U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-92-363

JEFFERY BIGELOW DESIGN GROUP, INC.
WASHINGTON, D.C. 20007

FEBRUARY 1977

I. TOXICITY DETERMINATION

An environmental survey was conducted on August 2nd and 3rd, 1976 by the National Institute for Occupational Safety and Health for the Jeffery Bigelow Design Group. Employees exposures to Acetone, Toluene Methyl Methacrylate, Methylene Chloride, Petroleum Distillate, Methyl Alcohol, Dibutyl Phthalate, Nuisance Dust, and Noise were evaluated. It was determined that the exposures to the above listed chemicals were not hazardous under the conditions of use observed during this survey. Noise levels were found to be potentially hazardous throughout the work area during periods of frequent or prolonged power tool use. These determinations are based on environmental measurements of airborne contaminant concentrations, sound level measurements, confidential interviews, a review of the pertinent literature, and observations of work practices and exposure controls.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

Copies of this report have been sent to:

a. Jeffery Bigelow Design Group, Inc. Washington, D.C.
b. U.S. Department of Labor - Region III
c. NIOSH - Region III

For the purpose of informing the eight "affected employees", the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place near where exposed employees work.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from the Jeffrey Bigelow Design Group, Inc. regarding the exposure of employees to contaminants from acrylic furniture manufacturing. No health problems were indicated.

IV. HEALTH HAZARD EVALUATION

A. Process Description

This shop employs four full time craftsmen and two others part time. In addition two people perform full time sales and administrative work. An additional driver is employed for delivery services.

The shop is equipped with a band saw, table saw, joiner, router, polishers and sanders. The work is not strictly segregated into separate locations therefore finishing, gluing, and layout are accomplished on work benches or in the middle of the shop floor as necessary. The power cutting tools are generally located at one end of the work area however due to the close proximity of the work benches no appreciable reduction in exposures to noise or vapors could be anticipated from the separation.

The shop layout is shown in Figure 1, not to scale. There is no more than 2,300 square feet of floor space with an average ceiling height of 13 feet. Furniture is fabricated from sheet or bar plastic by cutting and gluing. A small amount of heat forming is accomplished. The plastic used is Rohm and Haas Plexiglass GM® Sheets; about 500 sq/ft./mo. of various thicknesses are used. The adhesives are Cadco PS-30 Cement, usage is about 2 gallons per month, and RPC-25 which is used in small quantity. The A component of Cadco PS-30 is 65% Methyl Methacrylate Monomer, 35% Polymethyl Methacrylate, and 0.3% N, N-Bis (Hydroxyethyl)-P-Toluidine. The B Component

96.5% di-n-Butyl Phthalate and 3.5% benzoyl peroxide. The glue is mixed in paper cups and applied by syringe. The RPC-25 glue is primarily Methylene Chloride. Masking tape is used to avoid unwanted glue contact. Alcohol is used to remove tape adhesive after gluing. Plexiglass materials are cut and routed similarly to wood however finishing after sanding includes polishing with Jewelers Rouge, Plascor 205 and Plascor 1405, supplied by Unilab. Polishing and buffing are accomplished on a pedestal machine as well as with mobile units. Heat forming is not a routine procedure and did not occur during this survey. Heating elements are used to raise the temperature of the sheet from 280°F to 310°F. The heating period depends on the thickness of the sheet but normally would not exceed a 15 to 20 minute cycle. Small amounts (1 pint/mo) of Weld Wood filler, cleaner, and cement are used for certain types of work. None was observed in use during this survey.

The shop is ventilated by two exhaust fans and a window air conditioner. One small axial fan rated at 750 CFM is mounted in the ceiling above the primary gluing tables. The larger 3,000 CFM axial fan is wall mounted on the end where machining is accomplished. The air conditioner is mounted on the same wall as the exhaust fan. Five windows and an overhead door provide natural ventilation in moderate weather. It is the practice to conserve air conditioning by using the large wall exhaust fan only when gluing. This was the first summer in their new location. In the old unairconditioned shop the fan was used more often for comfort. Workers recognize the advantage of opening a window on the opposite end of the shop to optimize the air flow pattern and maximize exhausted air volumes.

B. Evaluation Design

Five workers who were active in the shop area were instrumented for measurement of breathing zone exposures to air contaminants. In addition area and high volume samples were taken to assist in laboratory analysis. Bulk samples of all glues, solvents, and polishing compounds were taken. Confidential interviews were given each worker. A general noise survey was conducted. Area combustible gas and total dust measurements were accomplished with a JW-SSP dual range combustible gas indicator and a GCA dust monitor. Air circulation observations were made.

C. Evaluation Method

1. Personal breathing zone and area samples for airborne contaminants were collected as follows (Consecutive Sequential samples two to three hours each were taken over a period of five to eight hours.):

   a. Charcoal tubes were used to sample for acetone, toluene, methyl methacrylate, methylene chloride, and petroleum distillates. Sipin pumps were used to sample at a rate of 200 cc/min. Analysis was by gas chromatograph with a Flame Ionization Detector. Limits of detection were 0.01 mg for each of these substances.

b. Silica gel tubes were used to sample for methyl alcohol with Sipin pumps at a rate of 50 cc/min. The detection limit was 0.01 mg by gas chromatography.

c. Dibutyl phthalate was collected on AA cellulose membrane filters with 0.8u average pore size by MSA model G pumps at a flow rate of one LPM using closed face cassettes. The detection limit was 0.01 mg by gas chromatography.

d. Nuisance dust samples were collected on PVC filters with an MSA model G pump at a flow rate of 1.5 LPM using closed face cassettes for total dust measurement.

2. Noise measurements were taken with a General Radio sound level type II meter, model GR1565B. Calibration checks were made pre- and post- shift with a GR1562A.

3. Air Circulation observations were made with the aid of an Alnor Junior velometer and smoke tubes.

D. Evaluation Criteria

1. There are a number of criteria available to assess the potential toxicity of contaminant exposures under investigation. Those with widest usage are the NIOSH Criteria Document Recommendations, The Threshold Limit Values (TLV) recommended by the American Conference of Governmental and Industrial Hygienists, and the Code of Federal Regulations Title 29 Part 1910.1000 used in the enforcement of the Occupational Safety and Health Act. These three criteria are included here in Table 1. Their comparison can be made only with an understanding of the differences in methods of measurement and intended degree of protection. The criteria which in the authors opinion represents the best health protection has been applied.

2. The criteria used in this evaluation are discussed in detail in the references given below. The limited information presented here is intended to provide laymen with a general knowledge of the basis of these exposure criteria.

a. The methyl methacrylate TLV of 100 ppm is considered sufficiently low to protect against discomfort from irritation and is well below the level giving rise to and systemic effects.[1]

b. The NIOSH Recommended Methylene Chloride Criteria is 75 ppm Time Weighted Average (TWA) in the absence of occupational exposure to carbon monoxide at or above 9 ppm (TWA) for a ten hour day. The reason for this conditional limit is that carbon monoxide and methylene

chloride have an additive toxic effect which must be taken into account. This criteria is based on studies which used blood chemistry measurements to determine the levels which would not cause any adverse central nervous system effects.[4]

c. Dibutyl phthalate has a TLV of 5 mg/M^3 based on controlling excessive mists rather than as a health measure.[1]

d. The NIOSH recommended criteria for methyl alcohol of 200 ppm (TWA) is based on the belief that exposures at this level will not affect judgement, or perception so that if an emergency were to occur, the worker might not take appropriate action; providing that no excursions above this level exceed 800 ppm as measured for a 15 minute sampling period, and that compensatory exposure periods are maintained below the TWA.[5]

3. Toxic effects of the substances evaluated are discussed here briefly so that the reader will know and recognize the symptoms and health consequences of overexposure. The specific effects occurring at any given time depend upon a number of factors such as concentration and length of exposure, individual susceptability, and possible synergistic effects of exposure to a combination of substances all at the same time.

a. Effects of overexposure to methyl methacrylate monomer which is present upon heating of plexiglass to decomposition are irritability, headache, anorexia, somnolence, and hypertension. This substance is known as a sensitizer. Therefore, once a person is exposed to a sufficient degree to cause sensitization he will thereafter be adversely affected by much lower exposures that would not effect unsensitized individuals. Fine dust from polymethyl methacrylate (plexiglass) has been reported to cause respiratory and skin irritation possessing allergenic properties similar to the monomer.[2,3]

b. Effects of overexposure to methylene chloride are anesthetic. The central nervous system is affected which may result in loss of alertness and light headed feeling. Methylene chloride is converted to carbon monoxide by the body metabolic process. Therefore, at high concentrations loss of consciousness and death may result.[4]

c. Dibutyl phthalate has low acute and chronic oral toxicity and due to its low vapor pressure would present little inhalation problems except from a spray or mist exposure.[1]

d. Effects of overexposure to methyl alcohol through the skin, inhalation, and orally are variable and usually occur a short while after the exposure. Effects can include dizziness, nausea, and vomiting, however the most characteristic symptoms are various visual disturbances and metabolic acidosis.[5]

4. The subject of Hazardous Noise Criteria and damage risk threshold is not readily treated in non-technical language and is subject to different interpretation depending on the opinion of the health professional. It is the opinion of the writer that an 85 decibal (dBA) TWA exposure for an eight hour period is the appropriate basis for developing a standard. The American Conference of Governmental and Industrial Hygienists have set forth such a criteria in their threshold limit value for Physical Agents.[6] This criteria is based on the belief that limiting the daily exposure to an 85 dBA (TWA), nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech. Hearing impairment is defined as an average hearing threshold level in excess of 25 decibels (ANSI-536-1969) at 500,1000, and 2000 Hz. These levels should be used as a guide in the control of noise exposure, due to the individual susceptability, should not be regarded as fine lines between safe and dangerous levels.[6] While the standard given here is more protective than the one presently required by OSHA, a 90 dB TWA 8 hour exposure, it is not the most conservative criteria presently in use. The Department of Defense has a long experience in hazardous noise control programs which has resulted in an 85 dBA TWA 8 hour day exposure criteria however, their permissible exposure periods for higher levels are shorter based on a damage risk doubling for every four decibel increase instead of the less protective five dB doubling used by ACGIH. There are even more conservative three dB doubling criteria in use outside the United States. It should be recognized that the application of the ACGIH-TLV's for noise will not protect all workers from the adverse effects of noise exposure. A hearing conservation program with audiometric testing is necessary when workers are exposed to noise at or above the TLV levels.

Threshold Limit Values[6]

Duration Per Day (Hours)	Sound Level dBA[a]
16	80'
8	85
4	90
2	95
1	100
½	105
¼	110
1/8	115*

*No exposure to continuous or intermittent in excess of 115 dBA.

a. Sound level in decibels as measured on a sound level meter, conforming as a minimum to the requirements of the American National Standard Specification for sound level meters, 51.4 (1971) type 52A, and set to use the A weighted network with slow meter response.

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of these factors:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots \frac{Cn}{Tn}$$

exceeds unity, then the mixed exposure should be considered to exceed the threshold limit value. Where C_n indicates the total duration of exposure at a specific noise level, and T_n the total duration of exposure permitted at that level. All on-the-job noise exposures of 80 dBA or greater shall be used in the above calculation. These criteria do not apply to impact or impulse noise. That is those variations in noise levels that involve maxima at intervals of greater than one per second. Where the intervals are less than one second, it should be considered continuous noise and this criteria would apply.

E. Evaluation Results

1. The interviews with each worker did not reveal any pattern of symptoms however, nearly all complained of some discomfort when gluing larger projects. The complaints ranged from not liking the smell to headache and nausea. The workers had no complaints of physical maladies except for one who stated he had a long standing hearing loss.

2. The levels of airborne contaminants measured during this survey period were within the previously defined accepted criteria for occupational exposures.

a. Neither acetone nor petroleum distillates were detected in any of the air samples. Therefore, concentrations were less than a milligram per cubic meter (See Table 2).

b. Methylene chloride was measured in the breathing zone of each worker. Exposures ranging from 0.3 to 5.9 mg/M^3 on the first day and from 0.1 to 35.0 on the second day. (See Table 2). The higher exposures on August 3, 1976, are explainable by a heavy usage of RPC-25 glue which a bulk sample analysis reported as 100% methylene chloride.

c. Methyl methacrylate was measured in all but one breathing zone sample and all but two area samples. Levels ranged from 3.0 to 10.0 mg/M^3 on the first day and from 0.3 to 18.0 mg/M^3 on the second day. There was a notable increase in samples taken later in the day although none of them approached the TLV. (See Table 2)

d. Toluene was measured at the detection limit in seven samples. (See Table 2) Concentrations were less than one milligram per cubic meter. The source of this contaminant is unknown since the only stocked substances reported to contain toluene were the weldwood products which were not in use during this survey.

e. Combustible gas indicator readings were very low and erratic, therefore, below the instruments effective measuring limits.

f. GCA RDM-1 dust measurements were less than 2.0 mg/M^3 in the vicinity of power saw, router, and rotary sanding operations. These readings were well below the 10.0 mg/M^3 TLV, however, they are few in number and not taken in the worker's breathing zone.

g. Dibutyl phthalate was measured in two area samples taken on the finishing table and gluing table between ten to twelve thirty on the second day. The measured levels were at and just above the detection limit. The concentrations were less than a tenth of a milligram per cubic meter of air. The other eleven area and six periodic BZ samples were below the detection limit.

h. Methyl alcohol was measured on one of twenty-six samples at slightly above the detection limit. The concentration was less than fifty micrograms per cubic meter. This personal BZ sample was taken during a period when tape removal was accomplished. The hand application of alcohol for removal of adhesive will result in skin absorption in addition to inhalation exposure. There is also a possibility of dermatitis from action on the skin.

i. Total dust measurements ranged from 0.17 up to 4.6 mg/M^3 on the first day and from 0.29 to 2.2 mg/M^3 on the second day. All but three of the 28 samples were below 2 mg/M^3. (See Table 3)

3. Noise levels were found to be well above the 85 dBA eight hour TLV in all areas of the shop during routing operations. Table saw operation was above this level in all but the farthest corner of the shop. The band saw operator was exposed to 87 dBA and adjacent workers were below 85 dBA, however, still above 80 dBA which will require inclusion of this exposure in the total daily dose calculations Ref. Par. D4. (See Table 4)

4. A bulk sample of red polishing compound, Plascor 205, was found to contain 66% free silica and a wax binder but no asbestos. A bulk sample of white polishing compound, Plascor 1405, was found to contain no asbestos and 1% free silica. A sample of debris taken from the portable tools motor mount platform contained 40% free silica and no asbestos.

F. Discussion of Results

1. The airborne contaminants measured during this survey period did not present a health hazard. There were noticeable odors from the machining and gluing of the plexiglass which were subjectively considered objectionable by the writer. Use of the wall exhaust system provided adequate control of these odors. The odor threshold for methyl methacrylate is very low around 0.21 ppm.

2. The limited amount of heat forming accomplished at this facility and the infrequent use of Weldwood Cement and cleaning compound resulted in our failure to observe these processes in use. The Rohm and Haas Company Industrial Hygienist advised us that the Plexiglass G product "GM sheet" would not decompose during heat forming if temperatures did not exceed the recommended levels. Please note that around 300°F the release of Methyl Methacrylate Monomers is to be expected.[8] The amount and rate of the release is dependent upon the molecular weight and the temperature and duration of heating.

3. Noise levels were found to be high throughout the work area during routing and cutting operations. Measurements were taken at the power equipment operators positions as well as at work stations representative of exposure to other workers. Due to the limited period of observation it is not possible to fully document individual workers daily accumulated noise dose. In the opinion of the writer the ACGIH TLV would be exceeded for all shop workers during periods of frequent or prolonged use of the router and table saw as observed on the morning of the first day. Note that variability in materials thickness and shape as well as variation in cutting depth and speed will cause a large variability in noise levels generated. Each worker is highly mobile and may operate or be near the operating machinery at frequent intervals. Two of the workers play in a band during evening hours which likely adds high level exposure time to their daily total dose.

4. The presence of a large percentage of free silica in the Plascor 205 polishing compound was unanticipated therefore, respirable silica samples were not taken and silica analysis were not obtained on dust filters. Free silica and wax from the polishing compound are not expected to be suspended as dust. However, it would possibly present an inhalation hazard to the operator. Accumulations of dried wax and silica could become resuspended in the atmosphere when sweeping.

The chief concern of excessive free silica exposure is the development of a condition termed silicosis. This form of pneumoconiosis usually occurs only after a number of years of exposure, although with severe exposure silicosis can occur in a short time. Early silicosis (termed "simple silicosis") is usually first diagnosed by chest x-ray examination. At this stage there is usually little if any functional impairment, and there are often no associated symptoms and signs. Symptoms usually occur when silicosis advances and is complicated by infection, emphysema, and other medical problems.

The deposition of crystalline free silica in the lungs in sufficient amounts over a period of years may produce fibrous nodules. These nodules cause many individual alveoli (air sacs within lung) to be compressed and collapsed, thus reducing the function of the lungs. Continuous exposure to elevated concentrations of dust containing free silica may produce increased debilitating effects. These changes are marked by intolerance to exertion, episodes of coughing and production of thick purulent sputum. When silicosis has progressed to this point, the chest x-ray is usually read as "conglomerate silicosis". Conglomerate silicosis many times progresses in spite of termination of exposure and becomes incapacitating to affected workers.[9]

G. Recommendations

1. It is recommended that the high volume wall exhaust fan be used when frequent or prolonged machinery or cutting operations are underway as well as continuing the current practice of use during the gluing operations.

2. The use of polishing compound containing free silica is unwise. Nontoxic substances should be substituted. As an interim measure approved respirators should be worn when operating polishing equipment. A respirator program must be established in accordance with OSHA Part 1910.134.

3. Noise exposures would be reduced by requiring ear defenders to be worn by all personnel in the shop during periods when power equipment is in use. Each worker should be tested annually to detect any loss. New employees should be given baseline audiograms and trained in hearing protection. The employees who participate in other high noise exposure activities during evenings and weekends must be made aware of the need for protecting themselves from these additional heavy exposures. Future purchases of power tools and replacement cutting blades should be guided by noise reduction specifications below 85 dBA.

4. Impermeable gloves should be worn during application of methyl alcohol to avoid skin absorption and dermatitis.

5. The ventilation could be improved by relocation of the air conditioner to the far corner of the shop (near the refrigerator) from the wall exhaust fan. The fan would then draw the cooled replacement air across the work area instead of short circuiting it. The exhaust should remain on the end where power equipment is located to remove the vapors and dust most effectively.

VI. AUTHORSHIPS AND ACKNOWLEDGEMENTS

Report Prepared By:

Bruce A. Hollett
Industrial Hygienist
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office: Jerome P. Flesch, Acting Chief
Hazard Evaluation and Technical
Assistance Branch
Cincinnati, Ohio

ACKNOWLEDGEMENTS

Laboratory Analysis: Richard E. Kupel
Research Chemist

Utah Biomedical Testing Lab

V. REFERENCES

1. Documentation of the Threshold Limit Values for Substances in Workroom Air with supplements for substances added or charged since 1971, 3rd ed., 1971, 3rd. printing, 1976, American Conference of Governmental Industrial Hygienists.

2. Occupational Diseases a Guide to Their Recognition, USPHS, 1964, Wm. Gafafer, Editor.

3. Industrial Toxicology and Dermatology in the Production and Processing of Plastics by K.E. Malter and R.L. Zielhuis, 1964.

4. Criteria for Recommended Standards for Occupational Exposure to Methylene Chloride.

5. Criteria for Recommended Standards for Occupational Exposure to Methyl Alcohol. HEW Publication No. (NIOSH) 76-138 dated March, 1976.

   HEW Publication No. (NIOSH) 76-138 dated March, 1976.

6. TLV's^{R} Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1976. Published by The American Conference of Governmental Industrial Hygienists.

7. Hazardous Noise Exposure, Air Force Regulations 161-31, July, 1973.

8. Thermal Degradation of Organic Polymer by Samuel L. Madorsky, 1964.

9. Criteria for Recommended Standards for Occupational Exposure to Crystalline Silica

   HEW Publication No. (NIOSH) 75-120 dated 1974.

TABLE 1

MULTIPLE CRITERIA
RHE 76-92
Jeffrey Bigelow Design Group
Washington, D.C.

TOXIC MATERIAL	NIOSH[a] RECOMMENDED	ACGIH TLV[b] 1976 Book	Title 29 Part 1910.1000, Subpart C
Methyl Methacrylate	No Recommended Criteria	100 ppm or 410 mg/M^3 (TWA) (Table Z-1)	
Methylene Dichloride	75 ppm or 26 mg/M^3 (TWA) 500 ppm (C)[d] in absence of CO > 9 ppm	200 ppm or 720 mg/M^3 (TWA) 250 ppm (STEL)[d]	None established
Methyl alcohol	200 ppm (TWA) 800 ppm (C)[d]	(skin) 200 ppm or 260 mg/M^3 (TWA) 250 ppm (STEL)[d]	(Table Z-1) 200 ppm (TWA)
tyl Phthalate	No Recommended Criteria	5 mg/M^3 (TWA) 10 mg/M^3 (STEL)[d]	(Table Z-1) 5 mg/M^3 (TWA)
Petroleum Distillates		computed based on chemical analysis	(Table Z-1) 500 ppm or 2000 mg/M^3
Nuisance Dust		For dust 1% quartz responsible 5 mg/M^3 TOTAL 10 mg/M^3	Dust 1% quartz (Table Z-3) TOTAL 15 mg/M^3
Acetone		1000 ppm or 2400 mg/M^3 (TWA) 1250 ppm (STEL)[d]	None established
Toluene	100 ppm (TWA)	100 ppm or 375 mg/M^3 (TWA) 150 ppm (STEL)[d]	(Table Z-2) 200 ppm (TWA) 300 ppm (C)[d]

MULTIPLE CRITERIA TABLE 1 - (cont)

a. All NIOSH recommended criteria cited here are time weighted averages (TWA) designed to protect the health and safety of workers for up to a 10-hour workday, 40 hour workweek over a working lifetime. Compliance with all sections of the applicable standard should prevent adverse effects on the health and safety of workers.

b. American Conference of Governmental Industrial Hygienists Threshold Limit Value's refer to time-weighted average concentrations for a 7- or 8-hour workday and 40-hour workweek. They represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effects. These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline.

c. From CFR Title 29 Part 1910.1000 Occupational Safety and Health Standards, Subpart G Occupational Health and Environmental Controls, air contaminants; any employee exposed to any material listed in Table Z-1, Z-2, or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section. (See Code of Federal Regulations dated July 1, 1976 for full discussion). Criteria cited here from Tables Z-1, Z-2, and Z-3 all are based on an 8-hour work shift of a 40-hour workweek time weighted average exposure.

Ceiling concentrations (C) and Short Term Exposure Limits (STEL) are listed ere available. These limits are based on various exposure control criteria and time limits which must be carefully studied before application to a specified working environment. Typical limits might be a 10 or 15 minute exposure once a day with a compensatory period of exposure below the TWA limit.

TABLE 2

Charcoal Tube Analyses

RHE 76-92

Jeffrey Bigelow Design Group, Inc.
Washington, D.C.

August 2 & 3, 1976

	DATE Aug.	NO. ct.	TYPE	PERIOD (HRS.)	VOL. (L)	1	2	3	4	5
							(Concentration mg/M^3)			
Employee #1	2	1	BZ	1.43	18	<0.6	<0.6	3.0	<0.6	<0.6
	2	6	BZ	2.12	25	<0.4	1.0	8.2	<0.4	<0.4
	3	14	BZ	2.52	30	<0.3	<0.3	0.3	<0.3	<0.3
	3	23	BZ	1.83	24	<0.4	0.4	4.5	<0.4	<0.4
	3	31	BZ	2.65	29	<0.3	0.7	1.0	<0.3	<0.3
Employee #2		ct.								
	2	2	BZ	2.85	39	<0.3	<0.3	5.4	<0.3	<0.3
	2	7	BZ	3.87	52	<0.2	5.3	6.9	<0.2	<0.2
	3	15	BZ	2.47	11	<0.9	<0.9	0.9	<0.9	<0.9
	3	24	BZ	1.8	82	<0.1	<0.1	1.5	<0.1	<0.1
	3	32	BZ	1.5 (max. pump failed)	4	<2.0	35.0	5.0	<2.0	<2.0
Employee #3		ct.								
	2	3	BZ	2.8	36	<0.3	<0.3	6.1	<0.3	<0.3
	2	8	BZ	2.82	17	<0.6	5.9	10.0	<0.6	<0.6
	3	16	BZ	1.97	26	<0.4	<0.4	1.0	<0.4	<0.4
	3	25	BZ	2.37	32	<0.3	12.0	7.8	<0.3	<0.3
	3	33	BZ	2.23	30	<0.3	8.7	8.7	0.3	<0.3
Employee #4		ct.								
	2	4	BZ	2.98	38	<0.3	<0.3	8.4	<0.3	<0.3
	2	9	BZ	3.48	45	<0.2	2.0	5.5	0.2	<0.2
	3	17	BZ	2.43	30	<0.3	<0.3	2.0	<0.3	<0.3
	3	26	BZ	2.07	25	<0.4	1.0	5.2	<0.4	<0.4
	3	34	BZ	2.18	18	<0.6	4.0	7.8	<0.6	<0.6
		ct.								
Employee #5	2	5	BZ	2.62	34	<0.3	<0.3	6.5	<0.3	<0.3
	2	10	BZ	3.5	31	<0.3	2.0	4.2	0.3	<0.3
	3	18	BZ	2.15	27	<0.4	1.0	0.7	<0.4	<0.4
	3	27	BZ	1.88	24	<0.4	13.0	18.0	<0.4	<0.4
	3	35	BZ	2.27	28	<0.4	10.0	12.0	<0.4	<0.4
AREA on post at band saw		ct.								
	2	11	A	2.87	34	<0.3	<0.3	5.0	<0.3	<0.4
	2	12	A	4.1	53	<0.2	0.8	2.5	0.2	<0.2
AREA on post above joiner		ct.								
	3	19	A	2.0	12	<0.8	<0.8	0.8	<0.8	<0.8
	3	30	A	2.0	5	<2.0	<2.0	2.0	<2.0	<2.0
		37	A	3.75	59	<0.2	3.2	2.7	<0.2	<0.2
AREA Gluing table		ct.								
	2	13	A	3.75	51	<0.2	1.0	4.1	<0.2	<0.2
	3	20	A	1.6	23	<0.4	<0.4	0.4	<0.4	<0.4
	3	29	A	2.1	25	<0.4	<0.4	2.0	<0.4	<0.4
	3	36	A	3.9	53	<0.2	3.0	5.3	0.2	<0.2
CRITERIA						2400 TLV	261 NIOSH	410 TLV	376 TLV skin	2000 TLV

(1) Acetone; (2) Methylene dichloride; (3) Methyl Methacrylate; (4) Toluene; (5) Petroeum Distillate

TABLE 3

Gravimetric Total Dust Analysis

RHE 76-92

Jeffrey Bigelow Design Group, Inc.
Washington, D.C.

August 2 & 3, 1976

	NO.	SAMPLE PERIOD (Hrs.)	VOL. (M^3)	mg*	DATE	mg/M^3
Employee #1						
Hand Sanding & Filing	2320	1.43	0.13	0.60	2	4.6
	2336	2.12	0.19	0.14	2	0.7
Rotary Sanding & Removing Tape	2319	2.52	0.23	0.37	3	1.6
Primarily in middle of work area	2303	1.83	0.17	0.39	3	2.2
	2359	2.65	0.24	0.13	3	0.55
Employee #2						
Band router, band saw	2305	2.85	0.26	0.35	2	1.4
Hand sander & buffer	2357	3.85	0.35	0.15	2	0.43
Belt sanding & edging	2301	2.47	0.22	0.09	3	0.4
Employee #3						
Router, table saw, band saw, joiner	2304	2.8	0.25	0.20	2	.80
uter & joiner	2307	2.82	0.25	0.14	2	0.5
olishing & sanding	2338	1.97	0.18	0.31	3	1.7
Employee #4						
Table saw & planer	2355	2.98	0.27	0.28	2	1.0
Sanding & polishing	2329	3.48	0.31	0.71	2	2.3
Routing, filing, & sanding	2340	2.43	0.22	0.33	3	1.5
	2333	2.07	0.17	0.17	3	1.0
	2248	2.18	0.20	0.15	3	0.7
Employee #5						
Hand sand., rotary sand., & polish.	2302	2.62	0.24	0.30	2	1.1
Joiner & grinder	2331	3.5	0.32	0.39	2	1.2
Gluing	2342	2.15	0.19	0.10	3	0.5
Gluing	2306	1.88	0.17	0.08	3	0.5
AREA						
Gluing table, buffing & sanding	2343	3.05	1.6	0.63	2	0.39
	2360	4.25	2.3	0.39	2	0.17
	2308	1.77	0.95	0.75	3	0.79
AREA						
Finishing table	2352	3.17	1.2	2.2	2	1.8
	2332	4.25	2.3	2.57	2	1.1
	2314	2.5	1.4	1.0	3	0.71
	2326	2.6	1.4	0.41	3	0.29
	2322	1.7	0.94	0.33	3	0.35
CRITERIA						10.00
*Blanks were not subtracted	2311			0.02		
	2312			0.06		

TABLE 4

Noise Measurements - Jeffrey Bigelow Design Group Inc. - Wash. D. C.

RHE 76-92; August 2, 1976; General Radio/GR 1565B SN 6865

Noise Location of Source/Measurement	(dB A)	(dB C)	Permissible exposure Tn (hours per day) without ear defenders
Table saw-cutting 3/4" PG			Tn (See equation in Par. D4)
@ Operators position	91	92	4.4
@ Middle of room	86	87	7.6
@ Nearest work table	91	92	4.4
@ Farthest work table	84	85	9.5
Router-cutting 1" PG			
@ Operators position	106	108	0.4
@ Table saw	95	97	2.0
@ Nearest work table	101	102	0.9
@ Farthest work table	96	98	1.8
@ Middle of room	98	99	1.4
Idling/@ operators position	89	90	4.8
Band-saw-cutting 1" PG			
@ Operators position	87	88	6.4
@ Middle of room	81	82	14.4
@ Farthest work table	82	84	12.8
Orbital Hand Sander			
@ Operators position	84	84	9.5

eld Calibration @114 dBC with GR 1562A SN 4066

HZ	125	250	500	1000	2000
dBC	116	116	115	114	113

FIGURE 1
RHE-76-92
JEFFERY BIGELOW DESIGN GROUP, INC.
WASHINGTON D.C. 20007