

**Survey of Moran Paint Division
Carboline Company
Xenia, Ohio**

**DATE OF SURVEY
June 5-7, August 13-15, 1974
and June 13, 1975**

**SURVEY CONDUCTED BY
Troy Marceleno, P.E.
Joseph S. Mallov, M.D.
Harry Donaldson
Ken Wallingford
Mel Cassady
Fred Wells
Cheryl Rae**

**REPORT PREPARED BY
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**DATE OF REPORT
April, 1975**

**Division of Field Studies and Clinical Investigations
National Institute for Occupational Safety and Health
Cincinnati, Ohio**

PLACE VISITED: Moran Paint Division, Carboline Company
125 Fairgrounds Road
Xenia, Ohio 45385
Telephone: (513) 372-3511

DATE OF MEDICAL SURVEY: June 5-7, 1974

DATE OF ENVIRONMENTAL SURVEY: August 13-15, 1974 and June 13, 1975

PERSONS PARTICIPATING IN SURVEY: Troy Marceleno, P.E.
Joseph S. Mallov, M.D.
Harry Donaldson
Ken Wallingford
Mel Cassady
Fred Wells
Cheryl Rae

PERSONS CONTACTED: Ardell Pitt, Vice President and
Plant Manager, Moran Paint
Division
Dale Boyer, Manufacturing Supervisor

PURPOSE: To conduct an environmental and
medical survey in a facility that
used methyl butyl ketone.

INTRODUCTION

Background

The National Institute for Occupational Safety and Health (NIOSH) is conducting a study of industrial users of methyl butyl ketone (MBK) and the possibility of peripheral neuropathy developing in workers exposed to this solvent. This investigation was initiated in September, 1973 because of the diagnosis of such neuropathies in employees of a coated fabric facility.^{1,2} MBK, which has been newly introduced in August, 1972, as part of a solvent formulation in various operations of the coated fabric facility was thought to be the probable etiological agent.³ However, two observations remained puzzling: (1) Only one of the 31 area air samples for MBK, taken in the print department, yielded a concentration above the OSHA standard (100ppm), while the other samples yielded a concentration 1/2 the present standard or less; (2) Twenty of the 31 samples analyzed for methyl ethyl ketone (not newly introduced solvent, but one also used most heavily in the print department where most of the cases occurred) had concentrations above the present standard for MBK (200ppm).

Three explanations presented themselves: (1) MBK was the causal agent, but the most important route of exposure was not respiratory. (Indeed, there was probably much skin exposure and some oral exposure which occurred, as the result of faulty work practices); (2) MBK was the causal agent; the main route of exposure was respiratory, and the present standard for MBK is therefore much too high; (3) MBK acted in synergism with MEK; the main route of absorption of MBK was by respiration, but relatively low air levels of MBK, not harmful in themselves, are harmful when present in conjunction with high air levels of MEK.

Two other explanations are also possible: (1) MBK acted in synergism with MEK; the main route of absorption of MBK was not respiratory, however; (2) There were high air levels of MBK at the breathing zone, but these were not picked up by area air samples.

To distinguish among these alternate explanations, and to evaluate further the possible neurotoxic effects of MBK, an industry-wide medical and environmental study was begun. This report summarizes the results of one part of the study conducted at the Moran Paint Division Plant, Carboline Company plant in Xenia, Ohio.

General

On June 5-7, 1974, Dr. Joseph Mallov from the Division of Field Studies and Clinical Investigations (DFSCI) of NIOSH, Cincinnati, Ohio, assisted by Mrs. Cheryl Rae, conducted a medical investigation of the Moran Paint Division plant, a producer of paints and user of MBK. Later, on August 13-15, 1974, Troy Marceleno, Harry Donaldson, Ken Wallingford, Fred Wells and Cheryl Rae conducted an environmental survey. Troy Marceleno and Melvin Cassady returned to the plant on June 13, 1975, to reconfirm ventilation measurements.

Survey objectives consisted of (1) identifying present and past work practices relating to the usage of MBK; (2) securing plant history and production data; (3) conducting clinical neurological examinations; (4) administering work and medical history questionnaires and (5) collecting air samples and bulk samples in an attempt to correlate worker exposure levels with medical findings.

Table 1 shows comparable figures for MBK, MEK, and MIBK purchased at Moran Paint Company in 1973. Table 2 gives a listing of all solvents used during the same period.

The company was inspected and cited on 6 counts by OSHA on October 30, 1973. Items cited included failure to provide facilities to cope with accidental chemical spills; failure to monitor asbestos fibers or display caution signs where asbestos was being used; failure to provide for proper respirator use; and failure to keep employee exposures to methyl isobutyl ketone below OSHA time weighted average (TWA) Standards.

A total of 58 employees received medical examinations during the survey period. Also, a total of 107 air samples were collected. These included 69 personal breathing zone and 29 area samples collected for organic vapors. Nine bulk asbestos samples were also collected to ascertain their composition and content.

PLANT BACKGROUND AND DESCRIPTION

The Moran Paint Division plant, Carboline Company, has been in Xenia since 1956. Previously, it was located in Dayton, Ohio. The plant consists of 7 buildings; the main production facility is an old building with three floors of working space. Separate facilities are used for storage of finished goods and for office space.

The company is a producer of epoxy paints, phenols, urethanes, water-based polyvinyl acetate, acrylics, alkids, esters and vinyls. The products are sold under two labels. One of these, Carboline, consists mostly of maintenance coatings that are used by painting contractors or large companies. The other, Moran Paints, consist mostly of industrial coatings used by large manufacturers such as General Motors, Ford, and Inland Container, Inc.

Approximately 58 people are employed in the plant. About 25 of them handle or are exposed to MBK. There are two work shifts.

The Moran Paint Division began using MBK in October, 1969. Initially the quantities used were small. By 1971, MBK was used at the approximate rate of 2000 gallons/month. In 1973, around 380,500 lbs. (56,400 gallons) of MBK were purchased. From January 1, 1974 - August 14, 1974 (the period for which the latest solvents consumption data was available) around 305,700 lbs. (45,300 gallons) were used.

Table 1
SELECTED SOLVENTS CONSUMPTION FOR 1973
 Moran Paint Division
 Xenia, Ohio

	MBK	MEK	MIBK
	380,500 lbs. (56,400 gallons)	487,400 lbs. (72,600 gallons)	217,200 lbs. (32,600 gallons)
Average Monthly Use:	4,700 gallons/ month	6,000 gallons/ month	2,700 gallons/ month

Table 2

SOLVENTS USED DURING 1973
Moran Paint Division
Xenia, Ohio

Mineral Spirits	HiSol 4A
Lectol Spirits	DiMethyl Formamide
Kerosene	Anhydrous Ethyl Alcohol
Shell Solvent TS-28	Isophorone
Pine Oil	Lacquer Thinner
Toluol	Ethyl Amyl Ketone
Xylol	Nitropropane
Cellosolve	Mesityl Oxide
Cellosolve Acetate	Pentoxone
Butyl Cellosolve	Chlorothane
Standard Oil Solvesso #100	Methyl Cellosolve (Occlatate)
Standard Oil Solvesso # 150	Ethyl Butyl Ketone
Ethyl Alcohol	M-Pyrol
Isopropyl Alcohol	Cyclohexan
Butyl Acetate	Methyl Ethyl Ketone Urethane Grade
Isopropyl Acetate	Cellosolve Acetate Urethane Grade
Butyl Acetate	Heptane
Acetone	Methyl Ketone N-Butyl
Methyl Ethyl Ketone	Ethyl Acetate 99%
Methyl Isobutyl Ketone	Adco S-622
Lacquer Thinner #450	Depentine 122
Methyl Alcohol	VMP Naptha Rule 66
Cyclohexanone	Perchlorethylene
Diacetone Alcohol	Hexylene Glycol
Methyl Cellosolve	Texanol Esther Alcohol
Dowanol DB	90 Flash VM&P

Medical Program

At the present time, employees are not given pre-employment or periodic medical exams. The plant depends on the Medical Associates Clinic in Xenia for treatment or exams when employees are sick or injured. On occasion the plant has also sent employees to Green Memorial Hospital in Xenia.

Safety and Industrial Hygiene

The plant has a safety committee which meets monthly. No organized industrial hygiene program exists at Moran Paint except for the observance of various work practices, including use of respirators, during hazardous operations such as the loading and mixing of paints which contain asbestos and solvents. Each morning employees are furnished respirators with new filters. The filters are changed daily by the maintenance man.

Employees are urged to shower daily on the completion of their workshift but some do not. Uniforms are provided only to a small number of employees. The majority use old work clothes.

DESCRIPTION OF THE OPERATION

As was indicated earlier, the manufacturing area is located in an old, three story building. Paints are mixed in pebble mills and cowles, which are manually loaded. The cowles are mainly located on the second floor but are loaded from the third floor level. The first level is used mostly for filling paint containers, and for storage and shipping of finished goods.

Raw materials (solvents and other paint ingredients) are kept in 55 gallon drums and in paper bags. Charging of solvents into the pebble mills is accomplished by removing bung-hole covers, tilting the drums over the floor openings leading to the pebble mills, and pouring in the desired amount of solvent. Resins, pigments, etc., which come in 50 pound paper bags are charged into the pebble mills in a similar fashion. The result is a powdery, messy floor. According to some employees several fires have occurred in the operation, probably as a result of static charges building up in the pebble mills which spontaneously ignite the resin powders being charged into them.

Asbestos is used in the manufacture of roofing and organic coatings. Bagged raw materials of a long fiber variety made by Powhatten, are stored separately in an adjoining building and are brought to the cowles by fork lift trucks. These materials are loaded into the cowles by hand, usually in a corner of the building away from the main traffic areas. Respirators are used during the loading operation. During the survey it was noted that signs were put up to restrict passage through the area while the loading operation was in progress. No lead or lead compounds are used as paint ingredients.

Empty drums are usually cleaned by a high pressure caustic cleaning machine that is located on the second floor. At the time of sampling, this machine was not operational. Drums not cleaned in this manner are sent to reconditioning plants in Columbus and Dayton, Ohio.

Housekeeping

The plant was in need of a general cleanup. Stairways and aisles were especially dirty. Aisle markings were non-existent and storage areas were overloaded and unorganized. Exit from the building, in case of an emergency would be difficult in some locations.

Workpractices

In many operations where solvents were being used, workmen were seen without protective gloves.

Some employees were seen cleaning the cowles by hand. These employees used reclaimed thinners and other solvents to wash the paint from their hands.

Fillers were observed working on the first floor without benefit of ventilation, gloves or respiratory protection.

Ventilation

In 1971 when the present plant manager first arrived, the plant's ventilation system was not operational. In December, 1972, the Occupational Safety and Health Compliance Corporation (OSHCC) of Cincinnati, Ohio was contracted by the company to make an OSHA compliance inspection of the plant. Their report is shown in Appendix A.

Today the plant's ventilation system depends primarily on makeup air introduced into the manufacturing area through large bay doors and through side windows. Window exhaust units serve to evacuate the solvent vapors which are emitted from the manufacturing process. No local exhausts are provided on the cowles or other mixing tanks although elephant trunks from the ceiling air plenums were being installed during the survey conducted August 13-15, 1974, to evacuate the solvent vapors from those areas where they were prevalent.

Because the system was not yet operational its effectiveness could not be ascertained. Flow measurements were made of the makeup air introduced through the doors and windows, as well as flows through the window-mounted exhaust fans.

On June 13, 1975, follow-up air flows and space measurements were deemed necessary to confirm readings made earlier. Ventilation system changes installed since the last survey were duly noted and all air measurements updated.

SURVEY PROCEDURES

Medical Survey (June 5-7, 1974)

All 58 employees were given a neurological exam by Dr. Mallov, without knowledge of the occupational history at the time of the examination. A standard form was used for noting the results of each examination (see Appendix B). An occupational history was solicited from each employee by Mrs. Cheryl Rae, a NIOSH trainee, immediately preceding or following each neurological examination. A questionnaire form was used and questions were asked regarding job history, solvent exposure, and hygiene practices (see Appendix C).

Following completion of the examinations, 10 men with physical findings were called back for further testing. A medical history was taken from these men by Dr. Mallov, according to a standard questionnaire from which included questions about neurologic symptomatology and possible non-occupational causes of neurological disease. (i.e. the presence of diabetes, excessive alcohol intake, certain medications, herniated discs, etc. (See Appendix D). Also, the following blood tests were obtained from this subgroup: CBC, differential, and sedimentation rate; SMA including 2 hour post-prandial glucose, BUN, creatinine, and liver function tests (SGOT, SGPT, LDH, bilirubin, and alkaline phosphatase) and prothrombin time. In addition one man underwent electromyographic and nerve conduction velocity measurements.

For purposes of analysis it was decided to divide the employees into three groups based on occupational exposures:

(1) Group E - all employees who had been employed at Moran Paint Company for six months or more and who had spent the past 6 months in a position other than truck driver, warehouse worker or shipping worker.

(2) Group C - the control group: all current truck drivers, warehouse workers, shipping workers, and receiving workers, provided that they had spent the past 12 months in one or more of these job categories and in no other job categories at Moran Paint, or that they had never worked in any other job category at Moran Paint. Also included in group C were all recent employees who had been with Moran Paint for less than 3 months.

(3) Group I (intermediate exposure) - all others, plus workers whose job histories were ambiguous.

In analyzing the data, the following convention was used: a "positive" neurologic exam was one with two or more distal bilateral sensory findings (grade 0-1) in the same anatomic area, or one distal bilateral motor finding (grade 0-4 muscular weakness). (See standard, Appendix B, form for definitions of grades). For example, a subject with diminished vibratory sense in his toes and diminished pinprick sensation in his feet would be considered to have a positive examination. This convention was adopted because it was considered that two positive sensory findings in the same anatomic area

were more likely to reflect real pathology than one such finding, or than one sensory finding in one anatomic region and another in a different anatomic region.

Deep tendon reflexes were ignored in this rating scheme because of the likelihood that an absent reflex without concomitant loss of muscle strength or sensation could be attributed to inadequate patient relaxation or some other artifactual source. Weak finger adduction was not considered a positive finding because of the unreliability of the paper-pulling test and its dependence on such factors as dryness or wetness of the fingers. Diminished pinprick sensation on the palms alone was not considered a positive finding because this could be attributed to callouses; diminished pinprick sensation on both the palms and dorsum of the hands was considered a positive finding.

It was felt that the most difficult problem medically would be to separate peripheral neuropathy due to alcoholism from that due to MBK. A person was considered to have a high consumption of alcohol if he had been drinking for more than 10 years and had averaged 6 or more cans of beer/day or 2 or more bottles of wine/week or 9 or more other drinks/week during the past 5 years. This information was obtained from the medical questionnaire given to individuals with physical findings. A person was also considered to have a high consumption of alcohol if he had 2 or more abnormal liver function blood tests. A person was considered a diabetic if his 2 hour post-prandial blood glucose was greater than 120.

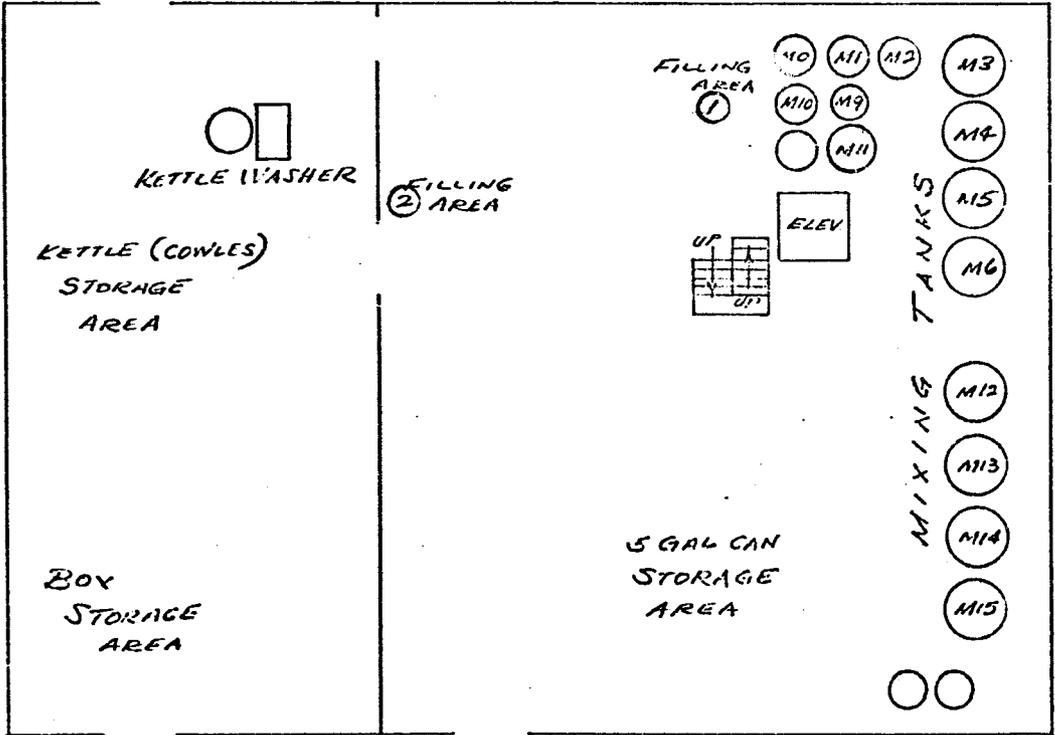
Industrial Hygiene Survey (August 13-15, 1974)

Environmental

Air sampling and environmental measurements were carried out during both shifts at Moran Paints. Long term (3 hour) personal breathing zone and area air samples were collected on charcoal tubes using Sipin Lo Flo pumps at approximately 50 cc/min. Around ten liters of air were collected per sample but the volumes varied because of individual pump characteristics. Figures 1-3 show the area sampling locations.

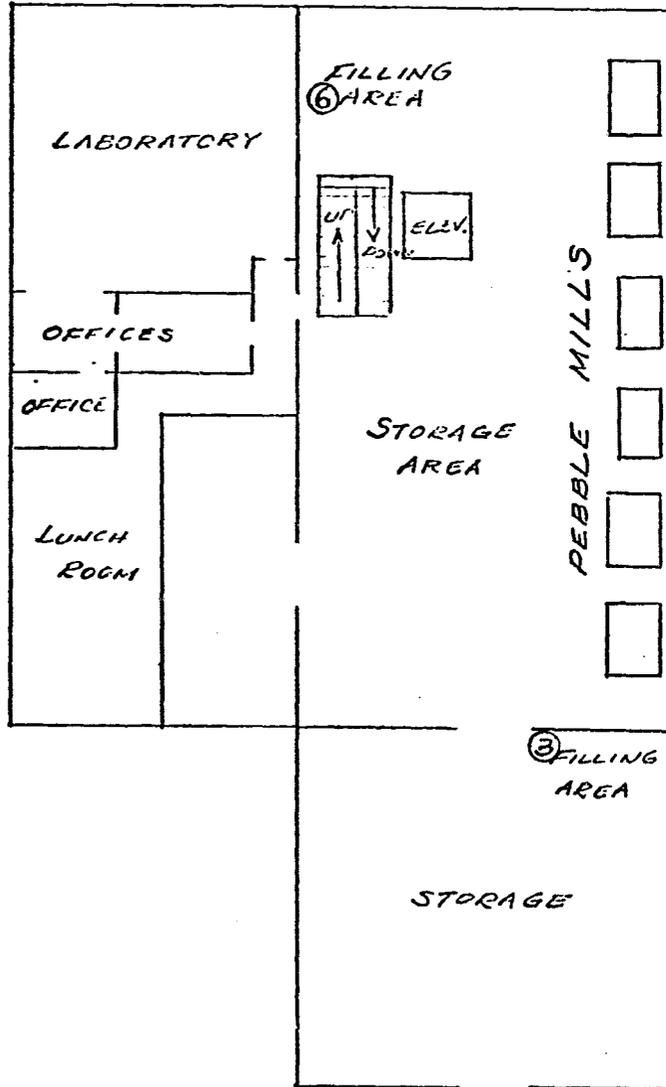
All samples were analyzed for MBK, MEK, MIBK, acetone, toluene, ethyl acetate, isopropanol, n-butyl acetate, xylene, styrene, cellosolve, cellosolve acetate, butyl cellosolve and methanol, using a gas chromatographic method similar to that described by White et al.⁴. To facilitate analysis, the lower limit of detection for each compound was set at 1/10 the TLV, assuming 10 liter air samples. These values are shown in Table 3. Appropriate backup tube sections were set aside for further analysis in the event that some samples exceeded the 1/10 TLV values being used. Table 4 lists all of the organic vapor samples collected and denotes those where the 1/10 TLV values were exceeded.

FIG. 1 - SAMPLING STATIONS



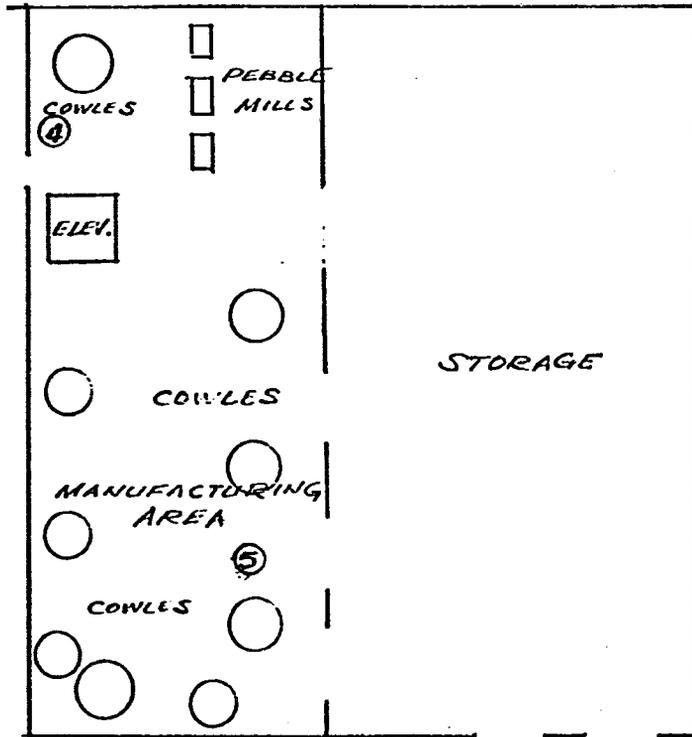
① - SAMPLING STATIONS
 FIRST FLOOR PLAN
 MORAN PAINT DIVISION
 CARBOLINE CO.
 XENIA, OHIO

FIG. 2 - SAMPLING STATIONS



DOCK
① - SAMPLING STATIONS
SECOND FLOOR PLAN
MORAN PAINT DIVISION
CARBOLINE Co.
YENIA, OHIO

FIG. 3 - SAMPLING STATIONS



① - SAMPLING STATIONS

THIRD FLOOR PLAN
MORAN PAINT DIVISION
CARBOLINE CO.

Table 3

Lower Detection Limits*

<u>Compound</u>	Concentration mg/tube	<u>Compound</u>	Concentration mg/tube
MEK	0.6	Xylene	0.4
Isopropanol (IPA)	0.9	Cellosolve	0.4
MIBK	0.4	Cellosolve Acetate	0.5
N-Butylacetate	0.7	Butyl cellosolve	0.2
Toluene	0.4	MBK	0.4

*Based on values at approximately 1/10 TLV assuming a 10 liter air sample.

Table 4

ORGANIC SOLVENTS CONCENTRATIONS*
 Carboline Company
 Xenia, Ohio
 August 13-15, 1974

Sample No.	Type Sample**	SOLVENT CONCENTRATIONS (mg/m ³)					Mixture Exposure 1.00****
		MEK 590***	MIBK 410***	Toluene 750***	Xylene 435***	Isopropanol 980***	
		<u>First Floor Areas</u>					
7	P	112	56	112	140		0.79
10							
14							
15							
16							
17							
19							
20							
21	P	1441					2.44
24				62	62		0.22
25							
27	A	353	85	1073	297		2.92
29	P	46		46	37		0.22
31	P			113	133		0.46
39							
44	A			44			0.10
51							

*Reflect 3 hour Samples. All other values were below 1/10 TLV

**A-Area; P-Personal

***Occupational Safety and Health Administration daily time-weighted average standard

****OSHA Multiple organic vapor exposure standard

Table 4

ORGANIC SOLVENTS CONCENTRATIONS*
 Carboline Company
 Xenia, Ohio
 August 13-15, 1974

Sample No.	Type Sample**	SOLVENTS CONCENTRATIONS (mg/m ³)						Mixture Exposure 1.00****
		MEK 590***	MIBK 410***	Toluene 750***	Xylene 435***	Isopropanol 980***	MBK 510	
55	P	141		94	38			0.45
69	P	305	51	347	203	102		1.68
70								
73								
83								
90	P	57		80	57			0.34
93								
99								
114		<u>Second Floor Areas</u>			40			0.09
3								
13	P		39					
18								
26								
30								
35	P	67						0.11
38	P	55						0.09
40								
41								
42	A	38						0.06
62	P							
64	P	66		106			66	0.38
67	P							
75	P				41			0.09
76	P				90			0.21

Table 4

ORGANIC SOLVENTS CONCENTRATIONS*
 Carboline Company
 Xenia, Ohio
 August 13-15, 1974

Sample No.	Type Sample **	SOLVENTS CONCENTRATIONS (mg/m ³)					Mixture Exposure	
		MEK 590***	MIBK 410***	Toluene 750***	Xylene 435***	Isopropanol 980***		MBK 510
85								1.00***
86								
89								
96								
106	P	340		41		83		0.83
109								
116								
<u>Laboratory/Other Areas</u>								
8								
9								
22								
36								
37	A		170					0.41
49	P		126					0.31
50	P	80		110		70		0.45
52	P		172					0.42
58	P		225					0.55
59	A		181			45		0.54
65	P		74					0.18
72	P		197					0.48
78	P			40				0.05
84	P		111					0.27
88								
<u>Third Floor Area</u>								
1								
2								
4								

Table 4

ORGANIC SOLVENTS CONCENTRATIONS*

Carboline Company

Xenia, Ohio

August 13-15, 1974

Sample No.	Type Sample **	SOLVENT CONCENTRATIONS (mg/m ³)					Mixture Exposure 1.00****
		MEK 590***	MIBK 410***	Toluene 750***	Xylene 435***	Isopropanol 980***	
		<u>Third Floor Area</u>					
5							
6							
11	P		50				0.12
12	A	351					0.59
23	A	107					0.18
28							0.06
32				46			
34							
43							
45							
46							
47	P			73			0.10
48							
53							
54	P	65			37		0.29
56	P			41	82	46	0.24
57	P			34	43		0.15
61							
63	P	68			148		0.46
66							
68	P	104		83	41		0.38

Table 4

ORGANIC SOLVENTS CONCENTRATIONS
 Carboline Company
 Xenia, Ohio
 August 13-15, 1974

Sample No.	Type Sample **	SOLVENT CONCENTRATIONS (mg/m ³)					Mixture Exposure 1.00****
		MEK 590***	MIBK 410***	Toluene 750***	Xylene 435***	Isopropanol 980***	
71	P	70	60				0.20
74	P		84				0.11
79	P	65					0.11
80							
81	P			316	35		0.50
82	A			37			0.01
87	P	95		38	66		0.36
102							
103	A						51
105							0.10

Samples were also collected where asbestos was used as an ingredient in coating formulations. The storage area where asbestos was handled, also was surveyed. Samples were collected at one liter per minute on AA 0.8 μ m millipore filters using MSA Model G personal samplers. The samples were analyzed by x-ray diffraction.

Ventilation and noise measurements were also made. Figures 4-9 show the results of these.

DISCUSSION AND RESULTS

Environmental

Organic Vapor

The OSHA Threshold Limit for multiple organic vapors as calculated by:

$\frac{C_1}{T_1} + \frac{C_2}{T_2} = 1$ where C = atmospheric concentrations and T = OSHA TLV, was

exceed three times. This occurred in the two filling areas located on the second floor. As Table 4 indicates, samples 21 and 69 (collected at sampling point 2) and sample 27 (collected at sampling point 1) had levels of 2.44, 1.65 and 2.95, respectively.

Samples 27 and 69 also exceeded the TLV values for individual solvents. Sample 27 had a Toluene level of 1073 (mg/m^3) which exceeded the TLV of 750 mg/m^3 . Sample 21 had a MEK value of 1441, exceeding the 590 mg/m^3 TLV.

Asbestos Samples

All of the asbestos samples collected were found to contain minimal amounts of long fiber asbestos.

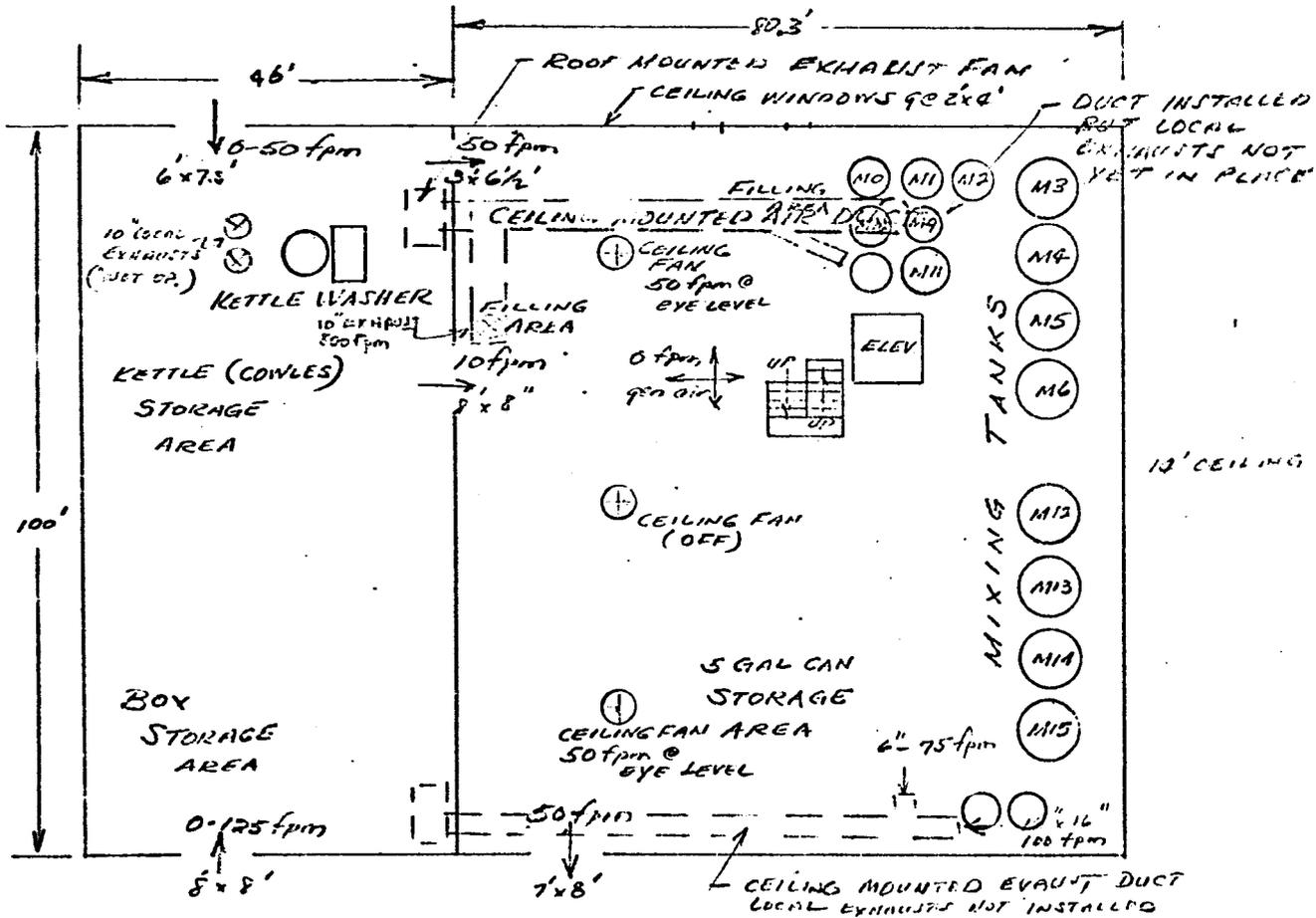
Ventilation

First Floor - Kettle Washer Room

During the survey conducted on August 13-15, 1974 no ventilation system existed in this area. Air flow measurement in door units showed that air changes from natural sources varied between 1 to 17 changes depending on whether or not the wind was blowing and also on wind direction. Follow-up measurements on June 13, 1975 were inconclusive because of the varying nature of the wind.

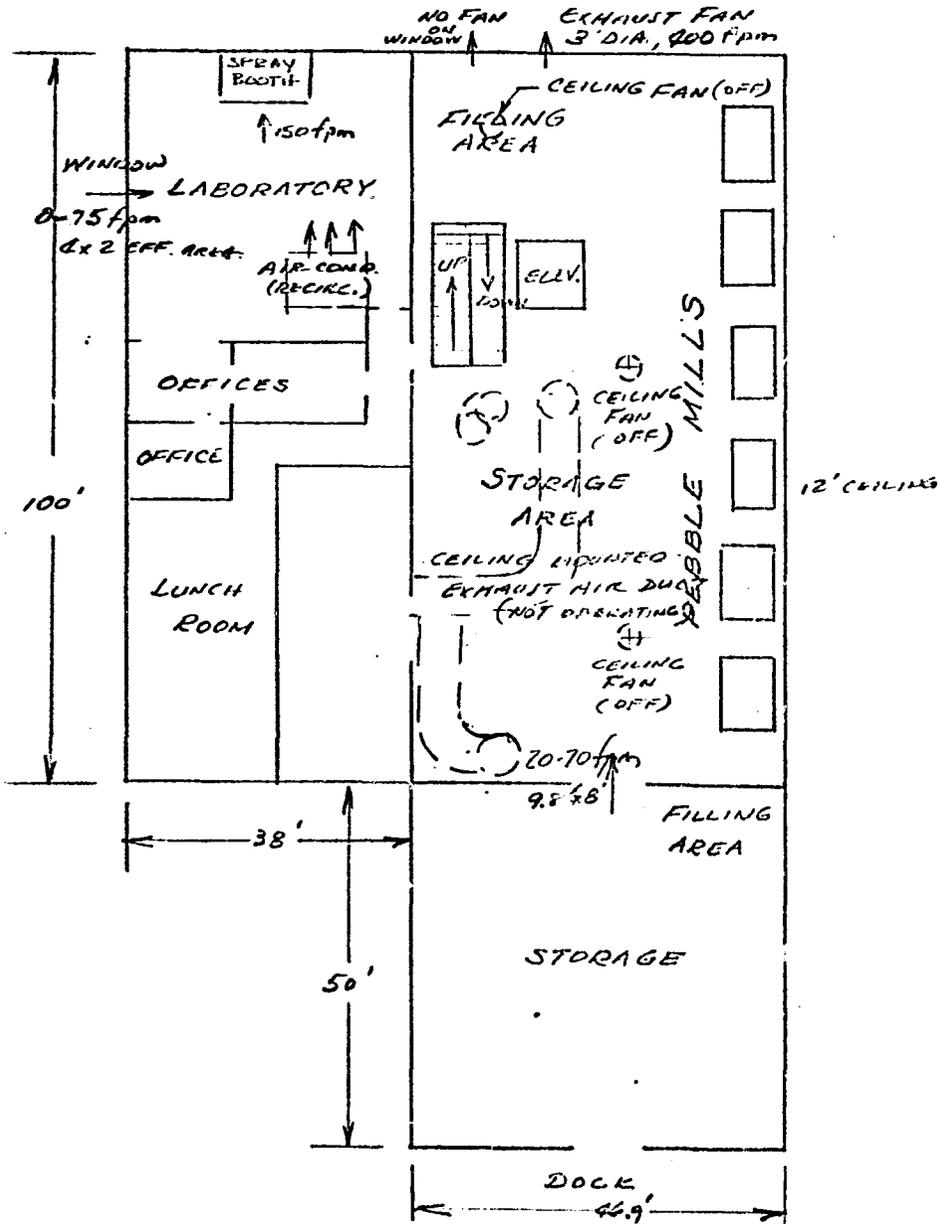
One ventilation system addition noted on June 13, 1975 was the installation of dual 10" elephant trunks from ceiling mounted exhaust units near the kettle washer. The exhaust system was not in operation so its effectiveness could not be evaluated. It was assumed that the unit is turned on when cowles (mixing kettles) are being washed.

FIG. 4. VENTILATION MEASUREMENTS



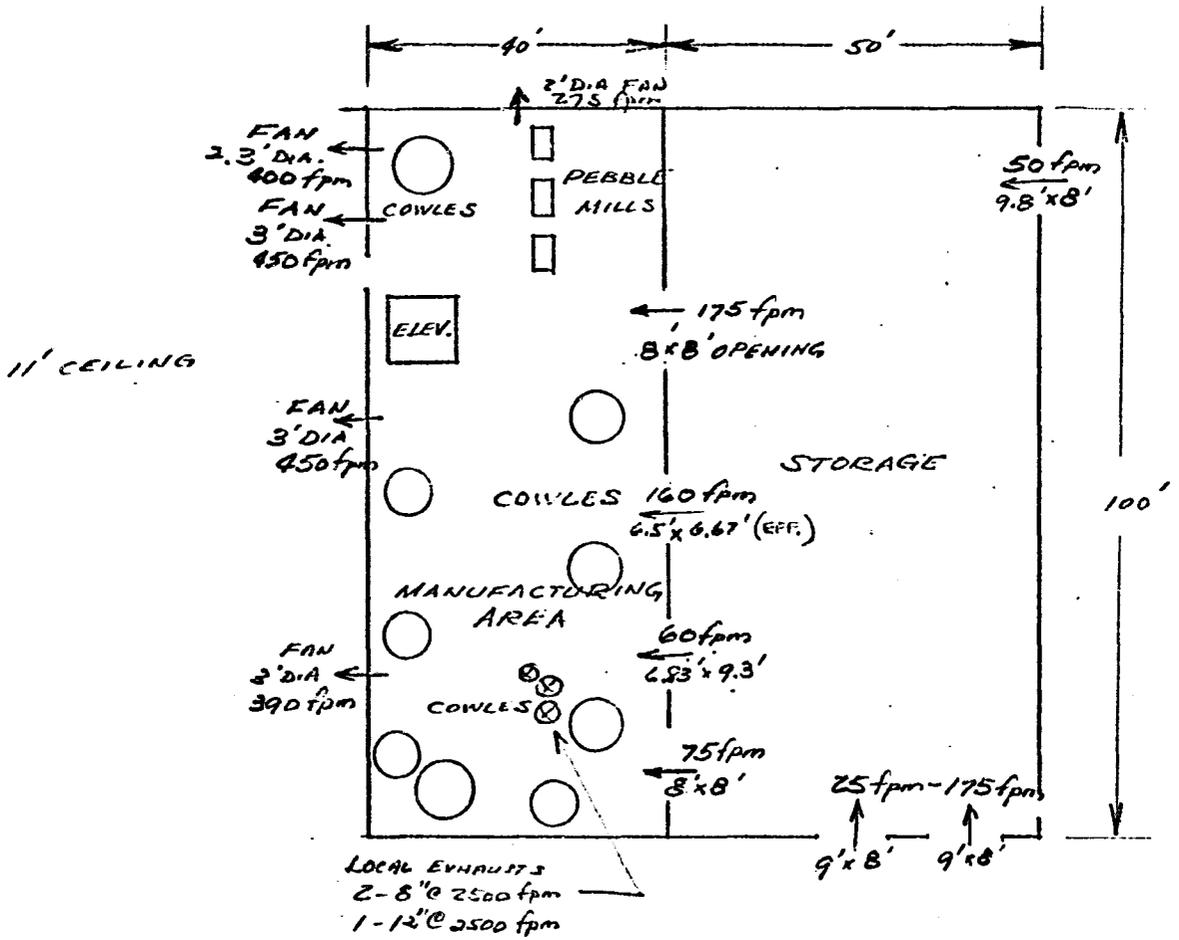
FIRST FLOOR PLAN
 MORAN PAINT DIVISION
 CARBOLINE CO.
 XENIA, OHIO

FIG. 5 - VENTILATION MEASUREMENTS



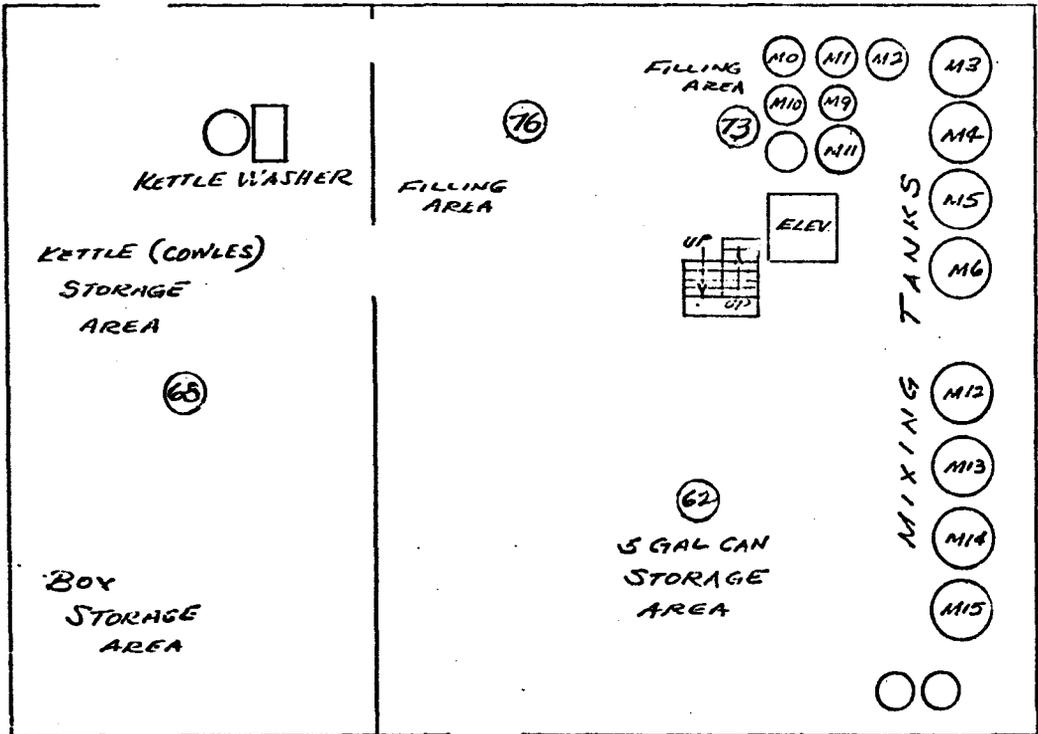
SECOND FLOOR PLAN
 MORAN PAINT DIVISION
 CARBOLINE CO.
 XENIA, OHIO

FIG. 6 VENTILATION MEASUREMENTS



THIRD FLOOR PLAN
MORAN PAINT DIVISION
CARBOLINE CO.

FIG. 7 - NOISE MEASUREMENTS



⊙ - NOISE LEVEL READINGS

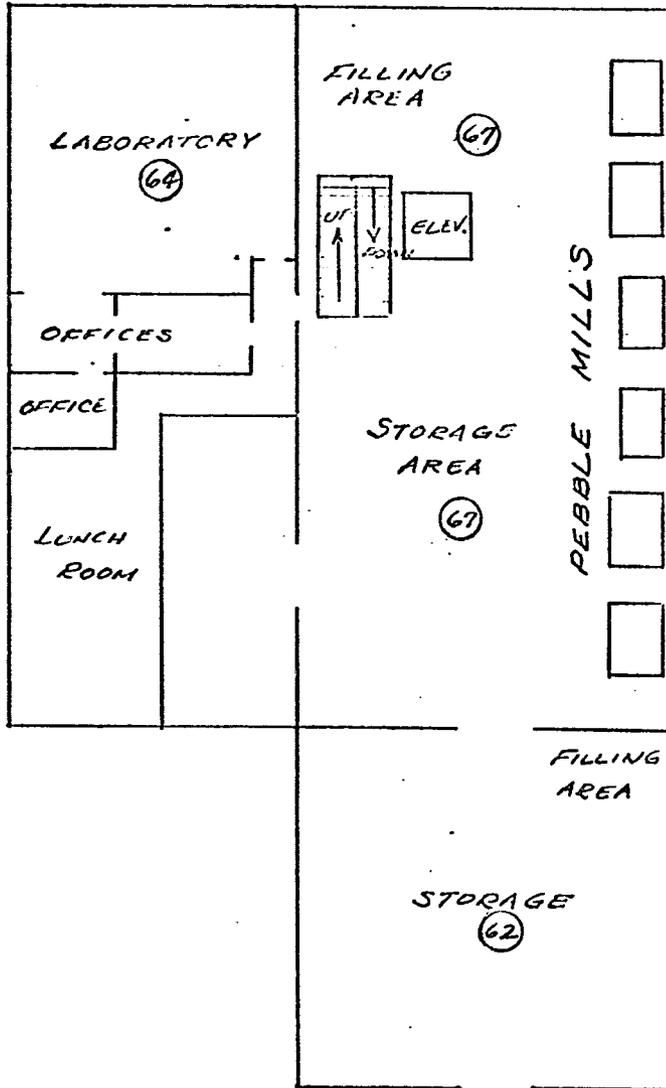
FIRST FLOOR PLAN

MORAN PAINT DIVISION

CARBOLINE CO.

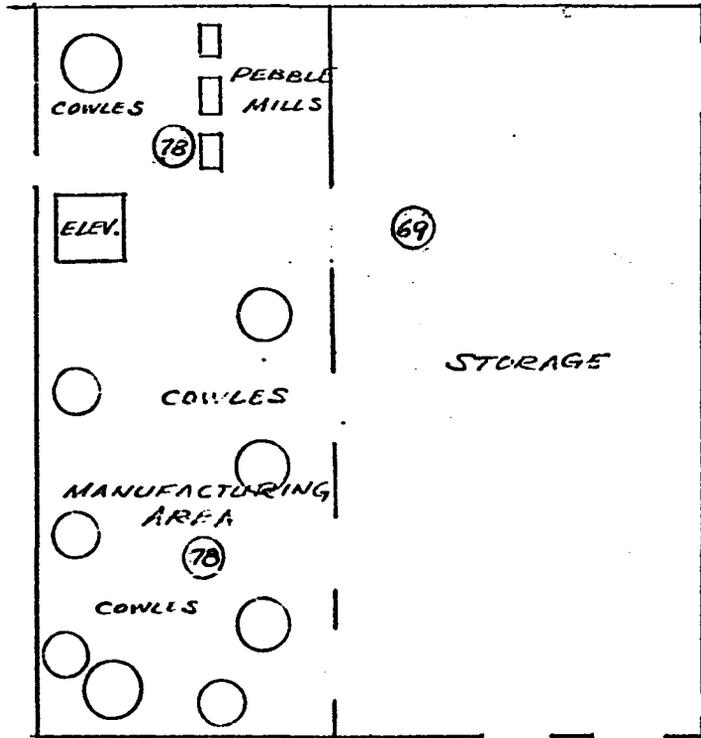
XENIA, OHIO

FIG. 8 - NOISE MEASUREMENTS



DOCK
 ○ - NOISE LEVEL READINGS
SECOND FLOOR PLAN
 MORAN PAINT DIVISION
 CARBOLINE CO.
 XENIA, OHIO

FIG. 9 - NOISE MEASUREMENTS



○ - NOISE LEVEL READINGS

THIRD FLOOR PLAN
MORAN PAINT DIVISION
CARBOLINE CO.

First Floor - Filling Room

Air changes from natural sources in this room were found to vary between 8 and 12 times/hour in measurements taken August 13, 1975. The latter is below the OSHA standard of 6 changes/hour. It was in this room that both the OSHA TLV values for MEK and Toluene and solvent mixtures were exceeded during the August 13-15, 1974 survey.

Exhaust ventilation system additions noted on June 17, 1975 include elephant trunks installed near sampling station 2. The 10" hose had a face velocity of 800 feet per minute (fpm) which provides an exhaust capacity of 436 cubic feet per minute (cfm). At the other end of this air plenum (near station 1), elephant trunks were not yet in place. The same was true of another air plenum on the opposite end of the room where a 16" X 16" duct was drawing 139 cfm (100 fpm velocity) and a 6" side inlet drew 100 cfm (75 fpm velocity).

Second floor - Pebble Mill Room

This room was found to have 4 and 13 air changes/hour on August 13, 1974 and June 13, 1975, respectively. This is from wind blowing through an open bay door located in the north side of the room. The ceiling mounted exhaust units were not operating during either of the two days that ventilation measurements were taken so they could not be evaluated. Small ceiling exhaust fans also were inoperable. Only a 3" diameter wall exhaust fan located on the south end of the room was operating. Flow measurements taken on the face of the fan showed an air velocity of 400 fpm or 2826 cfm being exhausted.

Third floor - Manufacturing Area

Air flow measurements taken in doorways leading to the area showed the estimated air changes per hour, were 29 and 27 on August 13, 1974 and June 13, 1975 respectively. This compared favorably with the 17 changes/hr. being drawn through the wall mounted exhaust fans and three ceiling mounted exhausts located near sampling station 5. The apparent discrepancy between the makeup air of 29 changes per hour and the 17 changes per hour from exhaust ventilation is due to the varying nature of the wind which provides the make-up air. Another reason for the difference is the fact that accurate air flow measurements could not be made on the window-mounted exhaust fans because of filter and fan housing obstructions.

Noise

Noise levels at Moran Paint ranged from 62 dBA to 78 dBA and do not appear to be a problem in the plant.

Medical

Table 5, shows that in Group E, four (4) out of 27 exposed workers (15%) had positive exams as compared with 2 out of 24 controls (8%). This difference did not achieve statistical significance ($p > 0.4$), however, in looking at the data it is apparent that the exposed population had a greater percentage of workers aged 41 and older (9/27 or 33% of the exposed group) than did the control population (3/24 or 12.5%), and that three of the four exposed workers with positive exams were 41 years old or older.

From Table 6, if the exposed and control workers aged 16-40 are compared, it is found that one out of 18 exposed workers in this age group had a positive exam (6%) as compared to one out of 21 control workers in this age group (5%). This is not a statistically significant difference.

If 2 workers with abnormal liver tests suggesting excessive alcohol intake and one worker with neurologic signs attributed to arthritis are eliminated from consideration, the overall results don't change much. The figures for the younger workers (16-40 years old) are identical. For the total sample population, 3 out of 25 exposed workers with no obvious extra-occupational reason for neuropathy had positive exams (12%) as compared with 2 out of 23 control workers with no obvious extra-occupational reason for neuropathy (9%). The difference between these proportions is not statistically significant ($p > 0.5$).

Following are clinical details on all individuals with positive exams:

Exposed Group

Worker 1, a man in his teens had no symptoms suggesting peripheral neuropathy. His neurological exam was normal except for diminished (grade 1) pinprick sensation in his hands distal to the metacarpal - phalangeal joints, and diminished vibratory sensation (grade 1) in the proximal phalanges of his thumbs, left femoral medial epicondyle, and right humeral medial epicondyle. Light touch and position sensation were normal throughout, as was muscle strength. Deep tendon reflexes were all grade 2 (hypoactive but normalizing with reinforcement).

He had no history of diabetes or neurological disease and drank only rarely (averaging 0 cans of beer/day, 0 bottles of wine/week, and 0 other drinks/week.) Two hour post-prandial glucose was 84, BUN was 16, hct was 46%, ESR was 2, and liver function tests were normal.

On work history questionnaire he admitted to washing his hands more than 10 times/day with solvents, usually reclaimed solvent.

Worker 2, a man in his 40's, had been working at the plant for 5 years. He had a history of arthritis in his ankles and feet, and had been taking cortisone and aspirin for this condition over the past 4-year period. During his period of active arthritis (approximately 10-11 years earlier) his ankles had been red, hot, and painful. He noted that during the past 5-6 years his feet persistently slap down when he walks but has had no

TABLE 5

Positive Neurologic Exams

Age	Group C (controls)	Group E (exposed)	Group I (intermediate exposure)
16-40	1/21 (5%)	1/18 (6%)	0/6 (0%)
41-50	1/1 (100%)	2/6 (33%)	0/0 (0%)
16-50 inclusive	2/22 (9%)	3/24 (12%)	0/6 (0%)
51 and older	0/2 (0%)	1/3 (33%)	0/1 (0%)
Total, all ages	2/24 (8%)	4/27 (15%)	0/7 (0%)

TABLE 6

Positive Neurologic Exams Among
Plant Employees, Excluding Workers
With an Obvious Non-occupational
Cause for Possible Neurologic
Disease

Age	Group C (controls)	Group E (exposed)	Group I (intermediate exposure)
16-40	1/21 (5%)	1/18 (6%)	0/6 (0%)
41-50	1/1 (100%)	1/4 (25%)	0/0 (0%)
16-50 inclusive	2/22 (9%)	2/22 (9%)	0/6 (0%)
51 and older	0/1 (0%)	1/3 (33%)	0/1 (0%)
Total all ages	2/23 (9%)	3/25 (12%)	0/7 (0%)

other neurological symptoms.

On physical exam his right ankle jerk was absent although all other deep tendon reflexes were normal. He had grade 4 weakness of the extensors of his great toes bilaterally, walked on his heels with difficulty, and could not walk on his toes at all. Otherwise muscle strength was normal. Position sense was diminished (grade 1) in his left great toe; vibratory, pinprick, and light touch sensation were normal throughout.

He had no history of diabetes, alcohol intake or neurologic disease. His 2 hour post-prandial blood sugar was 94, BUN 20, hct. 40%, ESR 18 and liver function tests all normal.

Worker 3 was a man in his 40's who had been working at the plant for 5 years. In 1963 he cut some tendons in his left palm and since then he has felt weakness and coldness in his left hand. In addition, he told of occasional numbness and tingling in both hands and both arms at night during the past year. He denied other neurologic symptoms. Three months prior to the examination he had cut the dorsal surface of his left forearm that had required stitches.

On physical exam there was a flexion contracture of the second, third, and fourth fingers of the left hand. Light touch sensation was absent in both hands (grade 0), both palm and dorsum. Pinprick sensation was diminished (grade 1) in both hands, palm and dorsum. Vibration sense was diminished on the great toes (grade 1) but was intact elsewhere, including the proximal phalanges of both thumbs and the styloid processes of both radii. Position sense was diminished (grade 1) in the left index finger, but was normal in the right index finger and great toes. Surprisingly, muscle strength appeared normal throughout. Knee and ankle jerks were grade 3 (normal); biceps reflexes were grade 3, and brachioradialis reflexes were grade 2 bilaterally.

Electromyography and measurement of motor nerve conduction velocities was done. Except for evidence of left median nerve loss to the thenar muscle, the study was normal. Left median nerve distal motor latency and conduction velocity were not obtainable. Right median nerve distal motor latency was 3.4 msec. (normal less than 4.4 msec). Right median nerve conduction velocity was 51 meters/second (normal greater than 48 msec). Right peroneal distal motor latency was 4.3 msec and left peroneal distal motor latency 4.5 msec. Right peroneal nerve motor conduction velocity was 44 msec (normal greater than 40 msec); left peroneal nerve motor conduction velocity was 43 msec. No abnormal dispersion of the muscle action potential was noted when nerve conduction velocity was tested. No fibrillation potentials were present in any muscle tested. There was reduced insertional activity in the left opponens pollicis muscle and only an occasional motor unit action potential seen in this muscle; otherwise all muscles tested were normal.

It should be noted that sensory nerve conduction velocities were not measured.

The patient had no history of diabetes or neurologic disease, and drank only 2-3 beers/day. Two hour post-prandial glucose was 83, BUN 20,

hct. 42%, ESR 6. All liver function tests were normal.

In the work history questionnaire this patient indicated that he washed his hands with solvents (usually MIBK) 1-2 times/day. He also cleaned his equipment with solvents (usually MIBK, MEK or Toluene) more than 10 times/week. He did not list MBK as a solvent which he frequently used; however there was no question specifically asking about MBK use. He did not wear gloves when handling solvents.

Worker 4 was a man in his 50's who had been working at the plant for 5 years. He gave a history of constant numbness in his great toes for the past 4-5 years, but no other neurologic symptoms. On physical exam his ankle jerks were grade 1 bilaterally (hypoactive, and not normalizing with reinforcement). He had some difficulty walking on his toes but had no signs of muscle weakness. He had diminished pinprick sensation (grade 1) in both feet up to mid-calf level, and in both hands. He also had diminished vibratory sensation (grade 1) in both great toes and in the proximal phalanc of his right thumb. Position sense and light touch sensation were normal throughout.

He denied a history of diabetes or neurologic disease and drank sparingly (0 beer cans/day, 0 bottles of wine/week, and 0 other drinks/week in the average). His two-hour, post-prandial blood glucose was 110, BUN was 18, hct. was 47.5%, ESR was 16, and liver function tests were normal.

Controls

Worker 5, was a man in his 30's with no history suggestive of peripheral neuropathy. Neurological exam was normal except for diminished (grade 1) pinprick sensation in his hands and diminished vibratory sensation (grade 1) in his thumbs and radial styloid processes. Position sense, light touch, muscle strength, and reflexes were all normal.

He had no history of diabetes or neurological disease. He drank only one beer/day. He had been treated for 2-3 kidney infections in the past with terramycin. His 2 hour post-prandial blood sugar was 101, BUN 10, hct. 44%, ESR 8, and liver function tests normal.

Worker 6 was a 50 year old man with no history to suggest peripheral neuropathy. Neurological examination was normal except for diminished (grade 1) pinprick sensation in both hands and lower arms up to mid-forearm level, and diminished vibratory sensation (grade 1) on both thumbs, radial styloid processes, humeral medial epicondyles, and great toes. Light touch and position sense were normal throughout, as was muscle strength. Deep tendon reflexes were also normal throughout (grade 3).

He gave no history of diabetes, neurologic disease or heavy drinking. He consumed 2-3 beers/day on the average and no other liquor. Two-hour post-prandial blood glucose was 119, BUN 22, hct. 41%, ESR 5, and liver function tests were normal.

Earlier, in analyzing the data, a positive neurologic exam had been defined as one with certain features which would characterize a peripheral

neuropathy. It was recognized, however, that a positive exam as so defined was not equivalent to a diagnosis of peripheral neuropathy and that the total clinical picture would have to be considered in making such a diagnosis.

As noted above, no statistically significant difference in the incidence of positive exams was found in the group exposed to MBK when compared to the group not exposed. Furthermore, in most of the men with positive exams, deep tendon reflexes and muscle strength were normal and 4 out of 6 had only mild neuropathic changes. Worker 2 had moderate changes attributed to arthritis.

Worker 3, however, had moderate clinical signs without an obvious non-occupational cause. He had a history of occasional paresthesia in both upper extremities of one year's duration and had striking absence of light touch sensation in both hands, palm and dorsum, together with less striking diminution in pinprick sensation in both hands. Although his EMG and nerve conduction velocity studies were normal except for abnormalities attributed to severed branches of the left median nerve, it should be noted that sensory conduction velocity was not tested. It is believed that he indeed had a moderate bilateral sensory neuropathy without motor involvement, and had no obvious extra-occupational cause for this. Worker 3 washed his hands "1-2 times/day" with solvents (usually MIBK) and cleaned his equipment "more than 10 times/week" with solvents (usually MIBK, MEK, and toluene). Furthermore he did not usually wear gloves when handling solvents. Thus, he appeared to have had considerable exposure to MEK and other solvents if not to MBK.

CONCLUSION AND RECOMMENDATION

Environmental

On the basis of the industrial hygiene survey, it appears that there is a potential danger to Moran Paint employees from continued exposure to organic vapors in excess of OSHA standards. This is based on the result of long term sampling and individual solvent concentrations that no doubt increase during colder weather when doors must be kept shut. While exhaust ventilation has been installed in some areas, measurements made on some of the ceiling mounted elephant trunk exhaust units show these to be substandard. Solvents exposure is also compounded by the poor industrial hygiene practices of some plant employees who clean mixing kettles by hand without benefit of gloves, respirators or proper ventilation and may fail to shower after each day's operation.

Medical

Solvent exposure did not lead to any statistically significant increase in the incidence of positive neurological exams among the exposed employees of Moran Paint. However, one worker had quite striking bilateral sensory findings in his hands and also a history of frequent solvent use without the protection of gloves. Although such a case reportedly can only be considered suggestive and not definitive, it should stimulate the adoption of better industrial hygiene measures at this plant. Since MBK was not listed as a solvent normally used by the worker in question, his sensory impairments can't be attributed to MBK only; however, he did clean his equipment with MEK frequently, and this solvent could have played a contributing causative role.

Recommendations

The recommendations below are intended to resolve the problems noted at Moran Paint from an environmental and medical point of view.

1. The plant management should conduct an industrial hygiene survey to further document the results presented here (especially when the building is closed during the winter); and where appropriate, institute further control measures and work practices to reduce the high vapor concentrations. This survey should include the entire plant but special attention should be given to the ventilation system in the second floor filling areas.

In this regard, larger exhaust fans should be utilized that will provide face velocities of at least 2000 fpm on each of the elephant trunk exhausts.

2. Plant management should implement a vigorous program of employee training and information regarding the consequence and means for reducing exposure to MBK and other solvents. This should include the use of respirators and protective gloves while cleaning mixing kettles and the use of industrial cleaners rather than solvents and thinners to clean paint from hands and other parts of the body.

3. Employees should be urged to shower after completing their work shift and changing into clean clothing prior to departing for home.
4. The use of pumps to draw solvents from 55 gallon drums into the pebble mills is recommended. This will enhance the housekeeping aspects of this work. A better means should also be found for changing resins, pigments, etc. into the pebble mills which will reduce the danger of fires and prevent the messy conditions which now result.

REFERENCES

1. Billmajor, Donald et al., "Peripheral Neuropathy in a Coated Fabrics Plant," Journal of Occupational Medicine, Vol. 16, No. 10, October 1974, pp. 665-671.
2. Mendell, J. R. et al., "Toxic Polyneuropathy Produced by Methyl N-Butyl Ketone," Science, Volume 185, August 30, 1974, pp. 787-789.
3. Herskowitz, Allan, et al., "N-Hexane Neuropathy, A Syndrome Occurring as a Result of Industrial Exposure," New England Journal of Medicine, Volume 285, No. 2, July 8, 1971, pp. 82-85.
4. White, Lowell D., et al., "A Convenient Optimized Method for the Analysis of Selected Solvent Vapors in the Industrial Atmosphere," AIHAJ, 31:225 (1970).

APPENDIX A

COMPLIANCE REPORT

DATE	12-6-72
TIME	All day
PLANT	Mine
AGENCY	

EMPLOYER: Moran Division of Carborundum, Inc.
 ADDRESS: 125 Fairview Road

PLANT: Xenia, Ohio 45385

DEPT. or: General and/or Repeated Items

Page 1

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
All Plant	.23 (c) (4)	NS 1. Failure to provide handrails and toe boards for storage platforms.
	.242 (b)	NS 2. Air, for cleaning exceeds 30 psi
	.93 (a) (1)	NS 3. Carbon Monoxide, in Warehouse, exceeds 50 PPM
	309nec	NS 4. Failure to ground all cord connected equipment
	.132 (a)	NS 5. Failure to enforce use of protective equipment
	.23 (a) (5)	NS 6. Failure to provide covers for holes in floor
	.26 (c) (3) (1)	S 7. Failure to provide ladder safe practices
	.22 (a) (3)	NS 8. Failure to provide adequate drainage
	.5 (a) (1) & .151 (c)	NS 9. Failure to provide safety showers and eye wash stations
	.30 (a) (1)	NS 10. Failure to capacity post dock boards
	.22 (a) & .176 (b)	NS 11. Failure to provide good housekeeping for all places
	.144 (a) (1)	DM 12. Failure to color code all fire equipment
	.157 (a) (5)	NS 13. Failure to mount all fire extinguishers
	.103 (b) (i) (2)	S 14. Failure to secure pressure cylinders
	.141 (a) (3)	NS 15. Failure to provide covers for trash receptacles
	.212 (a)	NS 16. Failure to properly guard grinding wheels
	.94 (b) (4)	DM 17. Failure to provide exhaust for grinders
	.176 (b)	NS 18. Misc. items atop storage lockers
	.132	NS 19. Failure to provide adeq. personal protective equipment

Not Serious But Citationable
S - Serious
DM - Not in Accordance with Good Safety Practice

COMPLIANCE REPORT

1. NAME Full day	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Rd.
 Xenia, Ohio 45388

PLANT

DEPT. OR General and/or Inspected Items

Page 2

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
.143(a)(2)	NS 20.	Failure to provide "No dead-man" controls for hand held power tools
.309nec	NS 21.	Failure to label all elec. panel switch boxes
.23(a)(1)	NS 22.	Failure to provide protective measures for floor openings.
.179(j)	NS 23.	Failure to provide records of inspections for crane accessories
.180(e)(1)(i)(e)	NS 24.	Failure to provide safety latches for all crane hooks

COMPLIANCE REPORT

1. TIME	2. DATE
8:50	12-6-72
3. INSPECTOR	
Mims	
4. ACCOMPANIMENT	
Marvie West	

EMPLOYER: Moran Div. of Carboline
 ADDRESS: 125 Fairgrove Road
 Xenia, Ohio 45385

PLANT: Moran
 DEPT. OF: Office

5. Page 3

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
General	.157 (a) (5)	NS 1. Failure to mount fire extinguisher
	.23 (a)	NS 2. Unprotected hole in floor by water fountain
	309nec	NS 3. Failure to ground air conditioner in Spare Management Office
	309nec	NS 4. Failure to ground electric heaters
	309nec	NS 5. Failure to ground fans
	.176 (b)	NS 6. Heavy misc. items stored atop lockers by Coke machine
	309nec	NS 7. Open ground on electrical receptacles
	309nec	NS 8. Open overhead electrical light fixture
	309nec	NS 9. Failure to label elec. switch boxes
	309nec	NS 10. Failure to ground air conditioner in Office (Managers)
Men's Room	.141 (c) (2)	NS 11. Failure to provide self closing doors with positive latches and coat hangers
Elec. Control Rm.	309nec	NS 12. Reversed polarity for wall receptacles
	.142 (g)	DM 13. Inadequate light. Apparently light bulb burned out.
	309nec	NS 14. Failure to provide junction box for air conditioning relay wires.
	309nec	S 15. Failure to re-hang broken door to main elec. control panel.
General	.212 (a)	NS 16. Failure to guard fan to 1/2"
Boiler Room	.212 (a)	NS 17. Failure to guard belt drive for compressor
	.22 (a) (1)	NS 18. Poor housekeeping. Burnable cartons should be removed and need organization

COMPLIANCE REPORT

EMPLOYER Moran Div. of Carboline, Inc.
 ADDRESS 125 Fairground Road
 Xenia, Ohio 45385
 PLANT Moran
 DEPT. or Office

1. TIME 8:50	2. DATE 12-6-72
3. INSPECTOR Mins	
4. ACCOMPANIMENT Marvie West	

5. Page 4

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
309nec	NS	19. Open elec. junction box
309nec	NS	20. Unlabelled elec. switch boxes
309nec	S	21. Protruding elec. wires
309nec	NS	22. Ungrounded wall receptacles

COMPLIANCE REPORT

1. TIME 9:15	2. DATE 12-6-72
3. INSPECTOR MIMS	
4. A.L. COMPANMENT Marvie West; Tony Dozich	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Road
 Xenia, Chic 45385
 PLANT Moran
 DEPT. or Laboratory

5. Page 5

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
Office	309nec NS	1. Failure to ground air conditoner
Elec. Control Room	.22(a) (1) NS	2. Poor housekeeping. Needs organization
	309nec S	3. Open elec. switch boxes
	309nec NS	4. Failure to label elec. panel box
	309nec NS	5. Elec. wiring installed in unworkmanlike manner
	309nec NS	6. Double socket elec. arrangement for dangling light bulb and heat tape
	309nec NS	7. Unprotected dangling light bulb
Storage Platform	.23(e) (4) S	8. Failure to provide handrails and toeboards
	.22(d) (1) NS	9. Failure to post floor capacity
	.22(a) (1) NS	10. Poor housekeeping. Cluttered.
	309nec NS	11. Open elec. junction boxes
	309nec NS	12. Elec. wiring istalled in unworkmanlike manner. Wrapped around metal pipes and beams
	.5(a) (1) NS	13. Failure to provide safe access to platform. Loose ladder and 1/2" rod to pull atop platform
General	309nec NS	14. Failure to ground wall receptacles
	.157(a) (5) NS	15. Failure to mount fire extinguisher
	309nec NS	16. Failure to ground automatic coffeemakers
	.141(a) (3) NS	17. Failure to cover trash receptacles
	309nec NS	18. Failure to guard heater fan belt drive
	.157(a) (6) NS	19. Fire extinguisher mounted in excess of 60"
	.212(a) NS	20. Failure to guard belt drive to pebble mill

COMPLIANCE REPORT

1. TIME 9:15	2. DATE 12-6-72
3. INSPECTOR Mins	
4. ACCOMPANIMENT M. West; Tony Bozich	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Road
 Xenia, Ohio 45385
 PLANT Moran
 DEPT. of Laboratory

5. Page 6

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
Mill Room	309nec NS	21. Open ground to wall receptacles
	.107(c) (2) S	22. Non explosion proof lighting within 20' of paint spray booth
General	.212(a) NS	23. Mixer belt driver inadequately guarded. Only partial covered.
	309nec NS	24. Open overhead junction boxes
Storage	.26(c) (3) NS	25. Failure to provide sign "Do Not Use For Elec. Work" for metal ladder.
	309nec NS	26. Failure to ground deep freezer
	309nec NS	27. Open overhead electrical fixtures for fluorescent lighting
Small Stg. Rm.	.142(g) NS	28. No light. Apparently bulbs burned out.
	309nec NS	29. Reversed polarity for elec. wall receptacle
	.22(a) (1) NS	30. Poor housekeeping. Needs organization
	.106(v) (6) NS	31. Failure to post adeq. "No Smoking" signs
General	.151(c) NS	32. Failure to provide eye wash station

COMPLIANCE REPORT

1. TIME 10:50	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Pl.
 Xenia, Ohio 45385

PLANT Moran
 DEPT. or Receiving and Storage

Page 7

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
General Receiving	.37(g) (1) NS	1. Exits not indicated by signs
	.37(g) (2) NS	2. Non exits not so marked
	.37(g) (6) NS	3. Exits not illuminated
	.22(b) (2) NS	4. Permanent aisles not marked
	.157(a) (6) NS	5. Fire extinguisher mounted in excess of 60" outside of office
	.22(d) (1) NS	6. Failure to capacity label dock plates
	.176(a) NS	7. Dock plate unsecured standing on edge, leaning against wall
	.22(d) (1) NS	8. Failure to capacity post floors
	.23(c) (1) NS	9. Failure to provide handrails and toeboards for storage platforms
	.22(a) (1) NS	10. Broken window pane North wall
	.22(d) (1) NS	11. Failure to capacity rate and post platform
	309nec NS	12. Reversed polarity for battery charging station outlet
	.151(c) NS	13. Failure to provide eye protection at Battery Charging Station
	.132 NS	14. Failure to post Battery Charging Station as an eye protection area
	.178(1) NS	15. Failure to provide adequate operator training for forklift drivers
	.178(m) (5) DM	16. Unattended forklift with key in ignition
General Storage	.157(a) (5) NS	17. Unmounted fire extinguisher in pigment weigh area
	.144(a) (1) DM	18. Failure to color code sprinklers red

COMPLIANCE REPORT

1. TIME 10:50	2. DATE 12-6-72
3. INSPECTOR Mins	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carbolinc
ADDRESS 125 Fairground Road
Xenia, Ohio 45385

PLANT Moran
DEPT. or

5. Page 3

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
	.176 (a) NS	19. Unsecured pallet standing on end near aisleway
	.37 (q) (1) NS	20. Exits not indicated by signs
	.37 (q) (2) NS	21. Non exits not so marked
	.37 (q) (5) NS	22. Routes to exits not indicated
	.37 (q) (6) NS	23. Exits not illuminated
	.22 (b) (2) NS	24. Permanent aisles not marked
	.22 (a) (3) NS	25. Broken pallets with protruding nails
	.36 (b) (8) S	26. Only one exit; other door blocked
Quonset Hut	.176 (a) NS	27. No aisleways. Storage should be reorganized
	.176 (b) NS	28. Poor housekeeping atop storage platforms. Needs organization
	.23 (c) (1) NS	29. Failure to provide handrails for storage platform
	.23 (c) (1) NS	30. Failure to provide toeboards for storage platforms
	.22 (d) (1) NS	31. Failure to post floor capacity for storage platform
	.176 (a) NS	32. Permanent aisles not indicated
Bucket Storage	.37 (q) (1) NS	33. Exits not indicated by signs
	.176 (a) NS	34. Permanent aisles not marked
	.22 (d) (1) NS	35. Failure to post floor capacity
	.5 (a) (1) S	36. Unprotected explosion proof light bulb
	.159 (e) (1) NS	37. Failure to prevent stacking within 36" of sprinkler head

COMPLIANCE REPORT

1. TIME	2. DATE
10:50	12-6-72
3. INSPECTOR	
Mids	
4. ACCOMPANIMENT	
M. West	

EMPLOYER Moran Div. of Carbolina
 ADDRESS 125 Fairground Road
 Xenia, Ohio 45385

PLANT Moran

DEPT. or

5. Page 9

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
	.212(a) (5) DM	38. Failure to guard exhaust fan to 1/2"
	.23(c) (1) DM	39. Failure to provide toeboard for ramp platform that exceeds 48"
	.26(d) (3) (viii) NS	40. Failure to provide "Do Not Use For Elec. Work" signs for metal ladders.
2nd Floor Addition	.144(1) (i) (k) DM	41. Failure to color code sprinklers red
	.36(b) (6) NS	42. Failure to provide adequate exits
Metal Stg. Bldg.	.22(a) (2) NS	43. Poor housekeeping
	.176(c) NS	44. Poor storage. Cartons leaning
	.37(c) (1) NS	45. Exits not indicated by signs
	.176(a) NS	46. Permanent aisles not marked
Solvent Tank Farm Stg.	.23(a) (1) NS	47. No intermediate handrail for stairway and platform
	.23(c) (1) NS	48. Failure to provide toeboards (4") for platform
	.5(a) (1) NS	49. Failure to provide safe entrance to tank farm
	.25(c) (3) (i) S	50. Substandards extension ladders. Dry rot and no safety shoes. Also one with broken runner.
Resin Storage	.5(a) (1) S	51. Failure to provide safe ladder to gain access to tanks
	.22(a) (2) NS	52. Poor housekeeping. Frozen resin (petroleum base) on ground around tanks.
Solvent Blend St.	.23(c) (1) NS	53. Failure to provide handrails for metal platform

COMPLIANCE REPORT

1. TIME 12:20	2. DATE 12-6-72
3. INSPECTOR Miles	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carboline, Inc.
ADDRESS 125 Fairgrounds Road
Xenia, Ohio

PLANT Moran
DEPT. or Maintenance

5. Page 10

6. Location:	7. Apparent Violations Noted	8. Comments
General	1910. .157(a) (5) NS	1. Failure to mount fire extinguisher in office
	309nec NS	2. Failure to ground water fountain
	309nec NS	3. Open ground for receptacle above water fountain
	.141(g) (2) NS	4. Failure to provide covers for trash receptacles
	.165(b) NS	5. Failure to secure oxygen pressure cylinder at door to office
	309nec NS	6. Failure to ground trouble light
	309nec NS	7. Open ground on elec. receptacle mounted on post east of grinder
	.215(b) (3) S	8. Failure to provide guard for pedestal grinder
	309nec NS	9. Frayed cord to coffee maker
	309nec NS	10. Open ground to receptacle just inside office door
	.212(a) NS	11. Failure to adequately guard belt drive for pedestal grinder
	.215(a) (2) NS	12. Failure to shield employees from Arc Rays
	.176(c) NS	13. Heavy misc items atop stg. lockers. Recommend slanted tops to prevent stg.
	.212(a) (3) NS	14. Failure to provide point of operation guard for table saw
	.212(a) NS	15. Failure to guard belt drive for table saw
	.26(d) (3) (viii) NS	16. Failure to provide "Do Not Use For Elec. Work" sign for metal ladder
	.106(d) (2) (i) NS	17. Failure to provide safety cans for Flammable solvents

COMPLIANCE REPORT

1. TIME 12:20	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT Marvic West	

EMPLOYER Moran Div. of Carboline
ADDRESS 125 Fairground Road
Xenia, Ohio 45385

PLANT Moran
DEPT. or

5. Page 11

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
	.215 (b) (3) S	18. Failure to guard small table grinder
	309nec NS	19. Failure to ground table grinder
	309nec NS	20. Ungrounded wall receptacles
	309nec NS	21. Failure to provide cover for wall receptacle Also not secure in use
	.93 (a) S	22. Failure to adequately ventilate ketone degreasers
	.134 (a) (2) NS	23. Failure to provide adeq. respirators for working with degreasers
	.134 (a) (3) NS	24. Failure to wear any respiratory protection when using degreasing solvents
	309nec NS	25. Failure to ground paint shaker
	.212 (a) NS	26. Failure to adequately guard belt drives for paint shaker
Rest Room	.165 (b) S	27. Unsecured pressure cylinders just outside restroom door
	.141 (a) (1) NS	28. Failure to provide proper cleanup for rest room. Unsanitary
	.5 (a) (1) S	29. Failure to provide safe heater. Gas space heater.
	.5 (a) (1) NS	30. Failure to provide pilot light for heater
	.141 (b) (1) (i) NS	31. Failure to adequately clean water fountain
	309nec NS	32. Failure to ground power saw. Ground broken off
	.176 (a) NS	33. Failure to mark permanent aiseways
	.36 (b) (8) NS	34. Failure to provide more than one exit
	309nec NS	35. Failure to label elec. switch boxes

COMPLIANCE REPORT

1. TIME 12:20	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carbolinc
ADDRESS 125 Fairground Road
Xenia, Ohio 45385

PLANT
DEPT. or Moran

5. Page 12

6. Location

7. Apparent Violations Noted

8. Comments

1910.
309nec NS 36. Failure to provide protective cover for 220 V outlet
- .133(a) (2) (v) NS 37. Failure to maintain clean and sanitary eye protection equipment

COMPLIANCE REPORT

1. TIME 1:40	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Pl.
 Xenia, Ohio 45385

PLANT Moran
 DEPT. or Pot House

5. Page 13

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
General	.157(a) (G) NS	1. Fire extinguisher mounted in excess of 60"
	.95(b) (3) NS	2. Failure to provide ear protection in an area that exceeds the noise standard
	.23(a) (1) NS	3. Failure to provide protective measures for floor openings
	.35(b) (6) DM	4. Failure to provide adequate light
	.5(a) (1) NS	5. Failure to provide pilot lights for burners
	309nec NS	6. Elec. extension cord wrapped around metal conduit

COMPLIANCE REPORT

1. TIME 1:55	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANYING M. West	

EMPLOYER Moran Div. of Carboline
ADDRESS 125 Fairground Rd.
Xenia, Ohio 45385

PLANT Moran
DEPT. or Manufacturing

5. Page 14

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
Third Floor General	.212 (a) NS	1. Failure to guard drive mechanism below 7'
	.37 (q) (1) NS	2. Exits not indicated by signs
	.179 (J) (1) (2) (3) NS	3. Failure to provide records of inspections for crane accessories
	.179 (h) (4) NS	4. Failure to provide safety latches for all crane hooks
	.23 (a) (5) S	5. Failure to protect floor openings when not in use.
	.25 (c) (3) (i) NS	6. Metal ladder to cluecel tank substandard. Needs cleanup
	.176 (a) NS	7. Permanent aisles not marked
	.144 (a) (1) (i) (k) DM	8. Failure to color code sprinklers red
	.134 (a) (3) NS	9. Failure to wear respiratory protection when using solvents for cleaning
	.132 (a) NS	10. Failure to wear protective equipment when drawing off ketones in open bucket
Plant Control Rm.	309nec NS	11. Open electrical starter boxes
	309nec NS	12. Reversed polarity for wall receptacle
	309nec NS	13. Open switch boxes
	309nec NS	14. Elec. wiring installed in unworkmanlike manner
	309nec NS	15. Doors removed from elec. panel boxes
Second Floor General	.23 (a) (2) NS	16. Failure to provide toeboards around stairs platform
	.26 (d) (3) (viii) NS	17. Failure to provide sign "Do Not Use For Elec. Work" for metal ladders

COMPLIANCE REPORT

1. TIME 1:55	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT M. West	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Rd.
 Xenia, Ohio 45385

PLANT Moran
 DEPT. or

5. Page 15

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
	.22(a) (3) NS	18. Failure to provide covers for holes in floor
	.176(a) NS	19. Permanent aisles not marked
	.141(g) (2) NS	20. Failure to provide covers trash receptacles
	309nec NS	21. Reversed polarity for elec. receptacle "pigtail" by group leaders desk.
Quality Control Lab	.106(d) (2) (i) S	22. Failure to bond MIBK solvent when transferring
	309nec NS	23. Reversed polarity for elec. receptacle by water fountain
	.144(a) (1) (i) (e) DM	24. Failure to color code fire extinguisher red
	309nec NS	25. Elec. wiring installed in unworkmanlike manner
	309nec NS	26. Elec. switch boxes not labelled
	.141(a) (3) (i) NS	27. Uncovered trash receptacles
	.141(g) (3) (i) NS	28. Food and chemicals stored together in refrigerator
	309nec NS	29. Ungrounded refrigerator
	.134(a) (3) NS	30. Failure to wear respiratory protection when using solvents "keytones" for cleaning
	.176(b) NS	31. Misc. items atop storage lockers
	.37(h) (1) S	32. Failure to provide proper emergency exit. 6' to 8' drop of outside door marked emergency exit
Supervisor's Office	.176(b) DM	33. Misc. items atop stg. lockers
	309nec NS	34. Elec. wiring wrapped across conduit
Control Lab-General	.5(a) (1) NS	35. Failure to provide eye wash station
	.5(a) (1) NS	36. Failure to provide safety showers

COMPLIANCE REPORT

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Rd.
 Xenia, Ohio 45385

PLANT Moran

DEPT. or

1. TIME 1:55	2. DATE 12-6-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT M. West	

5. Page 16

6. Location	7. Apparent Violations Noted		8. Comments
Solvent Pumping Station	.133(a) (1) 1910.	NS	37. Failure to provide eye protection when using solvents
	.133(a) (1)	NS	38. Failure to provide eye protection
	.133(a) (1)	NS	39. Failure to wear approved type respiratory protection
Lunch Room	.36(b) (8)	NS	40. Failure to provide adeq. exits. Only one exit.
	309nec	NS	41. Broken cover plate for wall receptacle
Hallway to Lunch Rm	309nec	DM	42. Open overhead elec. seal offs

COMPLIANCE REPORT

1. TIME 8:00	2. DATE 12-8-72
3. INSPECTOR MINS	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carboline
ADDRESS 125 Fairground Rd.
Xenia, Ohio 45385

PLANT Moran
DEPT. or Filling

5. Page 17

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
2nd Floor	.179 (J) (1) (2) (3) NS	1. Failure to provide records of inspections for crane accessories
	.179 (h) (4) NS	2. Failure to provide safety latches for crane hook
	.22 (b) (2) NS	3. Failure to mark permanent aiseways
1st Floor	.26 (d) (3) (viii) NS	4. Failure to provide sign "Do Not Use For Elec. Work" for metal ladder
Men's Rest Room	.23 (a) (5) NS	5. Failure to provide cover for hole in floor
	309nec NS	6. Failure to ground water fountain
	.22 (a) (3) NS	7. Failure to provide cover for drain hole in shower room
	.141 (c) (2) (i) NS	8. Failure to provide coat hangers for toilet stalls
General	.22 (b) (2) NS	9. Failure to mark permanent aisleway
	309nec NS	10. Failure to label elec. Switch boxes
	.178 (m) (3) NS	11. Failure to prohibit employee from riding elec. low lift
	309nec NS	12. Reversed polarity for elec. outlet near solvent filling line
Solvent Filling	.133 (a) (1) S	13. Failure to wear eye protection
	.134 (a) (1) (2) (3) S	14. Failure to wear respiratory protection
	.132 (a) S	15. Failure to provide non conductive shoes
	.106 (c) (5) (v) (vi) S	16. Failure to provide all tools of the non sparking type
	.132 (a) S	17. Failure to use hand and/or skin protection
General	.29 (f) (4) (i) S	18. Failure to provide handrails and toeboards for platform ladders

COMPLIANCE REPORT

1. TIME 8:00	2. DATE 12-8-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT M. West	

EMPLOYER Moran Div. of Carboline
 ADDRESS 125 Fairground Rd.
 Xenia, Ohio 45385

PLANT Moran
 DEPT. or

5. Page 18

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
	.26(c) (3) (i) S	19. Failure to provide ladder safe practices. Employee observed using metal ladder improperly. The angle should not exceed 1/4" length of ladder
	.144(a) (1) (i) (k) DM	20. Failure to color code sprinklers red
	.176(a) (b) NS	21. Failure to secure leaning pallets -- standing on end near aisleways.
	.22(a) (3) NS	22. Failure to provide cover for all of drain ditch
	.22(a) (2) NS & .141(a) (1) (ii)	23. Failure to provide adequate drainage for drain ditch. Water appears stagnated
Kettle Wash Area	.22(a) (3) NS	24. Failure to provide safe pallets several found to be badly broken with protruding nails
	.23(a) (3) S	25. Failure to provide cover for floor opening
	.37(q) (1) NS	26. Failure to provide exit signs
	.37(q) (2) NS	27. Failure to provide non exit signs
	.179(J) (1) (2) (3) NS	28. Failure to provide record of inspection for crane
	.179(h) (4) NS	29. Failure to provide safety latch for hoist hook
	.133(a) (1) S	30. Failure to provide eye protection when washing
	.134(a) (3) S	31. Failure to use respiratory protection when washing
	.5(a) (1) S	32. Failure to provide eye wash station
Boiler Room	.212(a) NS	33. Failure to adequately guard compressor belt drive. Should be extended to protect end.

COMPLIANCE REPORT

1.TIME 8:00	2.DATE 12-8-72
3.INSPECTOR Mims	
4.ACCOMPANIMENT M. West	

EMPLOYER Moran Div. of Carboline
ADDRESS 125 Fairground Rd.
Xenia, Ohio 45385

PLANT Moran
DEPT. or

5. Page 19

6.Location	7.Apparent Violations Noted	8.Comments
	1910.	
	309nec NS	35. Failure to ground wall receptacles
	.22(a) (3) NS	36. Failure to remove base where boiler had been removed. Presents trip hazard.
	.22(a) (3) NS	37. Failure to provide adequate cover for drain hole
	309nec NS	38. Failure to label electrical switch boxes
	.22(a) (1) NS	39. Failure to provide good housekeeping. Hoists and pipe on floor
	309nec NS	40. Failure to provide cover for elec. receptacle box
	.25(b) (1) (i) S	41. Substandard straight ladder. Broken and patched runners. No safety shoes.
	.157(a) (5) NS	42. Failure to mount fire extinguisher
	.133(a) (1) S	43. Failure to provide eye protection at Perolin Products Station
	.132(a) NS	44. Failure to provide skin protection at Perolin Products Station
Pollution Control	.23(a) (3) S	43. Failure to provide cover for valve pit
	.23(a) (3) NS	44. Failure to provide covers for narrow water pits
Storage Shed	.22(a) (1) NS	45. Broken window panes
	.176(d) NS	46. Failure to provide adequate drainage
Swamp Area	.176(d) NS	47. Failure to provide adequate drainage system
	.141(a) (1) (ii)	
Ball Mills	.95(a) NS	48. Failure to provide ear protection
Elevator	.5(a) (1) NS	49. Failure to provide bumper guards for closing doors with rope

COMPLIANCE REPORT

1. TIME	2. DATE
10:25	12-8-72
3. INSPECTOR	
Mims	
4. ACCOMPANIMENT	
Marvic West	

EMPLOYER Moran Div. of Carboline, Inc.
 ADDRESS 125 Fairground Rd.
 Xenia, Ohio 45385

PLANT Moran
 DEPT. or Warehouse

5. Page 20

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
Office	.144 (a) (1) (i) (e) DM	1. Failure to color code fire extinguisher
	.144 (a) (1) (i) (k) DM	2. Failure to color code sprinklers red
	309nec NS	3. Reversed polarity on elec. receptacle just inside PIC
	309nec NS	4. Open overhead junction P.I.C.
Storage Platform	.23 (a) (2) NS	5. Failure to provide intermediate handrails and toeboards
	.22 (d) (1) NS	6. Failure to post floor capacity
	.212 (a) (5) NS	7. Failure to guard exhaust fan to 1/2"
	.157 (c) (1) (i) NS	8. Failure to provide fire extinguisher
	.26 (c) (2) (vi) (d) NS	9. Failure to maintain clean platform ladder for entrance to overhead storage
General	.144 (a) (1) (i) (e) DM	10. Failure to color code sprinklers red
	.22 (a) (2) NS	11. Failure to remove water from aisleway-- outside office--. Water coming from drums brought in from outside. Suggest wet vacuum
	.37 (q) (1) NS	12. Exits are not indicated by signs
	.37 (q) (2) NS	13. Non exits not so marked
	.37 (q) (5) NS	14. Routes to exits not indicated
	.22 (b) (2) NS	15. Permanent aisles not marked
	.36 (b) (6) NS	16. Failure to provide emergency lighting
	.26 (d) (3) (viii) NS	17. Failure to provide sign "Do Not Use For Elec. Work" for metal ladder
	.23 (a) (2) NS	18. Failure to provide handrails and toeboards for stg. platform above lunch area and restrooms

COMPLIANCE REPORT

1. TIME 10:25	2. DATE 12-8-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT Marvie West	

EMPLOYER Moran Div. of Carboline, Inc.
ADDRESS 125 Fairground Rd.
Xenia, Ohio 45385

PLANT Moran
DEPT. or

5. Page 21

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
309nec	NS	19. Loose elec. wall receptacle in lunch area behind Pepsi machine.
.22 (d) (1)	NS	20. Failure to mark floor capacity for overhead platform
.178 (1)	NS	21. Failure to provide training for forklift drivers
.178 (h) (1)	DM	22. Failure to provide adequate lighting in center of main aisleway.
.68 (b) (3)	S	23. Failure to provide handrails and toeboards for order picking
.176 (b)	NS	24. Unsecured dock plates, stand on end near center aisleway.
.30 (a) (1)	NS	25. Failure to capacity post dock boards
.178 (1)	NS	26. Forklift unattended with key in ignition
.178 (a) (2)	NS	27. Failure to provide fire extinguishers for forklifts
.157 (a) (6)	NS	28. Fire extinguishers mounted in excess of 60
.212 (a)	NS	29. Failure to adequately guard paint shakers. No backplate
309nec	NS	30. Failure to ground portable fan by paint shakers.
309nec	DM	31. Failure to ground raids.
.135	NS	32. Failure to enforce hard hat rule. Employee in kit making area, not wearing hard hat.
.22 (a) (1)	NS	33. Failure to provide good housekeeping in Box stg. area.
.134 (a) (2)	NS	34. Failure to provide respirator for employee repacking 1600-178 catalyst. Label indicated respirator

COMPLIANCE REPORT

EMPLOYER Moran Div. of Carboline Inc.
 ADDRESS 125 Fairground Rd.
 Xenia, Ohio 45385
 PLANT Moran
 DEPT. or

1. TIME 10:25	2. DATE 12-8-72
3. INSPECTOR Mims	
4. ACCOMPANIMENT Marvie West	

5. Page 22

6. Location	7. Apparent Violations Noted	8. Comments
	1910.	
Back Porch Area	.5 (a) (1) NS	35. Failure to barricade gasoline drum
	.22 (a) (2) NS	36. Failure to provide adequate drainage.
Bubble	.157 (a) (5) NS	37. Failure to mount fire extinguisher
	.22 (b) (2) NS	38. Failure to mark permanent aiseways
	.157 (a) (6) NS	39. Fire extinguishers mounted in excess 60"
	.22 (a) (2) NS	40. Failure to provide adequate drainage.
	.22 (a) (3) NS	41. Failure to remove protruding stud by fans
Boiler Room	309nec NS	42. Failure to replace door on elec. breaker box
	309nec NS	43. Failure to provide cover for mercury vapor ballast elec. box
	309nec NS	44. Unprotected live elec. wires
	.26 (a) (1) NS	45. Substandard metal step ladder. Broken step
	.212 (a) NS	46. Failure to adequately guard belt drive for portable air compressor. No backplate.
	.22 (a) (3) NS	47. Failure to remove nails from scrap lumber
	.22 (a) (1) NS	48. Unsecured scrap lumber leaning against wall
	.93 (a) (1) S	49. CO content exceeds TLV of 50 ppm

APPENDIX B
Neurologic Exam

Name: _____

Date: _____

(Supplied by Subject)

NEUROLOGICAL EXAM

I. Reflexes

- KEY: 0 = absent
1 = hypoactive, doesn't normalize with reinforcement
2 = hypoactive, but normalizes with reinforcement
3 = normal
4 = hyperactive
5 = very hyperactive

9 = missing data

	<u>Left</u>	<u>Right</u>
Biceps		
Brachioradialis		
Knee jerk		
Ankle jerk		

II. Response to Plantar Stimulation

	<u>Left</u>	<u>Right</u>	
Normal _____	Abnormal _____	Normal _____	Abnormal _____

III. Muscle Strength

- KEY: 0 = no evidence of contractility
1 = incomplete motion against no resistance
2 = complete motion against no resistance, but no motion against mild resistance
3 = no motion against moderate resistance
4 = some motion against moderate resistance, but strength abnormal
5 = normal

	<u>Left</u>	<u>Right</u>
1. Flexors of great toe	_____	_____
2. Extensors of great toe	_____	_____
3. Flexors of foot	_____	_____

	<u>Left</u>	<u>Right</u>
4. Extensors of foot	_____	_____
5. Abductors of leg	_____	_____
6. Adductors of leg	_____	_____
7. Flexors of knee (hamstrings)	_____	_____
8. Extensors of knee (quadriceps)	_____	_____
9. Hand grip	_____	_____
10. Abductors of fingers	_____	_____
11. Adductors of fingers (paper-pulling test)	_____	_____
12. Extensors of wrists	_____	_____
13. Flexors of wrists	_____	_____
14. Biceps	_____	_____
15. Triceps	_____	_____
16. Shoulder girdle	_____	_____

Walking on toes _____

KEY: 0 = can't
1 = can, but with difficulty
2 = normal

Walking on heels _____

(Same Key as Above)

Atrophy Present _____ (note where) Absent _____

Fasciculations Present _____ (note where) Absent _____

Gait Abnormal _____ Normal _____

(Note Abnormality)

IV. Sensation (Note if impairment follows dermatomes)

KEY: 0 = absent
1 = diminished, but present
2 = normal

X = Left Side

-

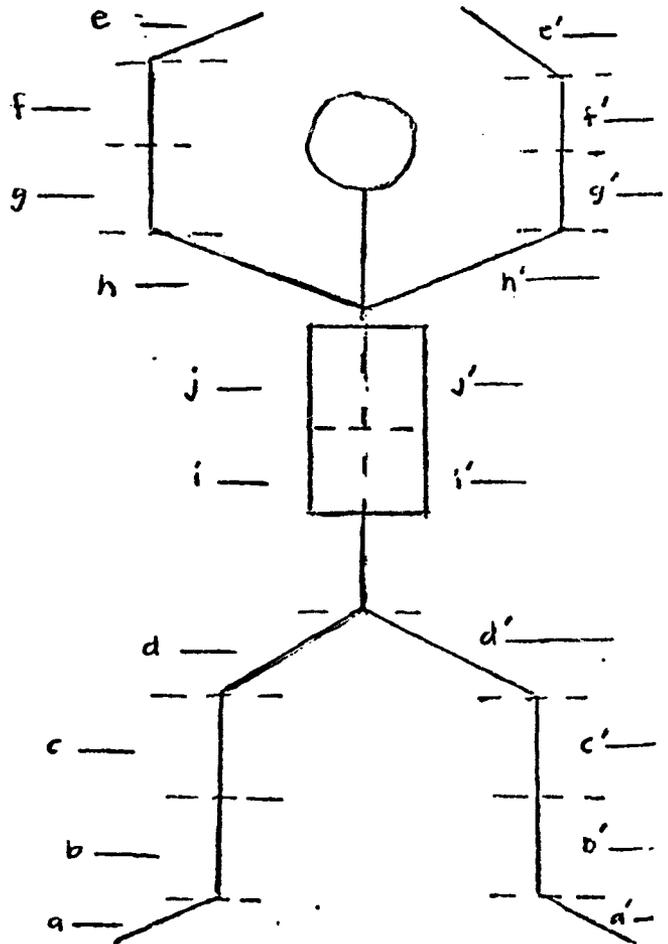
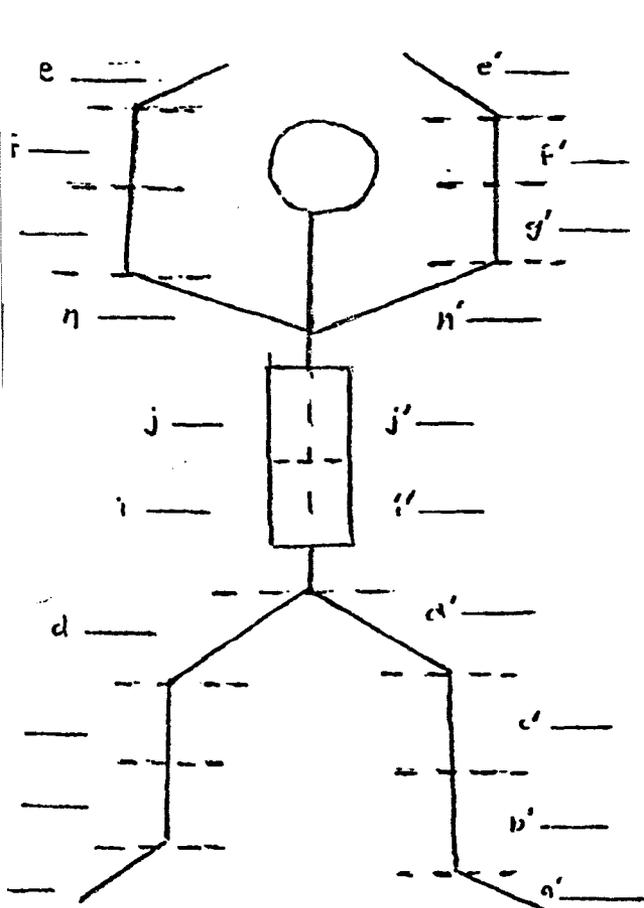
X' = Right Side

a = foot
b = leg below mid-tibia
c = knee to mid-tibia
d = leg above knee
e = hand

f = arm below mid-forearm
g = elbow to mid-forearm
h = arm above elbow
i = trunk below costal margin
j = trunk above costal margin

A. Pinprick

B. Light Touch



C. *Vibration*

	<u>Left</u>	<u>Right</u>
1. <i>Proximal phalanx of big toe</i>	_____	_____
2. <i>Medial malleolus</i>	_____	_____
3. <i>Medial epicondyle of femur</i>	_____	_____
4. <i>Proximal phalanx of thumb</i>	_____	_____
5. <i>Styloid process of radius</i>	_____	_____
6. <i>Medial epicondyle of humerus</i>	_____	_____

D. *Position Sense*

Index finger

Great Toe

V. *Cranial Nerves*

A = abnormal (Specify Abnormality)

N = normal

	<u>Left</u>	<u>Right</u>
1. <i>Smell</i>	_____	_____
2. <i>Pupillary light reflex</i>	_____	_____
3. <i>Extraocular movements</i>	_____	_____
4. <i>Visual fields</i>	_____	_____
5. <i>Light touch sensation on face</i>	_____	_____
6. <i>Muscles of mastication</i>	_____	_____
7. <i>Muscles supplied by 7th nerve</i> <i>(test wrinkling of forehead,</i> <i>closing of eyes, smile)</i>	_____	_____
8. <i>Hearing (watch)</i>	_____	_____
9. <i>Uvula</i>	_____	_____

	<u>Left</u>	<u>Right</u>
10. Gag reflex	_____	_____
11. Swallowing	_____	_____
12. Sternocleidomastoid	_____	_____
13. Trapezius	_____	_____
14. Protrusion and movement of tongue	_____	_____

VI. Coordination

A = abnormal (Specify Abnormality)
N = normal

A. Romberg

Left Right

B. Finger to Nose

C. Heel to Knee

D. Rapid alternating movements
(pronation and supination of
hands)

APPENDIX C

Work History

WORK HISTORY

NAME

I. Please list all jobs held during the past 6 months. Please include buildings, department, dates, and machines.

II. Usual number of hours worked/week during past 6 months _____

III. In the past 6 months, have you worked with solvents or paint?

Yes _____ No _____

If yes:

1) Please list solvents in order from the one most frequently used to the one least frequently used.

2) Do you wash your hands with solvents? Yes _____ No _____

How many times/day?

1-2 _____ 3-5 _____ 6-10 _____ more than 10 _____

With which solvents do you usually wash?

3) Do you clean your equipment with solvents? Yes _____ No _____

How many times/week?

1-2 _____ 3-5 _____ 6-10 _____ more than 10 _____

Which solvents do you use to clean your equipment?

4) Have you used any solvents at home? Yes _____ No _____

Which usually?

5) Where do you change your clothing after work? _____

1 = plant

2 = home, immediately

3 = home, at bedtime

6) Where do you usually take a shower after work? _____

1 = at plant

2 = at home, immediately

3 = at home, delayed

7) How often do you change work shirts?

daily _____ every other day _____ twice a week _____
weekly _____ less often than weekly _____

8) How often do you change work pants?

daily _____ every other day _____ twice a week _____
weekly _____ less often than weekly _____

9) How often do you take a shower or bath?

daily _____ every other day _____ twice a week _____
weekly _____ less often than weekly _____

10) When handling solvents, do you usually wear:

a. Rubber or plastic gloves? Yes _____ No _____

b. Respirator? Yes _____ No _____

If yes, type _____

c. Rubber or plastic aprons? Yes _____ No _____

d. Cloth gloves? Yes _____ No _____

Cloth aprons? Yes _____ No _____

e. Overalls? Yes _____ No _____

Other protection _____

11) Where do you usually eat during your work shift? _____

1 = in work area

2 = in cafeteria

3 = other areas (specify)

12) Do you usually wash with soap before you eat? Yes _____ No _____

13) Do you smoke at work? Yes _____ No _____

If yes, cigarettes? No./day

1-10 _____ 11-20 _____ 21-30 _____ 31-40 _____ more than 40 _____

Cigars? No./day

1-2 _____ 3-4 _____ 5-6 _____ more than 6 _____

Pipe?

Where do you usually smoke? _____

1 = work area

2 = other (specify)

APPENDIX D

Medical Questionnaire

MEDICAL QUESTIONNAIRE

1. Are you now under a doctor's care? Yes No

If yes, for what condition?

2. Have you ever been under a doctor's care for any extended period of time? Yes No

If yes, name conditions and dates.

3. Have you taken any medication in the past 5 years for longer than 2 weeks? Yes No

If yes, name medicine and date.

4. Have you ever been treated for:

A) Tuberculosis?

Yes No Year _____ Medicines _____

B) Cancer or Leukemia?

Yes No Year _____ Medicines _____

C) Urinary Tract Infection?

Yes No Year _____ Medicines _____

D) Epilepsy or Seizures?

Yes No Year _____ Medicines _____

5. Have you ever had:

A) Diabetes? Yes No

If yes, for how long?

0-5 Years _____ 6-10 Years _____ 11-15 Years _____ more than 15 _____

B) A Family History of Diabetes? Yes No

(parents, grandparents, brothers, sisters)

Relative(s) with diabetes _____

C) Diseased Kidneys? Yes No

Dates _____

Cause of Kidney Disease _____

Other Details _____

D) Anemia? Yes No

If yes, please give:

Dates _____

Cause _____

Treatment _____

E) Polio? Yes No

F) Syphilis or Venereal Disease of Unknown Type? Yes No

If yes, please give date, symptoms, and treatment.

G) Back or Neck Problems, including Disc Disease?

Yes No

If yes, please give date, cause, and whether hospitalization was necessary.

6. Do you drink alcohol in any form?

Yes No

If yes, for how long?

0-10 years _____ 11-20 years _____ 21-30 years _____

More than 30 years _____

Average quantities during past 5 years (choose best estimate)

Beer - cans/day: 0 1 2-3 4-5 6-9 more than 9

Wine - bottles/
week 0 1/4 1/2 1 2 more than 2

Other liquor -
drinks/week 0 1 2-4 5-8 9-16 more than 16

7. Have you ever had any persistent weakness in your feet?

Yes _____ No _____

If yes,
Approximate dates (from first development of weakness until weakness ended;
if weakness has continued to present time, please note this:

Cause _____ Both sides _____

One side _____

Duration:

Less than 1 day _____

1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

8. Have you ever had persistent weakness in your legs?

Yes _____ No _____

If yes,
Approximate dates (from first development of weakness until weakness ended;
if weakness has continued to present time, please note this:

Cause _____ Both sides _____

One side _____

Duration:

Less than 1 day _____

1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

9. Have you ever had persistent difficulty climbing two flights of stairs or less?

Yes _____ No _____

If yes, approximate dates (if difficulty has continued to present, note this)

Cause: Weakness of legs or feet _____
General Fatigue _____
Chest pain _____
Shortness of breath _____
Difficulty with balance _____
Other _____

10. Have you ever had persistent weakness in your hands?

Yes _____ No _____

If yes, approximate dates (from first development of weakness until weakness ended; if weakness has continued to present time, please note this)

Cause _____ Both sides _____ One side _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

11. Have you ever had persistent weakness in your arms?

Yes _____ No _____

If yes, approximate dates (from first development of weakness until weakness ended; if weakness has continued to present time, please note this)

Cause _____ Both sides _____ One side _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

12. Have you ever had any persistent feelings of numbness or tingling (pins and needles sensation) in your hands?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of numbness or tingling lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

13. Have you ever had any persistent feelings of numbness or tingling in your arms?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of numbness or tingling lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

14. Have you ever experienced any persistent coldness in your hands while indoors in a normally heated room?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this)

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of coldness lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

15. Have you ever experienced any persistent coldness in your arms while indoors in a normally heated room?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this)

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of coldness lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

16. Have you ever had any persistent feelings of numbness or tingling in your feet?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of numbness or tingling lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

17. Have you ever had any persistent feelings of numbness or tingling in your legs?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of numbness or tingling lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

18. Have you ever experienced any persistent coldness in your feet while indoors in a normally heated room?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of ^{coldness} ~~numbness or tingling~~ lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

19. Have you ever experienced any persistent coldness in your legs while indoors in a normally heated room?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Cause, if known _____

Both sides _____ One side _____

How long has the longest single episode of ^{numbness} ~~numbness or tingling~~ lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

20. Have you ever experienced any persistent pain or cramping in your arms or hands without an obvious cause?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Suspected cause _____

Both sides _____ One side _____

How long has the longest single episode of pain or cramping lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

21. Have you ever experienced any persistent pain or cramping in your legs or feet without an obvious cause?

Yes _____ No _____

If yes, approximate dates (if such feelings have persisted to the present time, note this).

Suspected cause _____

Both sides _____ One side _____

How long has the longest single episode of pain or cramping lasted?

Less than 4 minutes _____ 4-15 minutes _____

16-60 minutes _____ More than 1 hour _____

22. Have you ever noticed your feet persistently slapping down while you were walking?

Yes _____ No _____

Or have you ever had persistent difficulty lifting your feet while walking?

Yes _____ No _____

If the answer to either questions is yes,

Approximate dates _____

(If these experiences have persisted to the present time, note this)

Cause, if known _____

Both sides _____ One side _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

23. Have you ever experienced persistent difficulty in untwisting the tops of jars?

Yes _____ No _____

If yes, approximate dates _____

(If this difficulty has persisted up to the present time, note this)

Cause _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

24. Have you ever been persistently unable to open jars by untwisting the tops?

Yes _____ No _____

If yes, approximate dates _____

(If this difficulty has persisted up to the present time, note this)

Cause _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

25. Have you ever experienced persistent difficulty in turning a key in a lock?

Yes _____ No _____

If yes, approximate dates _____

(If this difficulty has persisted up to the present time, note this)

Cause _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

26. Have you ever been persistently unable to open a door by turning a key in a lock?

Yes _____ No _____

If yes, approximate dates _____

(If this difficulty has persisted up to the present time, note this)

Cause _____

Duration:

Less than 1 day _____ 1-6 days _____ 1-4 weeks _____

5-16 weeks _____ More than 16 weeks _____

27. Have you ever had any persistent double vision lasting longer than 5 minutes?

Yes _____ No _____ Year _____

28. Have you ever had any persistent difficulty in chewing your food unrelated to tooth problems?

Yes _____ No _____ Year _____

29. Have you ever had or noted any of the following:

	Yes	No	Years
Persistent hardness of hearing?	_____	_____	_____
Ringling or noises in your ears persistent for longer than 1 week?	_____	_____	_____
Difficulty swallowing not related to a sore throat and persistent for more than 1 week?	_____	_____	_____
Seizures or convulsions?	_____	_____	_____
Difficulty with coordination or balance persistent for longer than 1 week (for example, tripping over your own feet)?	_____	_____	_____
Joint pains persistent for longer than 1 week?	_____	_____	_____
Weight loss of more than 20 pounds?	_____	_____	_____

30. Have you ever had any serious injuries to your arms or legs, including fractures, industrial accidents, auto accidents, and sports injuries?

Yes _____ No _____

If yes, list month and year, type of injury, and limb affected
