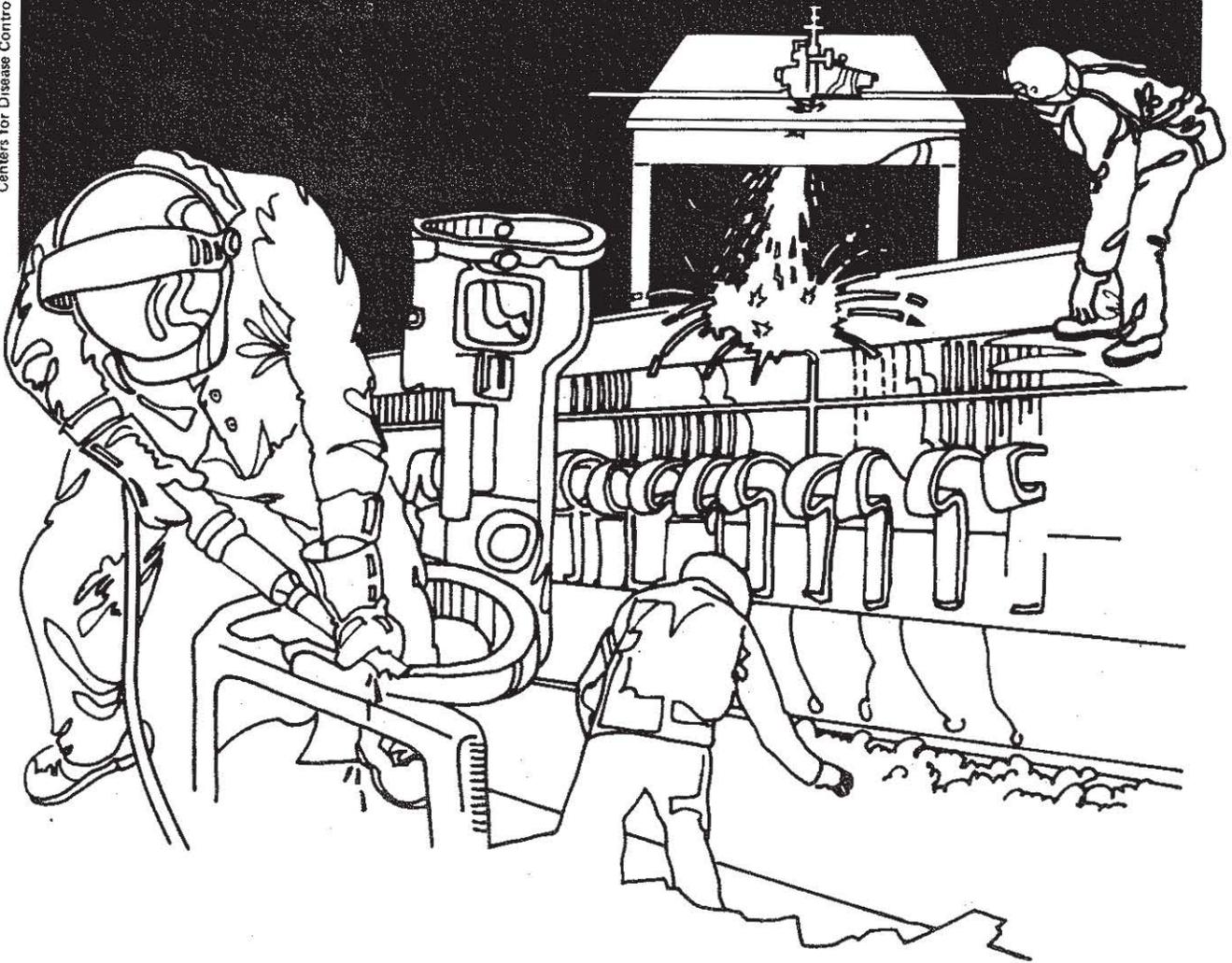


NIOSH



Health Hazard Evaluation Report

HETA 81-135-912
U.S. DEPARTMENT OF TRANSPORTATION
EAST LIBERTY, OHIO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HEITA 81-135-912
July 1981
U.S. Department of Transportation
East Liberty, Ohio

NIOSH INVESTIGATORS:
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I. SUMMARY

On December 29, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate worker exposures to welding emissions, test vehicle exhaust, asbestos from brakelining testing, solvents, and noise at the Department of Transportation (DOT), Vehicle Research and Test Center, East Liberty, Ohio. The NIOSH field investigation on February 3-4, 1981 included environmental sampling, ventilation measurements, and a review of DOT noise level data.

Five air samples in the Inertial Dynamometer Test Area showed non-detectable (ND) concentrations of asbestos fibers. Dust from within the dynamometer cabinet showed minor quantities of small asbestos fibers when analyzed by electron microscopy. Air samples for diesel emissions in Vehicle Preparation Area No. 1 showed total particulates (0.1 and 0.3 mg/M³), benzene solubles (ND), benzo(a)pyrene (ND), chrysene (ND), pyrene (ND and 0.01 ug/M³), benzo(a)anthracene (ND), fluoranthene (ND and 0.03 ug/M³), acrolein (ND), formaldehyde (ND, and <0.05 ppm), and nitrogen dioxide (ND, <0.5, 1.0, and 10 ppm). Air samples for welding emissions in the Fabrication Shop showed iron oxide (0.3 and 0.5 mg/M³), zinc oxide (0.1 and 0.3 mg/M³), total particulates (1.3 and 4.0 mg/M³), and nitrogen dioxide, ozone, and phosgene (ND). Air samples near the parts washer in the Machine Shop showed solvent vapors ranging from 230 to 980 mg/M³. Air samples for gas engine emissions in Vehicle Preparation Area No. 2 showed carbon monoxide ranging from 25 to 120 ppm. Three of 13 DOT noise data were above 85 dBA. The exhaust ventilation system in Preparation Area No. 1 was adequate, the welding table ventilation system was marginal, and the exhaust ventilation system in Preparation Area No. 2 was inadequate.

The survey evaluation criteria for the parts cleaning solvent is 350 ppm, for carbon monoxide is 35 ppm and for noise is 85 dBA. While actual employee exposures to the parts cleaning solvent, carbon monoxide, and noise may not exceed the 8-hour time weighted average criteria, the shorter term levels were significantly high, that potential hazards are judged to exist. For the other contaminants, neither the air levels or employee average exposures, exceeded the survey criteria (10 ppm nitrogen dioxide sample was taken near the vehicle's exhaust).

By comparisons with the survey evaluation criteria, it is concluded that there are potentials for hazardous exposures to parts cleaning solvent, carbon monoxide, and noise at the East Liberty facility. Because exposure times are limited, the actual employee exposures may not be hazardous. Recommendations are included in the text of this report.

KEYWORDS: SIC 8922 (Noncommercial Educational, Scientific, and Research Organizations), asbestos, benzene solubles, polynuclear aromatic hydrocarbons, acrolein, iron oxide, zinc oxide, total particulates, carbon monoxide, nitrogen dioxide, ventilation, petroleum distillate.

II. INTRODUCTION

On December 29, 1980, the Hazard Evaluations and Technical Assistance Branch of NIOSH received a request from the National Highway Traffic Safety Administration, Department of Transportation, to evaluate certain work conditions at the Vehicle Research and Test Center, East Liberty, Ohio. The request concerned exposures to welding emissions, test vehicle exhaust, noise, solvents, and asbestos from brakelining testing. The field investigation was conducted by NIOSH on February 3-4, 1981. The survey included environmental sampling in the Vehicle Preparation Areas, Fabrication Shop, Inertial Dynamometer Test Area, Machine Shop, and Instrument Room. Several NIOSH documents, including the "Recommended (Interim) Procedures for Asbestos Brake and Clutch Servicing" were provided to management.

III. BACKGROUND

The test center (Bldg. 60) is engaged in such vehicle research activities as crash avoidance, crash worthiness, and quick reaction testing. There are about 37 employees (engineers, technicians, administrators) in the 43,000 square foot single-story facility. The various work areas include the Inertial Dynamometer Test Room, Vehicle Preparation Areas 1 and 2, Fabrication Shop, Machine Shop, and the Instrument Shop.

The inertial dynamometer (double ended) is designed to simulate a vehicle's mass for testing vehicle brake assemblies. The system is computer controlled and is equipped with a closed circuit ventilation system which controls air temperatures in the cabinets housing the brake shoes. Two men work in this area, spending most of their time in the control room. They are potentially exposed to asbestos from the brakelining while "setting up" the dynamometer.

Vehicle Preparation Area No. 1 has three drive through bays to process heavy-duty vehicles (straight trucks, tractor trailer units, buses). The area is currently used primarily for maintenance and instrumentation of diesel tractors and related trailers. Occasionally a diesel is idled within the area but this is kept to a minimum. About four diesel tractors leave and re-enter the area each day. An overhead exhaust ventilation system with six flexhose drops is operational. Two of the flexhoses are normally capped. Use of the flexhose drops is required for vehicles with horizontal tail pipes but not required for vehicles with vertical tail pipes. Two 30-inch roof fans may be operated to aid in removing exhaust fumes. Up to 10 men may work in this area and are potentially exposed to diesel exhaust emissions. One person may be exposed to asbestos (brake assembly inspection and rebuilding) but exposures are kept to a minimum by proper work practices and infrequent brake assembly work. Respirators are used when brake assemblies are inspected/rebuilt. An industrial vacuum cleaner is used to remove brake shoe dust.

The Fabrication Shop is a layout and welding area where one man may arc weld intermittently for up to 5 hours per day. A work bench equipped with a local exhaust ventilation system is used for small welding jobs. For large jobs (done on the floor) there is no exhaust ventilation. Potential exposures are welding gases and fumes.

Within the Machine Shop, two parts cleaning tanks are located at the wall separating this area from the Fabrication Shop. Parts are laid on trays in the tanks and a petroleum distillate based solvent is pumped over them. There are no engineering controls. Any vapors dissipate through the shops and Preparation Area No. 1. Although there are weeks of no use, one man may use the tanks for an occasional maximum of 2 hours per day.

In Vehicle Preparation Area No. 2, passenger vehicles are instrumented and otherwise prepared for outside testing. Engine tune-up and vehicle drive train tests necessitate engine operation in this area. Generally one vehicle may idle 1-2 hours per day. A portable 1/2 hp exhaust blower is used to draw exhaust fumes, via a 3" flexhose, from the vehicle's tail pipe to a point just outside the building. Three to four men may work in this area and are potentially exposed to gasoline engine exhaust emissions. These same exhaust emissions may evolve to the adjacent Instrument Shop where several individuals may spend the better part of a work day.

IV. EVALUATION METHODS

On February 3-4, 1981, environmental sampling was conducted in the following areas:

<u>AREA</u>	<u>SUBSTANCES</u>
Inertial Dynamometer	Asbestos
Vehicle Preparation Area 1	Diesel Emissions
Vehicle Preparation Area 2	Carbon Monoxide
Fabrication Shop	Welding Gases and Fumes
Machine Shop	Solvent Vapors
Instrument Shop	Carbon Monoxide

The air sampling and analytical methodologies for the different contaminants are shown in Table 1. Included in Table 1 are, for each substance evaluated, the collection device, the pump flow rate, the range of sample durations, the analysis method, the analytical detection limit, and where applicable, the reference for the detailed sampling and analytical method. Personal air samples are those for which the worker actually wears the air sampler with the collection device pinned to his/her shirt lapel or collar so as to obtain air samples representative of what he/she is breathing. The fixed location samples are obtained by placing the sampling apparatus either in general work areas or in positions thought to have air quality similar to that to which the workers are exposed.

The overhead exhaust ventilation system in Preparation Area No. 1, the welding table ventilation system and the portable exhaust system in Preparation Area No. 2 were evaluated with a heated thermocouple type anemometer and smoke tubes. Also, the respirator program was reviewed and noise data obtained from management.

V. EVALUATION CRITERIA

The environmental evaluation criteria used for this study are presented in Table 2. Listed in Table 2, for each substance, are the recommended

environmental limit, the source of the recommended limit, the principal or primary health effects underlying each recommended limit, and the current OSHA legal standard. For the substances listed on Table 2, only the polynuclear aromatics do not have legal (OSHA) standards. The NIOSH and American Conference of Governmental Industrial Hygienists (ACGIH) recommendations are often lower than the legal standards because they incorporate newer information and are mainly based on health considerations and technical feasibility rather than political-economic factors.

VI. RESULTS - DISCUSSION

A. Inertial Dynamometer Test Area

The air and bulk samples for asbestos (Table 3) in the Inertial Dynamometer Test Area showed non-detectable concentrations of asbestos fibers when analyzed by the phase contrast microscopic technique. When the bulk sample was analyzed by transmission electron microscopy, a small number of chrysotile asbestos fibers were identified. These fibers were less than 0.3 um in diameter and appeared to total less than 2% of the sample. These results suggest that airborne asbestos fibers (if any) generated during the routine operation of the dynamometer, are effectively controlled by the ventilation system. Since the operator neither inspected or changed the brake assemblies during the sampling period, any such asbestos exposures were not included in the air samples. However, considering the bulk sample analysis (no asbestos detected by phase contrast microscopic technique), and the limited number of "dynamometer setups" it is concluded that any asbestos exposures would be minimal.

B. Vehicle Preparation Area No. 1

The general area air samples for total particulates, benzene solubles, polynuclear aromatics (benzo(a)pyrene, chrysene, pyrene, benzo(a)anthracene, fluoranthene) and acrolein; and the indicator tube samples for formaldehyde and nitrogen oxides indicate low or non-detectable (ND) air concentrations (Table 4) as compared to the evaluation criteria. Also, these samples were collected under "worst-case" conditions, that is, two diesels were operated for periods (15-30 minutes) greatly exceeding normal idling times, with the exhaust system not operating. Typically about four diesel tractors would leave and re-enter this area once each day. It is concluded that worker exposures to diesel emissions are not hazardous during normal operating conditions. It should be noted that one indicator tube sample taken near the exhaust of one of the diesels, indicated about 10 ppm of nitrogen dioxide as compared to the NIOSH recommended ceiling of 1.0 ppm for a 15-minute sample. This sample result may indicate a potential for exposure to nitrogen dioxide.

Air flow measurements of the overhead exhaust system indicate flow rates of 360, 400, 580, and 610 cfm when two of the six drops are "capped" and flow rates of 470, 490, and 740 cfm when three of the six drops are "capped". The American Conference of Governmental Industrial Hygienists recommends a minimum of 400 cfm/drop to effectively control diesel exhaust emissions (Figure 1). These results show that "capping" unused "drops" improves the performance of the system and that the system can meet ACGIH recommendations.

C. Fabrication Shop

The personal air samples for iron oxide, zinc oxide, copper, chromium, and total particulates indicated air concentrations of 0.5, 0.1, N.D., N.D., and 4.0 mg/m³, respectively. The general area sample for the same substances indicated air concentrations of 0.3, 0.3, N.D., N.D., and 1.3 mg/m³ respectively. Both data sets (Table 5) show air concentrations below the survey criteria of 5.0, 5.0, 0.2, 1.0, and 5.0 mg/m³ for iron oxide, zinc oxide, copper, chromium, and total particulates respectively. The personal air sample was not taken within the welding helmet of the welder and thus would probably overestimate the total particulates exposure of the welder. Since welding is only done occasionally for up to a maximum of 5 hours per day, there is most likely not a hazardous exposure to the welder while working with plain or galvanized steel. If more toxic materials such as stainless or leaded steel were used, the exposures could become hazardous.

The measured flow rate of the welding table ventilation system was 240 cfm. This flow rate would meet the ACGIH recommendation (Figure 2) where the point of welding is within 6" of a flanged or cone hood. If the point of welding were 12" from the hood, the ACGIH recommendation would call for 1000 cfm (the current ventilation system would not meet this criteria).

D. Machine Shop

The bulk "Tellus 68" solvent sample (98% petroleum distillate) was analyzed by mass spectrometry and found to contain branched chain and cycloalkanes in the C₉ to C₁₀ range. Its initial boiling point was 162 C. The material therefore resembles stoddard solvent. The two air samples (Table 6) simulating the operator's exposure indicated air concentrations of 540 and 550 mg/m³ for the sample periods. Since an operator would use the washer for a maximum of about 2 hours/day, the time-weighted average exposure would be about 135 mg/m³, a value below both the survey criteria of 350 mg/m³ and the legal standard of 2950 mg/m³. Toluene, in low concentrations, was found on the charcoal tube samples but not in the bulk sample. The source is unknown.

E. Vehicle Preparation Area No. 2

During the idling of two gasoline powered vehicles the CO levels were measured with a continuous monitor and detector tubes for about a two hour period (Table 7). Although the CO levels ranged from 25 to 120 ppm, the survey criteria of 35 ppm (8-hour average exposure) would likely not be exceeded because normally only one vehicle is run for perhaps a maximum of one hour per day. Detector tube and continuous monitor measurements for CO in the Instrument Room (adjacent to Vehicle Preparation Area No. 2) showed up to 50 ppm. During the sampling period, the portable exhaust system was connected to both vehicles by means of a "Y" arrangement. Air flow measurements indicated the system to be only pulling about 25-35 cfm per vehicle. Also, smoke tube tests showed the system to provide inadequate control.

On the following day, the exhaust system was improved by removing the "Y" connector and shortening the length of the 3" flex duct to about 45 feet. An air velocity measurement showed the system to be pulling about 60 cfm for one vehicle. Smoke tube tests showed improved performance of the system. Over a one hour period (one car idling and exhausted) CO levels were about 50-60 ppm by detector tube. Over a second four hour period, ambient air levels of CO dropped from about 40 to about 10 ppm (continuous monitor). Carbon monoxide levels in the Instrument Shop were stable at about 10 ppm. These lower CO levels substantiate the improvement of the exhaust system (but just one vehicle can be exhausted). The ACGIH recommends 100 cfm/vehicle (up to 200 hp) and 200 cfm/vehicle (over 200 hp) as shown in Figure I. Therefore, even through the modified exhaust system showed a noticeable improvement, it was not adequate as judged by the ACGIH recommendation.

The finding of CO in the Instrument Room, and smoke tube tests, showed the room to be under negative pressure with respect to the preparation area, and not under positive pressure as desired by management. Consequently, the Instrument Room can be contaminated by Preparation Area No. 2.

F. Department of Transportation Noise Survey

The DOT noise survey for 13 locations indicated noise levels which ranged from 58 dBA to 104 dBA as measured by a General Radio Model 1933 Precision Sound Level meter. Three determinations were above 85 dBA. These were:

1. Machine Shop, Bench Grinder (87 dBA)
2. VP-1, Diesel at heavy rpms (93 dBA)
3. Machine Shop, Portable Grinder (104 dBA)

Of these noise determinations, considering possible exposure times, it is at all likely that only use of the portable grinder would produce exposures in excess of this survey's evaluation criteria. The ACGIH Threshold Limit Value would allow exposure of 0.5 hours/day at 105 dBA, assuming no other exposures above 85 dBA. It is concluded that an employee might use the portable grinder in excess of 1/2 hour/day.

VII. RECOMMENDATIONS

- A. When cleaning the brake housing cabinet of the inertial dynamometer, the shop vacuum cleaner (for asbestos) should be used.
- B. The current practice of using a vacuum cleaner and respirator during wheel pulling and brake inspection procedures should be continued.
- C. If it becomes necessary to run diesel engines for more than a minute or so in Preparation Area No. 1, the present exhaust ventilation system should be modified so that it can be used for trucks with vertical exhaust stacks. Exhaust hoses not being used should be kept "capped".
- D. The point of welding should be kept within 6" of the welding local exhaust hood.

- E. Employees should not use the parts washer for more than 2 hours per day. This should limit exposures to about one-half of the NIOSH recommendation (when using the current solvent).
- F. Employees should use impervious gloves when washing parts. Such gloves should be kept clean and stored in a clean dry place.
- G. Further improvements in the local exhaust ventilation system in Vehicle Preparation Area No. 2 are probably warranted. Modifications should be made in accordance with the design criteria of Figure 1 of this report.
- H. Individuals using the portable grinder in excess of 0.5 hours per day should wear hearing protective devices.
- I. The current "hodge-podge" of respirators should be discarded. NIOSH approved, disposable, respirators should be adequate for use during the infrequent wheel pulling and brake inspections.

VIII. AUTHORSHIP/ACKNOWLEDGEMENT

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IX. DISTRIBUTION/AVAILABILITY OF REPORT

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

This report (copies) has been sent to:

1. U.S. Department of Transportation
2. OSHA, Region V
3. NIOSH, Region V
4. Ohio Department of Industrial Relations
5. Industrial Commission of Ohio
6. Ohio Department of Health

For purposes of informing the "affected employees" the employer shall promptly post for a period of 30 calendar days, this report in a prominent place(s) near where the exposed employees work.

TABLE 1
AIR SAMPLING AND ANALYSIS METHODOLOGY

<u>SUBSTANCE</u>	<u>COLLECTION DEVICE</u>	<u>FLOW RATE (L/min)</u>	<u>DURATION</u>	<u>ANALYSIS</u>	<u>DETECTION LIMIT</u>	<u>REFERENCE</u>
Asbestos	AA Filter	1.5	2 hours	Phase Contrast Microscopy	4500 fibers/filter	NIOSH P&CAM 239
Total Dust	M-5 Filter	1.5	2-7 hours	Electro Balance	0.01 mg	---
Copper	"	1.5	6 hours	Atomic Absorption	2.0 ug	NIOSH P&CAM 173
Chromium	"	1.5	6 hours	"	3.0 ug	"
Iron Oxide	"	1.5	6 hours	"	3.0 ug	"
Zinc Oxide	"	1.5	6 hours	"	2.0 ug	"
Carbon Monoxide	Ecolyzer	0.7*	Direct Reading	Electrochemical	1-2 ppm	Mfg. Data
Benzene Solubles	Glass Fiber Filter Silver Membrane Filter Porus Polymer Tube	1.5	6 hours	Benzene Extraction	0.02 mg/sample	NIOSH P&CAM 217
Polynuclear Aromatics	"	1.5	6 hours	HPLC-UV Detector	10 ng/sample 20 ng/sample (pyrene)	"
Acrolein	Silica Gel Tube	1.5	5 hours	Gas Chromatograph	0.01 mg	Gold's Method**
Solvent Vapors	Charcoal Tube	0.2	4 hours	"	0.01 mg	NIOSH P&CAM 127
Formaldehyde	Indicator Tube	1.6 L Sample	1-3 minutes	Colorimetric	0.5 ppm*	Mfg. Data
Nitrogen Dioxide	"	0.5 L Sample	1-3 minutes	"	0.5 ppm	"
Ozone	"	1.0 L Sample	1-3 minutes	"	0.05 ppm	"
Phosgene	"	2.6 L Sample	4-8 minutes	"	0.04 ppm	"
Carbon Monoxide	"	1.0 L Sample	2-3 minutes	"	5.0 ppm	"

*By manufacturer

**Gold, Dube, and Perni, Analytical Chemistry 50:13, 1978.

TABLE 2
ENVIRONMENTAL EVALUATION CRITERIA

<u>SUBSTANCE</u>	<u>RECOMMENDED ENVIRONMENTAL LIMIT</u>	<u>SOURCE</u>	<u>PRIMARY HEALTH EFFECTS</u>	<u>OSHA STANDARD</u>
Asbestos is a human carcinogen--exposures should be minimized		NIOSH	Asbestosis, Lung Cancer	2.0 fibers/cc
Acrolein	250 ug/m ³	ACGIH*	Irritation, Resp. Disease	250 ug/m ³
Carbon Monoxide	35 ppm	NIOSH	Heart Effects	50 ppm
Copper	0.5 mg/m ³	ACGIH	Lung Fibrosis	1.0 mg/m ³
Chromium	0.2 mg/m ³	ACGIH	Irritation, Nasal Perforation	0.1 mg/m ³
Benzene Solubles	0.1 mg/m ³	NIOSH	Lung, Skin Cancer	0.2 mg/m ³
Formaldehyde is an animal carcinogen - exposures should be minimized				3.0 ppm
Iron Oxide (as iron)	5.0 mg/m ³	ACGIH	Pulmonary Disease	10.0 mg/m ³
Nitrogen Dioxide	1.0 ppm (15 min. ceiling)	NIOSH	Airway Effects	5.0 ppm
Noise	85 dBA	ACGIH	Hearing Loss	90 dBA
Ozone	0.1 ppm	ACGIH	Irritation, Resp. Disease	0.1 ppm
Phosgene	0.1 ppm	NIOSH	Airway Effects	0.1 ppm
Polynuclear Aromatics - Certain PNA's are carcinogenic - exposures should be minimized				
Petroleum Distillates	350 mg/m ³	NIOSH	Irritation, CNS	2000 mg/m ³
Total Particulates	10 mg/m ³	ACGIH	Pulmonary Effects	15.0 mg/m ³
Zinc Oxide/fume	5 mg/m ³	NIOSH	Pulmonary Effects	5.0 mg/m ³

All air concentrations are time weighted average (TWA) exposures for a normal (8 to 10 hour) work day of a 40 hour work week unless otherwise designated.

*American Conference of Governmental Industrial Hygienists. Threshold Limit Values (TLV's) for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1980.

TABLE 3
RESULTS OF AIR SAMPLES FOR ASBESTOS FIBERS
INERTIAL DYNAMOMETER TEST AREA

FEBRUARY 3, 1981 (1:32 p to 3:23 p)

<u>SAMPLE TYPE</u>	<u>LOCATION</u>	<u>ASBESTOS CONCENTRATION</u> <u>(fibers/cc)*</u>
Personal	Operator	Less than 0.02
Fixed Location	Control Room - panel table	Less than 0.02
Fixed Location	Dyn. Room - 2" from brake shoe housing opening	Less than 0.02
Fixed Location	Dyn. Room - 1" from brake shoe housing opening	Less than 0.02
Fixed Location	Dyn. Room - 6' from brake shoe housing opening	Less than 0.02

Survey Criteria - exposures should be minimized
OSHA Standard (8-hour average daily exposure)

2.0

*Fibers greater than 5 microns in length per cubic centimeter of air.

NOTE: An analysis of settled dust from within the dynamometer housing showed no asbestos fibers when analyzed by the standard phase contrast microscopic technique. When analyzed by transmission electron microscopy, a small number of chrysotile asbestos fibers were identified. These fibers were less than 0.3 um in diameter and appeared to total less than 2% of the sample.

TABLE 4

FIXED LOCATION AIR SAMPLE RESULTS FOR DIESEL EMISSIONS
PREPARATION AREA NO. 1.
FEBRUARY 4, 1981

<u>SAMPLE TIME</u>	<u>SAMPLE LOCATION</u>	<u>TOTAL DUST</u>	<u>BENZENE SOLUBLES</u>	<u>BENZO (a) PYRENE</u>	<u>CHRYSENE</u>	<u>PYRENE</u>	<u>BENZO (a) ANTHRACENE</u>	<u>FLUORANTHENE</u>	<u>ACROLEIN</u>
0904-1552	Room Center - Bed of Ford 900	0.3	-	-	-	-	-	-	-
0904-1552	"	-	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	-
1010-1548	Room Center-Work Bench	0.1	-	-	-	-	-	-	-
1012-1548	"	-	N.D.	N.D.	N.D.	0.01	N.D.	N.D.	-
1020-1548	"	-	-	-	-	-	-	-	N.D.
1020-1552	"	-	-	-	-	-	-	-	N.D.
Evaluation Criteria (8-hour average daily exposure)		10	100						250
OSHA Standard (8-hour average daily exposure)		15	200						250

NOTES:

1. Except for total dust (mg/m³), all air concentrations are in ug/m³.
2. N.D. means none detected at laboratory detection limits.
3. Indicator tube sample results (general area samples)

<u>Time</u>	<u>Substance</u>	<u>Concentration (ppm)</u>
1140	Formaldehyde	<0.5
1144	Nitrogen Dioxide (by diesel exhaust)	10.0
1145	Nitrogen Oxides	<1.0
1151	Nitrogen Oxides	1.0
1155	Nitrogen Oxides	<0.5
1157	Nitrogen Oxides	<0.5
1257	Formaldehyde	N.D.
1301	Nitrogen Dioxide	N.D.
1304	Nitrogen Dioxide	N.D.

TABLE 5
RESULTS OF AIR SAMPLES FOR WELDING CONTAMINANTS IN THE FABRICATION SHOP
FEBRUARY 4, 1981

<u>SAMPLE TIMES</u>	<u>SAMPLE DESCRIPTION</u>	<u>AIR CONCENTRATIONS (mg/m³)</u>				
		<u>IRON OXIDE</u>	<u>ZINC OXIDE</u>	<u>COPPER</u>	<u>CHROMIUM</u>	<u>TOTAL PARTICULATES</u>
10:54-1:14	Personal sample on welder	0.5	0.1	ND	ND	4.0
11:00-1:22	Area sample about 6' from welder	0.3	0.3	ND	ND	1.3
<hr/> Survey Criteria (8-hour average daily exposure)		5.0	5.0	0.2	1.0	10.0
OSHA Standard (8-hour average daily exposure)		10.0	5.0	0.1	0.5	15.0

NOTE: Indicator tube sampling between 12:26 and 12:51 revealed non-detectable concentrations of nitrogen dioxide, ozone, and phosgene.

TABLE 6

RESULTS OF FIXED LOCATION AIR SAMPLING FOR SOLVENT VAPORS
AT THE GRAY MILLS MODEL 500-A PARTS WASHER

FEBRUARY 4, 1981

<u>SAMPLE TIME</u>	<u>SAMPLE LOCATION</u>	<u>TOLUENE</u> <u>(ppm)</u>	<u>TOTAL SOLVENT</u> <u>VAPORS (mg/M³)</u>
0740-1157	≈2' above washer, by lid	1.6	980
0744-1157	≈18" above washer, operators position	1.2	540
0752-1157	≈18" above washer, operators position	1.2	550
0815-1157	≈3' to side of washer, 5' above floor	0.7	230
Survey Criteria (up to 10-hour shift average)		100	350
OSHA Standards (8-hour shift average)		200	2950

NOTE: Since no work was scheduled at the parts washer, air samples were collected under simulated conditions. A J-W "SSP" combustible gas detector indicated solvent air concentrations of about 500 mg/M³ (peaks to 2500 mg/M³) in the operator's breathing zone. The J-W "SSP" indicated solvent air concentrations of about 150 mg/M³ (peaks to 500 mg/M³) in the operator's breathing zone at the smaller parts washer (Gray Mills Model PL-32), also under simulated conditions.

TABLE 7

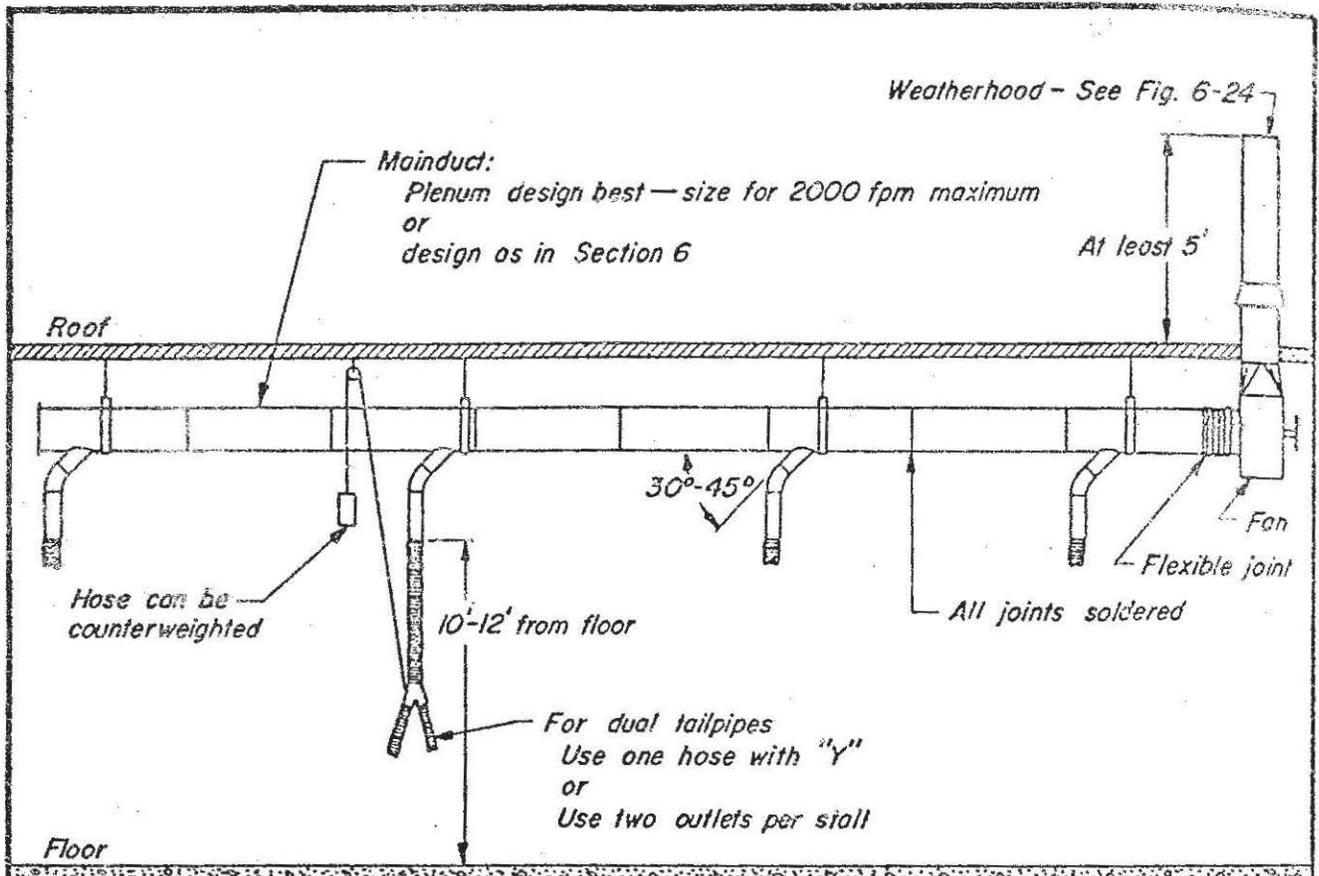
RESULTS OF AIR SAMPLES FOR CARBON MONOXIDE
 PREPARATION AREA NO. 2
 FEBRUARY 3, 1981

<u>TIME</u>	<u>INSTRUMENT</u>	<u>CONDITION</u>	<u>CARBON MONOXIDE (ppm)</u>
1400		Car & Truck Started	-
1406	Ecolyzer		30
1409-1418	Ecolyzer		30
1422	Drager		50
1430	Drager		35
1421-1430	Ecolyzer		30
1430		Car & Truck Shut Down	
1430-1442	Ecolyzer		25-30
1442		Car & Truck Started	
1445	Drager		25
1442-1500	Ecolyzer		20-50
1500-1545	Ecolyzer		60-100
1530	Drager		120
1605	Drager	Instrument Shop	50
Survey Criteria (8-hour average daily exposure)			35
OSHA Standard (8-hour average daily exposure)			50

NOTES:

1. Car was a 350-V8 Chevrolet Pickup
2. Truck was a 351-V8 Ford
3. The portable exhaust system connected to both the car and truck was operating.

FIGURE 1



Vehicle horsepower	cfm/vehicle	Flexible duct diam	Branch connection
Up to 200 hp	100	3"	4"
Over 200 hp	200	4"	4"
Diesel trucks	400	4 1/2"	6"

On dynamometer test rolls

Automobiles and light duty trucks = 2 x cfm above

Heavy duty trucks = 1200 cfm minimum

For friction loss of flexible duct; consult manufacturers' data

See VS-908 for additional details

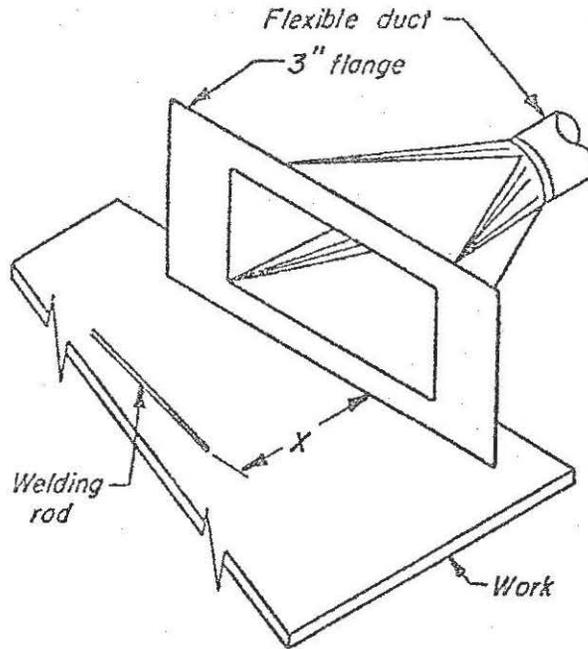
AMERICAN CONFERENCE OF
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SERVICE GARAGE VENTILATION
OVERHEAD

DATE 1-78 VS-907

FIGURE 2

INDUSTRIAL VENTILATION



PORTABLE EXHAUST

<i>X, inches</i>	<i>Plain duct cfm</i>	<i>Flange or cone cfm</i>
<i>up to 6</i>	<i>335</i>	<i>250</i>
<i>6 - 9</i>	<i>755</i>	<i>560</i>
<i>9 - 12</i>	<i>1335</i>	<i>1000</i>

Face velocity = 1500 fpm

Duct velocity = 3000 fpm minimum

Plain duct entry loss = 0.93 duct VP

Flange or cone entry loss = 0.25 duct VP

GENERAL VENTILATION, where local exhaust cannot be used:

<i>Rod, diam</i>	<i>cfm/welder</i>
<i>5/32</i>	<i>1000</i>
<i>3/16</i>	<i>1500</i>
<i>1/4</i>	<i>3500</i>
<i>3/8</i>	<i>4500</i>

OR

- A. For open areas, where welding fume can rise away from the breathing zone:
cfm required = 800 x lb/hour rod used*
- B. For enclosed areas or positions where fume does not readily escape breathing zone:
cfm required = 1600 x lb/hour rod used*

For toxic materials higher airflows are necessary and operator may require respiratory protection equipment.

OTHER TYPES OF HOODS

Bench: See VS-416

Booth: For design See VS-415, VS-604

Q = 100 cfm/sq ft of face opening

"Granite Cutting" VS-909

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WELDING BENCH

DATE 1-78

VS-416.1

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