25711 Southfield Road
Southfield, Michigan 48075
Telephone 313 424-8860

January 6, 1976

Mr. Ronald R. Eureka
Plant Manager
TEMPO PRODUCTS COMPANY
6200 Cochran Road
Cleveland, Ohio 44139

Clayton Environmental Consultants, Inc.

Dear Mr. Eureka:

Presented herewith are three (3) copies of a report summarizing the results of our evaluations of your vacuum cleaner (Model 75-D) for effectiveness in containment and control of asbestos-containing dust during a series of experimental tests with actual brake lining dust conducted by Mr. Dennis D. Zaebst of our staff on December 16, 1975.

In summary, we have concluded that, under normal conditions of use, workers operating the vacuum cleaner in connection with service work on automobile brakes are not likely to be exposed to concentrations of airborne asbestos in excess of present or proposed occupational health standards established by the Occupational Safety and Health Administration, assuming proper use and maintenance of the vacuum cleaner and filtration system. In the accompanying report we have recommended that industrial hygiene studies be conducted during actual use of the vacuum cleaners in typical garage or service shop environments to confirm the findings resulting from our tests. In addition, we have recommended that a rigid quality control program be implemented to insure that the integrity of the vacuum cleaner components, particularly the filtration elements, is maintained during large scale production.

It has been a pleasure to be of assistance to you on this project. Please contact us if you have questions concerning any aspects of this report.

Sincerely,

Robert D. Soule, P.E.
Vice-President
Director, Industrial Hygiene Services

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Encl.

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Vacuum Cleaner Evaluation

TEMPO PRODUCTS COMPANY
Cleveland, Ohio

INTRODUCTION

Tempo Products Company retained Clayton Environmental Consultants to conduct an evaluation of a vacuum cleaner identified as "Part No. 75-D." The primary purpose of the test was to determine the effectiveness of the unit for containment and control of emissions of asbestos during use in cleaning asbestos-containing dust. It is understood that these vacuum cleaners are intended to be used in automotive service centers for dust cleanup associated with brake rebuilding operations, including the removal of dust from brake drums and dust produced by grinding and fitting of brake shoes. Results of this evaluation, conducted by Mr. Dennis D. Zaebst of Clayton Environmental Consultants on December 16, 1975, are presented in this report.

DESCRIPTION OF TEST PROCEDURE

The spatial arrangement and relative locations of the vacuum cleaner, air sampling devices, and operator are shown in Figure 1. The tests were carried out in a relatively small confined room (room volume was approximately 800 cubic feet) which was sealed to prevent air movement into or out of the room during each test. The only circulation of air within the room was that generated by the exhaust action of the vacuum cleaner. These conditions were imposed for the purpose of maximizing the severity of use conditions.

During each of three tests, the operator of the vacuum cleaner cleaned approximately ten pounds of asbestos-containing brake dust (described below) from a cardboard container placed on the floor of the room. During each test, one air sample was taken in the breathing zone of the operator and two area samples were taken at stationary locations equidistant from the vacuum cleaner exhaust port. An additional area sample, located in the northeast corner of the room, was taken immediately after the vacuum cleaner was turned off. The room was then ventilated for approximately two hours to minimize the possibility of interference with subsequent tests. To reduce the possibility that fibrous dust, which might normally be present in the indoor air, or fibers generated by a previous test might interfere with the analyses of the test samples, "control" samples were taken immediately prior to each of the tests before any handling of the asbestos-containing dust.

Since it would be difficult, if not impossible, to simulate with a commercial asbestos product actual "brake dust," with respect to particle and fiber size distributions and thus to simulate the efficiency with which the fibers were removed by the vacuum

cleaner filtration system, it was desirable to use for the evaluation actual asbestos-containing dust generated in a manner similar to that associated with automobile maintenance procedures, e.g., grinding of brake shoes. A bulk sample of dust produced by grinding of brake shoes was obtained from a local automotive axle plant. This dust had been collected by fabric filters incorporated in the plant's local exhaust ventilation systems. No other dust was mixed with the brake dust during or after entrainment by the exhaust-filtration systems. The dust was analyzed in the Clayton laboratory for percent fiber and fiber length distribution by phase contrast microscopy at 400X magnification. The results indicated that the dust was composed of approximately 18.2 percent fiber (i.e., fiber to particle ratio), and that fiber lengths ranged from approximately two micrometers to greater than fifty micrometers. Approximately ten percent of the fibers were less than five micrometers in length, about fifty percent measured between five and ten micrometers, and the remaining forty percent measured greater than ten micrometers in length.

SAMPLING AND ANALYTICAL METHODS

Both general area and breathing zone samples were collected by drawing air at a nominal flowrate of two liters per minute through 37-mm diameter cellulose ester membrane filters (Millipore, Type AA, nominal pore size 0.8 micrometers) mounted in a three-piece cassette with the cover removed, using portable battery-operated pumps (Mine Safety Appliances Company, Model G). Breathing zone samples were obtained by fastening the pump to the operator's belt and the filter head to the outside of his collar at approximate breathing zone height. Thus, the breathing zone sample was representative of the time-weighted average conditions to which the operator was exposed during the sampling period.

Each sample was analyzed subsequently for asbestos fibers using the method specified by the National Institute for Occupational Safety and Health. Briefly, this method consists of the following steps: a pie-shaped section of each filter is cut carefully from the filter and mounted on a standard microscope slide using a high viscosity solution of membrane filter material in a 1:1 mixture of diethyl oxylate and dimethyl phthalate to render the filter transparent. Asbestos fibers, defined as particles having an aspect ratio (apparent length to width) of three or greater, which were observable on the surface of the filter were counted using a 10X eyepiece and a 40X objective with phase contrast illumination. A minimum of 100 fields, selected at random on the sample, were examined and fibers greater than five micrometers in length were counted. The microscopic analysis, that is, fiber count data, was used in conjunction with field sampling data (air flowrates and duration of sampling) to calculate the concentrations of asbestos fibers in air corresponding to each sample in units of fibers, greater than five micrometers in length, per cubic centimeter of air.

This procedure is consistent with the method used by the Occupational Safety and Health Administration in its compliance effort.

Data thus obtained were then compared to applicable standards promulgated by the Occupational Safety and Health Administration (OSHA) and by the American Conference of Governmental Industrial Hygienists (ACGIH). The present OSHA and ACGIH standards limit eight-hour, time-weighted average exposures of workers to a concentration of five fibers (greater than five micrometers in length) per cubic centimeter of air. Effective July 1, 1976, the OSHA limit for eight-hour, time-weighted average exposures is scheduled to be reduced to two fibers per cubic centimeter of air. The present OSHA standard also establishes a ceiling (or peak) exposure limit of ten fibers per cubic centimeter of air. On October 9, 1975, OSHA issued proposed rule-making to lower the present standard such that eight-hour, time-weighted average exposures would be limited to 0.5 fiber per cubic centimeter of air, and ceiling exposures measured over a period up to fifteen minutes would be limited to five asbestos fibers per cubic centimeter of air. The proposed standard is based largely on evidence of the carcinogenicity of asbestos in humans.

PRESENTATION OF DATA

Results of microscopic analysis of the bulk sample of brake dust for percent fiber and fiber length distribution are presented in Table I. Examination of these data indicate that the bulk sample was composed of 18.2 percent fibrous material (by count) and fiber lengths ranged from approximately two micrometers to greater than fifty micrometers.

Results of microscopic analysis of the filter samples taken during the vacuum cleaning tests are summarized in Table II. These data indicate that the background level of airborne asbestos in the room prior to any testing was approximately 0.07 fiber per cubic centimeter of air. Control samples taken just before the second and third tests indicated that airborne concentrations of fibrous dust were approximately equal to the background level measured prior to the tests. Airborne concentrations of fibrous dust as measured by the stationary monitors ranged from 0.07 to 0.4 fibers per cubic centimeter of air for all tests. The personal breathing zone samples indicated that airborne concentrations of fibrous dust in the operator's breathing zone ranged from 0.3 to 1.0 fiber per cubic centimeter.

CONCLUSIONS

Interpretation of the sampling data leads to the following conclusions:

1. General airborne concentrations of fibrous dust, as measured by area monitors strategically located in the enclosed room, ranged from 0.07 to 0.4 fiber per cubic centimeter during vacuuming tests, well below the proposed OSHA ceiling concentration of five fibers

per cubic centimeter of air, the most stringent occupational health standard applicable to short (15 minutes or less) exposures. In fact, the concentrations are below the proposed limit for eight-hour, time-weighted average exposures of 0.5 fiber/cc. Due to the extreme severity of the test conditions (small, confined room, no dilution of room air, vacuuming of a very large quantity of brake dust), these data indicate that under normal conditions of use, emissions of fibrous (asbestos) dust from the tested vacuum cleaner are not likely to result in room air concentrations in excess of present or proposed OSHA standards, assuming proper use and maintenance of the vacuum cleaner and its filtration system.

2. Airborne concentrations of fibrous dust in the breathing zone of the operator ranged from 0.3 to 1.0 fiber/cc during vacuuming test procedures, again well below the proposed OSHA ceiling limit for short term exposures.

It is apparent from the data that concentrations of airborne asbestos in the breathing zone of the operator averaged slightly higher than general area concentrations as measured by the stationary monitors. This is more likely due to the unavoidable primary generation of small amounts of dust from the container by the wand of the vacuum cleaner during vacuuming and to the close proximity of the operator's breathing zone to the point of generation of the dust than to the emission of dust from the vacuum cleaner. Again, due to the severity of the test conditions, it is concluded with reasonable confidence that, under normal use conditions, workers using the vacuum cleaner are not likely to be exposed to concentrations of airborne fibrous (asbestos) dust in excess of present or proposed OSHA standards, assuming proper use and maintenance of the vacuum cleaner and filtration systems.

RECOMMENDATIONS

1. Although the vacuum cleaner and its filtration system appear to be effective in filtering out asbestos fibers present in brake dust from the air stream, it is recommended that further industrial hygiene evaluations be conducted during actual use of the vacuum cleaners in typical garage or shop environments to confirm the conclusions presented in this report.

2. The conclusions presented in this report are based on the assumption that quality control of vacuum cleaners and filter bag systems is adequate. It is therefore recommended that a rigid quality control program be developed to insure that adequate performance of the vacuum cleaner components, particularly the filtration elements, is assured during large scale production operations.

This report prepared by: Dennis D. Zaebst

Dennis D. Zaebst
Industrial Hygienist

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FIGURE 1

Diagram of Test Room Used for Evaluation of Tempo Vacuum Cleaner

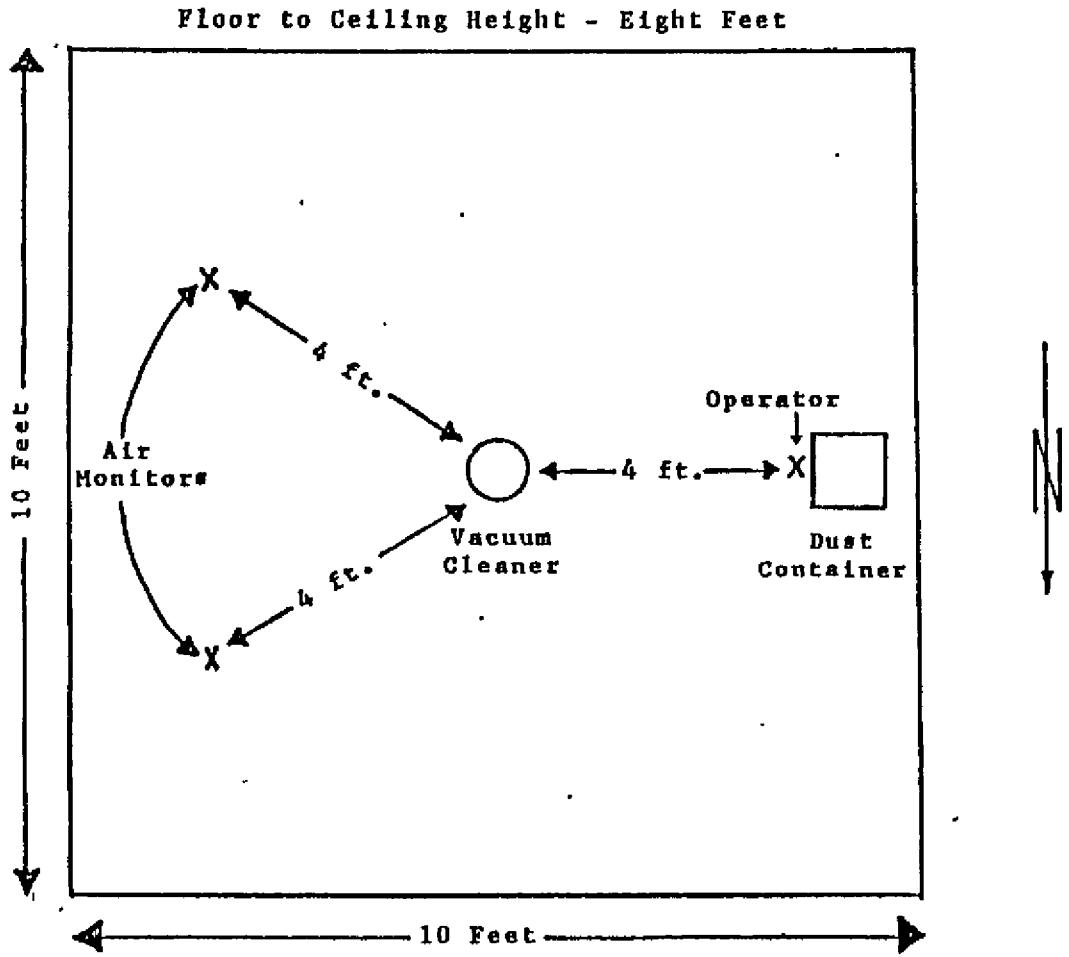

TABLE I

CLAYTON ENVIRONMENTAL CONSULTANTS, INC.
MICROSCOPIC SIZING DATA FOR PARTICLES

Date 12/15/75
Plant Tempo Products Company
Process

Sample No. Bulk Brake Dust
Objective Phaco 40X
Eyepiece Periplan 10X
Total Magnification 400X

SIZE DISTRIBUTION OF FIBERS:

Length Range, μm	Mean Length,	No. of Particles	Size Distribution by Count	
			% of Total	Cumulative %
0.8-1.1	0.95	-	-	-
1.1-1.6	1.35	-	-	-
1.6-2.2	1.90	-	-	-
2.2-3.1	2.65	3	4.5	4.5
3.1-4.4	3.75	-	-	-
4.4-6.2	5.3.	4	6.0	10.5
6.2-8.8	7.5	10	14.9	25.4
8.8-12-5	10.6	20	29.9	55.3
12.5-17.7	15.1	9	13.4	68.7
17.7-25.0	21.3	7	10.4	79.1
25.0-35.2	30.1	6	8.9	88.0
35.2-50.0	42.6	4	6.0	94.0
	>50.	4	6.0	100.0
TOTAL		67		

Ratio, fibers: total particles = 112:617

Fibrous Content, Percent 18.2

- Any particle which has an aspect ratio of 3 or greater is considered a fiber.

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TABLE II-A

CLAYTON ENVIRONMENTAL CONSULTANTS, INC.
INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Tempo Products Company
Cleveland, Ohio

Material(s) Fibrous Dust

Date 1975	Sample Number	Description	Sampling Period		Sample Weight	Sample Volume (Liters)	Concentration		
			Start	Stop			Fibers/cc*		
12/16		FIRST TEST	09:54	10:03					
12/15	AA-1	Control, center of room, elevation four feet	15:23	17:29		284	0.07		
12/16	AA-17	Northeast corner of room, four feet from vacuum exhaust, elevation four feet	09:53	10:04		27	0.1		
12/16	AA-11	Southeast corner of room, four feet from vacuum exhaust, elevation four feet	09:52	10:06		39	0.07		
12/16	AA-21	Personal, breathing zone of operator	09:53	10:04		20	0.3		
12/16	AA-16	Northeast corner of room, after vacuum shut off	10:05	10:19		35	0.08		
12/16		SECOND TEST	12:10	12:19					
12/16	AA-10	Control, center of room, elevation four feet	11:45	12:00		42	<0.07		
12/16	AA-5	Northeast corner of room, four feet from vacuum exhaust elevation four feet	12:08	12:19		27	0.3		
12/16	AA-2	Southeast corner of room, four feet from vacuum exhaust, elevation four feet	12:08	12:20		34	0.08		

TABLE II-B

CLAYTON ENVIRONMENTAL CONSULTANTS, INC.
INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Tempo Products Company
Cleveland, Ohio

Material(s) Fibrous Dust

Date 1975	Sample Number	Description	Sampling Period		Sample Weight	Sample Volume (Liters)	Concentration		
			Start	Stop			Fibers/cc *		
12/16	AA-7	Personal, breathing zone of operator	12:08	12:21		24	0.6		
12/16	AA-9	Northeast corner of room, after vacuum shut off	12:22	12:33		27	0.4		
12/16		THIRD TEST	14:35	14:44					
12/16	AA-8	Control, center of room, elevation four feet	14:04	14:20		37	<0.08		
12/16	AA-6	Northeast corner of room, four feet from vacuum exhaust,	14:32	14:45		30	<0.1		
		elevation four feet							
12/16	AA-12	Southeast corner of room, four feet from vacuum exhaust,	14:32	14:45		36	0.3		
		elevation four feet							
12/16	AA-15	Personal, breathing zone of operator	14:32	14:45		24	1.0		
12/16	AA-20	Northeast corner of room, after vacuum shut off	14:47	15:14		63	0.2		
		Acceptable OSHA eight-hour, time-weighted average concentration (TWA)					5		
		OSHA eight-hour, time-weighted average concentration limit effective 7/1/76					2		
		OSHA ceiling limit					10		
		Proposed OSHA standard					0.5 (TWA) 5 (ceiling)		

* Fiber greater than five micrometers in length and an aspect ratio (length to width) of 3:1 or greater.

NUMBER 4

As noted in the correspondence, the original cautions and warning labels are prepared by the manufacturer. They were then reviewed with the industrial hygiene office and Office of General Counsel for completeness and proper wording.