately one-half the shift at two locations. A time-weighted-average concentration of 279 ppm MeCl was obtained near the operation; near a bay door approximately 20 feet from the rail car. A second area sample was collected in the paint store room/locker room, adjacent to the paint shop. Analytical results show an average concentration of 96 ppm MeCl in this area (Table 5).

An important point concerning sample acquisition and analysis is that a significant amount of MeCl (greater than 1/3 of the reported value) was found on the reference portion, or backup section, of the charcoal tube sample collection devices in all but one of the MeCl samples. This indicates that the saturation limit of the charcoal tubes was reached. Reported sample results are therefore somewhat lower than the actual concentrations.

The current federal standard for MeCl is 500 ppm for an average 8-hour exposure with a 1000 ppm ceiling limit. The ACGIH currently recommends a 100 ppm average exposure limit, based in part on increased blood carbon monoxide levels (COHb) following exposures to MeCl. NIOSH has recommended a 75 ppm time-weighted-average exposure limit, primarily for the prevention of significant interferences with delivery of oxygen to tissues and abnormalities in central nervous system functions.

As evidenced by sample results, ventilation in the paint shop is reliant on natural convection through the bay doors. The existing overhead exhaust ventilation does little to ventilate the area due to the relatively high vapor density of the solvent (3.0-3.5 (air=1)). During the initial portion of the shift, the bay doors were nearly closed due to weather conditions. Samples collected during this time were from two to four times higher in concentration than subsequent samples collected while the bay doors were at least half open.

Priming and Painting:

Priming and spray painting are conducted in essentially the same manner with one worker responsible for each operation. The operations are conducted during the third shift to minimize the number of exposed employees (the only operations underway during the third shift in this area of the facility were priming and painting). During the time of our survey, these jobs were conducted in the car repair shops.

The car repair shops house a number of rail cars situated laterally, each car accessible by large bay doors along the longitudinal walls. Ventilation is dependant upon air flow through these door-ways; however, bay doors adjacent to the operations are only slightly opened, if at all, due to cross drafts which can have a negative impact on paint application. Ventilation is further hampered due to the closeness of the rail cars, creating an area of air stagnation between them.

Environmental air samples were collected during priming in the breathing zone of the worker and in the general work area for determination of airborne exposures to methyl butyl ketone, heptane, xylene, toluene, 1-nitropropane, and 2-nitropropane. As indicated in Table 6, all exposure concentrations were well within the limits expressed in the evaluation criteria and calculations concerning multiple exposures were well below unity. Furthermore, priming is conducted during a relatively small portion of the work shift (only 45 minutes during our evaluation) which would substantially reduce the overall 8 hour time-weighted-average exposures.

Painting operations were evaluated by obtaining breathing zone and general area environmental air samples for methyl ethyl ketone, cellosolve acetate, butyl acetate, toluene, and xylene. As indicated in Table 7, all exposures to these substances were also well within the appropriate evaluation criteria. Area samples were also obtained for peak and time-weighted determinations of exposures to hexamethylene diisocyanate (HDI). One sample was obtained for the duration of the painting cycle, and four were obtained for 10 minute peak determinations. The long-term sample was reported at 0.027 ppm, while the short-term samples were reported at 0.028, 0.054, 0.029, and 0.035 ppm, indicating a rather consistent exposure. While no federal standard exists, as yet, for HDI, NIOSH recommends that average exposures be maintained below 0.005 ppm, and 0.020 ppm as a ceiling concentration for any 10-minute sampling period. These recommendations were exceeded in every case. Table 7 summarizes this environmental data. The recommended standard was based on three types of effects of exposure to HDI: direct irritation, sensitization*, and chronic decrease in pulmonary (lung) function.

* Sensitization is generally defined as the initial exposures of an individual to a substance resulting in an immune response; subsequent exposure to this substance at greatly reduced levels then induces a "hypersensitivity reaction".

Other Areas of Investigation:

A full shift environmental air sample was collected in the breathing zone of the air-conditioning maintenance worker and in his general work area for exposure to dichlorofluoromethane. Both time-weighted results were below 1 ppm.

Exposure to nuisance particulates at the air-brake cleaning station were within acceptable limits (Table 1).

A bulk sample of sand-blasting material was obtained for analysis of free silica content. Results showed amounts of quartz and cristobalite to be less than the analytical limits of detection (<1.5% for both polymorphs of silica).

VII. CONCLUSIONS AND RECOMMENDATIONS

During the time of the environmental survey, hazardous exposure conditions existed at the electric motor steam cleaning station, the paint stripping area, and during spray painting operations, involving excessive exposures to nusiance particulates, methylene chloride, and hexamethylene diisocyanate, respectively. Although other areas of the investigation showed exposure concentrations below their respective evaluation criteria, both management and labor should be aware of the numerous variables effecting worker exposures, including seasonal ventilative variations (open vs. closed doors and windows). It is important to note that our evaluation was conducted during the summer when natural ventilation was optimal.

As discussed with the L.I.R.R. Safety Officer, major renovations are planned for the facility. It should be stressed that engineering controls to reduce employee exposures should be considered in the design phase.

The following recommendations are based on results of environmental sampling, conversations with employees, and observations made during the survey.

1. Re: exhaust ventilation in the battery shop;

   a) Relocate the exhaust fans or the work-bench so that exhaust air is not drawn past this work station.

   b) Ventilate the battery recharge area prior to the work shift, especially when batteries are charged overnight. Larger quantities of stibine are liberated during the latter portion of charging cycles.(2)

   c) Periodically clean the exhaust fans. Deposits on fan blades can substantially reduce efficiency.

2. Provide respiratory protection to employees at the armature steam cleaning station in compliance with part 1910.134 of the OSHA General Industry Standards.

3. Control volatile emissions generated from the vacuum impregnation vessel and associated processes. Continuation of the current plans to enclose the area appears to be an appropriate solution to vapors generated from armatures and casings prior to oven drying.

4. Heighten the exhaust stack from the VPI area oven. Stack emissions are currently released on the outside of the building near working areas of upper stories.

5. Provide eye protection for employees engaged in stripping of armature cores, particularly when using pressurized air, in compliance with part 1910.133 of the OSHA General Industry Standards.

6. Provide improved local exhaust ventilation for the upholstery shop table saw to reduce airborne wood-dust exposures. Although exhaust volume appears to be adequate, numerous openings around the blade are producing ineffective capture velocities.

7. Improve ventilation in the paint shop. The existing overhead ventilation does little to reduce airborne concentrations of MeCl since vapors of this substance are three to four times heavier than air. Furthermore, open bay doors are ineffective in providing sufficient air exchange. A multi-purpose design to facilitate both stripping and spray-painting operations would seem practical. Re-design should also include guard-rails to protect employees while working on top of the passenger cars.

8. Conduct spray-painting operations in a ventilated area (re: recommendation #7). In the meantime, provide respiratory protection to employees involved in paint stripping, priming, and painting operations in compliance with Part 1910.134 of the OSHA General Industry Standards.

9. Eliminate solvent exposures in the paint store room/locker area generated in the paint shop. This can be accomplished by keeping the paint shop door closed and installing a fan(s) to supply fresh (outside) air and thus creating an area of positive pressure.

10. Minimize travel of non-essential personnel through the paint shop.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. REFERENCES

1. American Conference of Governmental Industrial Hygienist: Documentation of the Threshold Limit Values for Substances in the Workroom Air, pp. 47, 1980.

2. Haring, H.E. and Compton, K.G. "The Generation of Stibine by Storage Batteries." Transactions of the Electrochemistry Society (Paper presented at the 68th General Meeting of the Electrochemistry Society, October 12, 1935), Vol. 68, pp. 283-292.

X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available, upon request, from NIOSH, Division of Technical Services, Information 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 NIOSH, Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

1. Long Island Rail Road, Richmond Hill, New York.
2. Federal Railway Administration, Washington, D.C.
3. International Brotherhood of Electrical Workers, Richmond Hill, New York.
4. NIOSH, Region II

Table 1

Summary Results of Environmental Monitoring for Particulates (Nuisance Dusts)

Long Island Rail Road
Richmond Hill, New York

June 2-5, 1980

HE 80-57

Substance	Type Sample	Job/ Location	Number Samples	Average Conc. (mg/M^3)	Range Conc.	Evaluation Criteria Federal Standard	NIOSH	ACGIH
nuisance dust	breathing zone respirable	electric motor cleaning	1	16.1	-	5 mg/M^3	-	5 mg/M^3
nuisance dust	breathing zone respirable	air brake cleaning	1	0.3	-	5 mg/M^3	-	5 mg/M^3
nuisance dust	general area total particulate	air brake cleaning	1	2.5	-	15 mg/M^3	-	10 mg/M^3
nuisance dust	breathing zone respirable	paint shop grinding	1	0.3	-	5 mg/M^3	-	5 mg/M^3
nuisance dust	general area total particulate	paint shop grinding	1	0.9	-	15 mg/M^3	-	10 mg/M^3
nuisance dust	breathing zone respirable	sandblasting*	1	0	-	5 mg/M^3	-	5 mg/M^3

* Analysis of material used in sandblasting showed less than 1.5% content of quartz or cristobalite.

Table 2

Summary Results of Environmental Monitoring for Airborne Metals
Armature Room - Breathing Zone

Long Island Rail Road
Richmond Hill, New York

June 2-5, 1980

HE 80-57

	Concentration (mg/M^3)				Evaluation Criteria mg/M^3		
Substance	Silver Solder	Slot Cutting	TIG Welder	Silver Solder	Federal Standard	NIOSH	ACGIH
aluminum	0.009	0.010	0.006	<0.001	-	-	5.0
chromium	<0.001	<0.001	0.003	<0.001	1.0	0.025	0.5
copper	0.010	0.251*	0.047	0.015	0.1 (fume)	-	0.2 (fume)
iron	0.046	0.019	0.013	0.010	10.0	-	5.0
phosphorus	0.005	0.012	0.006	0.003	-	-	-
lead	0.0009	0.001	0.015	<0.001	0.05	0.10	0.15
selenium	0.0025	0.001	<0.001	<0.001	0.2	-	0.2
tin	<0.001	0.004	<0.001	0.002	2.0	-	2.0
zinc	0.011	0.002	0.002	0.001	5.0	5.0	5.0

* Exposure was primarily to copper dust rather than fume (Federal Standard = 1 mg/M^3).

Table 3

Summary Results of Environmental Monitoring
Armature Room

Long Island Rail Road
Richmond Hill, New York

June 2-5, 1980

HE 80-57

Substance	Type Sample	Job/ Location	Number Samples	Average	Range	Evaluation Criteria		
						Federal Standard	NIOSH	ACGIH
vinyl toluene	breathing zone	VPI	3	2.3 ppm	1.6-3.7 ppm	100 ppm	-	100* ppm
vinyl toluene	general area	VPI	3	1.5 ppm	<0.3-2.8 ppm	"	"	"
maleic anhydride	general area	VPI	6	<0.05 ppm	-	0.25 ppm	-	0.25 ppm

* Notice of intended change to 50 ppm.

Table 4

Summary Results of Environmental Monitoring
Battery Shop

Long Island Rail Road
Richmond Hill, New York

June 2-5, 1980

HE 80-57

Substance	Type Sample	Job/ Location	Number Samples	Average Conc. (ppm)	Range Conc. (ppm)	Evaluation Criteria		
						Federal Standard	NIOSH	ACGIH
arsine	general area	charging area	6	0.0003	0.0002-0.0004	0.05 ppm	0.0006* ppm	0.05 ppm
stibine	general area	charging area	6	0.0006	0.0002-0.0013	0.1 ppm	-	0.1 ppm
sulfuric acid	breathing zone	charging area	1	0.029 mg/M^3	-	1 mg/M^3	1 mg/M^3	1 mg/M^3
sulfuric acid	general area	charging area	1	0.068 mg/M^3	-	1 mg/M^3	1 mg/M^3	1 mg/M^3

* For any 15 minute period.

Table 5

Summary Results of Environmental Monitoring
Paint Shop
Paint Stripping Operation

Long Island Rail Road
Richmond Hill, New York

June 2-5, 1980

HE 80-57

Substance	Type Sample	Job/ Location	Number Samples	Average	Range	Evaluation Criteria		
						Federal Standard	NIOSH	ACGIH
methylene chloride	breathing zone	paint stripping/ paint shop	6①	115.3 ppm	12.6-201.4	500 ppm	75 ppm	100 ppm
methylene chloride	general area	paint stripping/ paint shop	4①	187.2 ppm	86.1-421.5	500 ppm	75 ppm	100 ppm
isopropanol	breathing zone	paint stripping/ paint shop	6	9.7 ppm	1.3-15.1	400 ppm	400 ppm	400 ppm
methanol	breathing zone	paint stripping/ paint shop	4	47.1 ppm	18.8-74.3	200 ppm	200 ppm	200 ppm

① Sample analysis showed breakthrough; exposure conditions were somewhat higher than shown.

Table 6

Summary Results of Environmental Monitoring
Paint Shop
Priming Operation

Long Island Rail Road
Richmond Hill, New York

June 2-6, 1980

HE 80-57

Substance	Type Sample	Job/ Location	Number Samples	Average	Range	Evaluation Criteria Federal Standard	NIOSH	ACGIH
methyl butyl ketone	breathing zone	priming car repair area	1	6.4 ppm	-	100 ppm	-	25①
methyl butyl ketone	general② area	priming car repair area	3	0.9 ppm	0.7-1.3	100 ppm②	-	25①
heptane	breathing zone	priming car repair area	1	2.5 ppm	-	500 ppm	85 ppm	400 ppm
heptane	general area	priming car repair area	3③	0.4 ppm	0.4	500 ppm	85 ppm	400 ppm
1-nitropropane	breathing zone	priming car repair area	1	less than 0.4 ppm	-	25 ppm	-	25④
1-nitropropane	general area	priming car repair area	1	less than 0.4 ppm	-	25 ppm	-	25④
2-nitropropane	breathing zone	priming car repair area	1	less than 0.3	-	25 ppm	-	25⑤
2-nitropropane	general area	priming car repair area	1	less than 0.4	-	25 ppm	-	25⑤
xylene	breathing zone	priming car repair area	1	2.8 ppm	-	100 ppm	100 ppm	100 ppm
xylene	general area	priming car repair area	3	0.5 ppm	0.3-0.8	100 ppm	100 ppm	100 ppm
toluene	breathing zone	priming car repair area	1	17.2 ppm	-	200 ppm	100 ppm	100 ppm
toluene	general area	priming car repair area	3	6.1 ppm	4.7-7.5	200 ppm	100 ppm	100 ppm

① Notice of intended change to 5 ppm.
② Standards are for personal exposures.
③ One of 3 below 0.01 mg. analytical limit of detection.
④ Notice of intended change to 15 ppm.
⑤ Suspect carcinogen.

Table 7

Summary Results of Environmental Monitoring
Paint Shop
Painting Operation

Long Island Rail Road
Richmond Hill, New York

June 2-6, 1980

HE 80-57

Substance	Type Sample	Job/ Location	Number Samples	Average	Ranges	Evaluation Criteria		
						Federal Standard	NIOSH	ACGIH
methyl ethyl ketone	breathing zone	painting/ car repair area	3	8.3 ppm	6.3-9.6	200 ppm	-	200 ppm
methyl ethyl ketone	general area	painting/ car repair area	6	1.3 ppm	<0.6-2.2	200 ppm	-	200 ppm
cellosolve acetate	breathing zone	painting/ car repair area	3	8.8 ppm	5.7-14.4	100 ppm	-	100 ppm
cellosolve acetate	general area	painting/ car repair area	6	2.2 ppm	0.3-3.4	100 ppm	-	100 ppm
butyl acetate	breathing zone	painting/ car repair area	3	4.4 ppm	3.1-6.9	150 ppm	-	150 ppm
butyl acetate	general area	painting/ car repair area	6	1.5 ppm	<0.2-2.2	150 ppm	-	150 ppm
toluene	breathing zone	painting/ car repair area	3	8.3 ppm	4.4-11.8	200 ppm	100 ppm	100 ppm
toluene	general area	painting/ car repair area	6①	3.5 ppm	2.3-5.1	200 ppm	100 ppm	100 ppm
xylene	breathing zone	painting/ car repair area	3	1.6 ppm	<0.5-2.3	100 ppm	100 ppm	100 ppm
xylene	general area	painting/ car repair area	6	0.5 ppm	<0.2-0.7	100 ppm	100 ppm	100 ppm
hexamethylene diisocyanate	general area	painting/ car repair area	5	0.035 ppm	0.027-0.054	-	0.005 ppm	-

① Three samples reported as showing breakthrough; average concentration is somewhat higher.