HEALTH HAZARD EVALUATION REPORT 72-40-52

HAZARD EVALUATION SERVICES BRANCH

DIVISION OF TECHNICAL SERVICES

Establishment	Ford Motor Company Lorain, Ohio
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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

CINCINNATI, OHIO 45202

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FORD MOTOR COMPANY
LORAIN, OHIO
JUNE 1973

I. SUMMARY DETERMINATION

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 an authorized representative of employees regarding exposure to substances used at the Ford Motor Company, Lorain, Ohio.

The substances used or found in the workplace with potentially toxic properties are listed below with their respective exposure standards as promulgated by the U.S. Department of Labor (Federal Register, Volume 37, 1910.93, October 18, 1972).

SUBSTANCE	STANDARD CONCENTRATION *
Acetone	1000 ppm**
Carbon Monoxide	50
Methyl Chloroform	350
Mineral Spirits	500
Toluene	200
Xylene	100

INERT or NUISANCE DUST	RESPIRABLE FRACTION mg/M³***	TOTAL DUST mg/M³
Paint Dust	5	15
Synthetic & Cleaned Cotton Fibers	5	15
Fiberglass	5	15

* Eight Hour time-weighted average
** ppm - Parts of vapor or gas per million parts of contaminated air at 25°C and 760 mm Hg pressure
*** Milligrams of substance per cubic meter of air

An investigation was conducted on August 15, and October 17-19, 1972, by NIOSH personnel. It has been determined as a result of that investigation, that approximately 40 employees (20 per shift) at the end of the passenger assembly line, and the passenger roll test area are exposed to potentially toxic concentrations of carbon monoxide. This conclusion is based on the following pertinent information: 1. out of the 12 sampling locations in these areas, the average carbon monoxide concentrations were 42 ppm and higher, three were 50 ppm and higher, and one; the area between the final assembly line and the toe-in adjustment pit, was 100 ppm. 2. the recent NIOSH Criteria Document for Occupational Exposure to Carbon Monoxide recommends that the eight hour time-weighted average standard be lowered to 35 ppm and 3. the existing federal standard for carbon monoxide is 50 ppm.

Nuisance dust levels were measured at four locations. The time-weighted average dust levels where the synthetic and cotton pads are installed in the Econoline van roof were: "total dust" 1.2 mg/M^3, and "respirable dust" 0.13 mg/M^3; where the pads are installed under the dash board of the passenger cars they were: "total dust" 2.3 mg/M^3, and "respirable dust" 0.12 mg/M^3 which indicates that the majority of the dust particles in this area are not respirable; and in the paint refinishing area, they were: "total dust" 1.5 mg/M^3, and "respirable dust" 0.27 mg/M^3. It is judged that the dusts are not toxic at the concentration found as all the respirable dust values and all but one of the total dust samples were less that 20% of the existing federal standards.

Solvent vapors, measured at five locations, are judged not to be toxic at the concentration found. The basis for this judgement is: 1. combined acetone and toluene levels at the vinyl top installation area were less than 10% of the standard 2. combined mineral spirit and toluene levels where insulation pads are installed in the roof and the van sides were less than 10% of the standard and 3. the methyl chloroform concentration where the door and trunk hinges are sprayed with grease was 11% of the standard and 4. the combined solvent (toluene, xylene, acetone, methyl ethyl ketone, and isobutyl ketone) concentration in the econoline paint repair booth could not be calculated as the amount and type of painting varies on each van, and the flow of units through the booth is not constant.

Recommendations have been suggested to management to alleviate the potentially hazardous conditions observed in this evaluation.

Copies of the Summary Determination of the evaluation are available upon request from the Hazard Evaluation Services Branch, NIOSH, U. S. Post Office Building, Room 508, Fifth and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a. Ford Motor Company, Lorain, Ohio
b. Authorized Representative of Employees
c. U.S. Department of Labor, Region V

For purposes of informing the approximately 40 affected employees (20 per shift), the employer will promptly "post" the Summary Determination in a prominent place(s) near where affected employees work for a period of 30 calendar days.

II 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 concentration as used or found.

The National Institute for Occupational Safety and Health received such a request from an authorized representative of employees of the Ford Motor Company at Lorain, Ohio.

The Ford Motor Company in Lorain, Ohio assembles automobiles and Econoline vans.

III BACKGROUND HAZARD INFORMATION

A. Standards

The Occupational Health Standards as promulgated by the U.S. Department of Labor (Federal Register, Part II, Section 1910.93, Tables G-1, 2&3) applicable to substancesof this evaluation are as follows:

SUBSTANCE	STANDARD CONCENTRATION*
Acetone	1000 ppm**
Carbon Monoxide	50
Methyl Chloroform	350
Mineral Spirits	500
Toluene	200
Xylene	100

INERT OR NUISANCE DUST	RESPIRABLE FRACTION mg/M3***	TOTAL DUST mg/M3
Paint Dust	5	15
Synthetic & Cleaned Cotton Fibers	5	15
Fiberglass	5	15

* Eight hour time-weighted average
** ppm - Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm Hg pressure
*** Milligrams of substance per cubic meter of air

B. Toxic Effects

Acetone: Reports of poisonings due to repeated exposures have usually involved a solvent consisting of acetone in combination with other materials.(1) Chronic respiratory tract irritation and dizziness have been reported in workers exposed to levels of 1000 ppm for an average of three hours per day.(2) Acetone is a mild skin irritant due to its defatting property.(3) Long-term studies have shown that acetone has no significant chronic effects in concentrations averaging 2000 ppm, and with the paucity of reported illness due to this chemical, the standard was set at 1000 ppm.(4)

Carbon Monoxide: The toxicity of carbon monoxide (CO) is related to its affinity for the hemoglobin molecule of blood. CO will combine with hemoglobin, which normally carries oxygen to the body tissues, to form a compound called carboxyhemoglobin (COHb). In the normal situation, the blood contains only oxyhemoglobin. The amount of COHb in the blood is proportional to CO exposure levels. The first noticeable effects occur when COHb saturation reaches 10 to 20 percent and acute effects result from oxygen deprivation to vital organs (i.e., asphyxia).

The most common source of CO in the ambient atmosphere is generated by the emissions from the gasoline-powered, internal combustion engine. However, CO will be produced during the incomplete burning of any carbonaceous matter. Thus, cigarette smoking individuals may run levels of COHb from 2 to 10 percent without any other source of exposure. There is a normal background level of COHb which is approximately one percent. This is due to atmospheric contaminants and it is found in the blood of non-smokers.

The present standard of 50 ppm for an eight hour time-weighted exposure was set by the American Conference of Governmental Hygienists on the basis that this level of CO will result in COHb concentrations between 8 and 10 percent (which should not produce worker discomfort). This standard does not take the long-term effects into account, nor does it address the fact that individuals who smoke will have higher levels of COHb and any workers with pre-existing arteriosclerotic cardiovacular disease (ASCVD) and may be placed at serious risk. For these reasons, the recent "Criteria Document" on carbon monoxide that has been formulated by the National Institute for Occupational Safety and Health, recommends lowering the TLV to 35 ppm. Yet, they still warn that this level may not protect employees with known cardiovascular disease.(5)

1,1,1 - Trichloroethane (Methyl Chloroform): Chronic exposures to concentrations that are without acute effects are unlikely to produce injury. 1, 1, 1 - trichloroethane is readily absorbed and excreted through the lungs. In acute exposure the most important toxic action is a functional depression of the central nervous system leading ultimately to respiratory failure. In controlled human exposures to 500 ppm no effects other than slight, transient eye irritation were noted, but at 1000 ppm and above, mild eye irritation was experienced by all subjects, and some became dizzy.

B. Toxic Effects (continued)

As with most solvents, dermatitis might result from repeated skin contact. 1, 1, 1-trichloroethane is only poorly absorbed through the skin. Eye contact may result in pain and discomfort, but no impairment of vision is likely (6).

Mineral Spirits: (stoddard solvent, varsol and numerous other synonyms) This compound is approximately 85 percent aliphatic hydrocarbon derivatives and its toxic effects relate to the longer chain members. At concentrations of greater than 500 ppm, symptoms of intoxication first appear and loss of appetite, nausea, and a gasoline taste in the mouth may be present. Mineral spirits are quite similar to stoddard solvent except for a slight variation in the boiling point, and the toxic effects are essentially the same. (7) While there has been no standard set for mineral spirits, the standard for stoddard solvent has been set on the basis of known effects for the C7 - C9 derivatives in the compound.(8)

Toluene: Toluene is well known for its narcotic effects. "Controlled exposures of human beings to concentrations of 50 to 80 ppm indicates that exposure to a concentration of 200 ppm for a period of eight hours produces mild fatigue, weakness, confusion and paresthesian of the skin. The fatigue persisted for hours and moderate insomnia and restlessness resulted. The same symptoms were more pronounced with 300 ppm. With 400 ppm, mental confusion was added to the list of symptoms. With 600 ppm extreme fatigue, mental confusion, exhilaration, nausea, headache, and dizziness resulted by the end of three hours. After eight hours, the mental confusion, weakness, dizziness, and nausea were pronounced." "Exposures to 50 to 100 ppm failed to present distinct symptoms or after effects."

Xylene: Toxicity of xylene is similar to Toluene, although it is more pronounced(10) with symptoms including headache, fatigue, lassitude, anorexia, and flatulene.(11) The standard of 100 ppm, is recommended to prevent irritant and narcotic effects. It is believed that no significant chronic injuries will result from continued occupational exposure at this level.(12)

Fiberglass Dust (also Fibrous Glass Dust): The only well accepted effects of this material are those of upper respiratory tract irritation(13), eye and skin irritation(15). In California, during the period extending from January 1960 to June 1962, 691 cases of occupational disease were attributed to fibrous glass exposure. Of these, 38 were primarily problems of respiratory tract irritation and the remainder involved the effects of fibrous glass on the skin and eyes. The most commonly reported respiratory problems attributed to this exposure were bronchitis, pharyngitis, rhinitis, asthma, laryngitis, sinusitis, and in one case, nosebleed. Skin exposure is uslually manifest by pruritis to which the exposed individuals usually develop a tolerance and eye effects which are usually limited to a mild conjunctivital irritation. To date, many investigators have examined humans and animals exposed to fibrous glass for evidence of pulmonary lesions.(15, 16,17) All evidence tends to place this dust in an inert category.

B. Toxic Effects (continued)

Inert or Nuisance Dust (paint dust, synthetic and cleaned cotton fibers are considered nuisance dusts): Nuisance dusts have little adverse effects on the lungs and do not produce significant disease or toxicity when exposures are kept under reasonable control.(18) These dusts are biologically inert and when inhaled the architecture of the alveoli remains intact, little or no scar tissue is formed, and any reaction provoked is potentially reversible. Excessive concentrations in workroom air may reduce visibility, and cause unpleasant accumulations in the eyes, ears, or nose and secondarily cause injury to skin and mucous membranes by chemical or mechanical action, or by the vigorous cleansing procedures necessary for their removal.

IV HEALTH HAZARD EVALUATION

A. Initial visit - Observational Survey

An initial hazard evaluation survey of the Ford Motor Company at Lorain, Ohio was made on August 15, 1972, by NIOSH representative Arvin G. Apol. The function of the National Institute for Occupational Safety and Health and its relation to Section 20(a)(6) of the Occupational Safety and Health Act of 1970. The purpose of the visit was explained to Messrs. Charles Hancock, Plant Manager; Paul Toth, Industrial Hygienist; and John Kostyo, Safety Supervisor.

A walk through survey of the ten areas in the request was made. The following persons were present on this survey: Messrs. Tony Potino, Safety Representative and Vice-President of UAW Local 425; Ed Siefert, Acting President and District Committeeman, UAW Local 425; Paul Toth, Industrial Hygienist with Ford Motor Company; John Kostyo, Safety Supervisor of Ford Motor Company; and Charles Minnich, Safety Engineer with Ford Motor Company.

The ten areas of concern are:

1. Spraying glue on vinyl tops COL U-13

   An adhesive containing acetone and toluene is sprayed on both the back side of the vinyl fabric and top of the car. The vinyl fabric is then installed on the car. Dilution ventilation is used in this area.

2. Installation of pads in Econoline roofs COL M-11

   Insulation pads composed of synthetic and cotton fibers are sprayed with water emulsified adhesive containing mineral spirits and

toluene. The pads are then installed into the roof of the vans. Dilution ventilation is used in this area.

3. Installation of pads under the dash board COL W-7

   Insulation pads composed of synthetic and cotton fibers are clipped in place under the dash board before the dash board is installed in the car. The radio speaker punchout portion is removed at this point.

4. Installation of pads on the inside of econoline vans COL G-13

   Insulation pads composed of fiberglass are installed in the inside of the van after the van has been sprayed with a water emulsified adhesive containing mineral spirits and toluene. Dilution ventilation is used in this area.

5. Spraying grease on door and trunk hinges COL AA-8

   A grease containing methyl chloroform is sprayed on the door and trunk hinges.

6. Econoline spray paint booth

   A portion of the outside and inside of the econoline vans is painted in this booth. The paint contains toluene, xylene, and small amounts of acetone, methyl ethyl ketone, and methyl isobutyl ketone. The downdraft ventilation works well when painting is conducted outside the van, however, it has little affect when painting inside the van.

7. Paint refinishing line COL H-1 and H-2

   After final assembly, some vehicles require additional painting and touch-up. The areas to be repainted are sanded and the baked paint dust is blown off the car with an air hose.

8. Passenger assembly line toe-in and headlight adjust COL P-5 and P-6

   Cars are started at the end of the assembly line and are driven to the toe-in and headlight adjust machines which are located about forty feet away. The engines are left idling during these adjustments and the vehicles are then driven to the passenger roll test area. The employees in this area are exposed to auto exhaust fumes. Dilution ventilation and down draft local exhaust are used.

9. Roll test of passenger cars COL M-4

   Passenger cars are driven to the roll test area where they are roll tested at various speeds under their own power. Local exhaust systems are used during the roll test and dilution ventilation is used when the cars are driven on and off the roll test station.

IV EVALUATION (continued)

10. Commercial assembly line toe-in adjust and roll test COL L-5

The vans are driven on the toe-in adjust machine and the engines are turned off. Following the toe-in adjustment, they are started and driven to the roll test where they are shut off and roll tested using a mechanical power source to spin the rear wheels. They are then driven off the roll test machine and out of the area. Dilution ventilation is used in this area.

B. Environmental Evaluation

Environmental sampling was conducted on October 17th and 19th by NIOSH Representatives Arvin G. Apol and Richard Kramkowski.

1. Sampling Methods and Procedure

a. Dust Samples

Employee exposure to total and respirable airborne dusts were measured using personal air sampling equipment which sampled air in the close proximity of the employees' breathing zone. MSA model G vacuum pumps were used to draw air through Millipore Cassettes fitted with analytically pre-weighed, 37 mm, millipore type AA 0.8u cellulose membrane filters. Air sampling rates were maintained at 1.8 liters per minute. The respirable dust samples were drawn through an MSA cyclone assembly, before passing through the filter. The filters were then analytically conditioned and re-weighed.

b. Solvent vapors

Employees exposure to solvent vapors were measured using personal air sampling equipment which sampled air in the close proximity of the employee's breathing zones. MSA model G vacuum pumps were used to draw air thru MSA charcoal sampling tubes at a flow rate of 0.8 to 1.0 liters per minute (each lot of charcoal tubes received is statistically sampled and subsequently checked for absorptive characteristics). These tubes were sent to the NIOSH laboratory located in Salt Lake City, Utah, where they were analyzed by gas chromatographic techniques. (Each charcoal tube vapor sample is desorbed in carbon disulfide and injected into a gas chromatograph for qualitative and quantitative analysis).

c. Carbon Monoxide

Employee exposure to carbon monoxide was measured using an MSA model D carbon monoxide indicator. The results were recorded on a continuous operating strip chart recorder. The unit was

IV EVALUATION (continued)

calibrated before and after sampling with a series of carbon monoxide gases standardized using infrared techniques.

2. Survey Results

a. Dusts

The eight hour time weighted-average (TWA) dust levels are presented in Table 1, Section VIII. The TWA dust levels where the synthetic and cotton pads are installed in the Econoline van roof were; "total dust" 1.2 mg/M^3, and "respirable dust" 0.13 mg/M^3; where the pads are installed under the dash board of the passenger cars, they were: "total dust" 2.3 mg/M^3, and "respirable dust" 0.15 mg/M3; where the fiberglass insulation pads are installed in the vans, they were: "total dust" 10.9 mg/M^3, and "respirable dust" 0.12 mg/M^3, which indicates that the majority of the dust particules in this area are not respirable; and in the paint refinishing area, they were: "total dust" 1.5 mg/M^3, and "respirable dust" 0.27 mg/M^3.

There was an accumulation of dust and lint from the insulation pads on the fans, beams, etc., in the areas where they were handled.

b. Solvent Vapors

Calculated TWA exposures to solvent vapors are presented in Table II, Section VIII. In all but one area sampled, there were two or more different solvent vapors present. When two or more hazardous substances are present that have similar health effects, their combined effect rather than that of either individually, should be considered. This criteria was applied to all the solvent samples collected.

Vinyl top installation: The TWA solvent exposure for three job classifications in the vinyl top installation area were all less than 10% of the combined acetone-toluene standard. The acetone concentration ranged from 54 to 91 ppm, and the toluene from 3 to 4 ppm.

Spraying glue and installing insulation pads: The exposure to mineral spirits and toluene in these areas was less than 6% of the combined standard. The toluene concentrations were from 1 to 6 ppm, and the mineral spirit from 1 to 11 ppm.

Spraying grease on the door and trunk hinges: The TWA exposure to the methyl chloroform used in this job was 39 ppm, which is 11% of the existing federal standard.

Econoline paint repair booth: The amount and type of painting on each van varies so an eight hour time-weighted exposure was

IV EVALUATION (continued)

B. Environmental Evaluation (continued)

not able to be determined. When painting inside the van, the combined solvent exposure will appraoch the standard and when painting outside the van, the exposure is approximately 10% of the standard. It would be a good practice for the painter to wear an approved respirator, for use with paint vapor and mists, when painting inside the van, as this is when the paint exposure is highest.

c. Carbon monoxide in passenger assembly line and toe-in adjust: The carbon monoxide level measurements are listed in Table III, Section VIII. The average carbon monoxide concentration at six of the seven different sampling locations in this area ranged from 35 to 80 ppm (individual samples ranged from 70 to 90 ppm). One sampling location, the area vetween the assembly line and the toe-in adjust machine averaged 100 ppm (individual samples ranged from 70 to 140 ppm). No one works full time in the latter area, however, the driver drives thru this area 60 times per hour and walks thru it another 60 times per hour. The remainder of time he is at the end of the assembly line where the average was 43 ppm. The ventilation systems were worked on (e.g., belts adjusted, dusts cleaned) by maintenance 10/18/72. The carbon monoxide levels were lower on 10/19/72. This was probably due to maintenance performed on the ventilation system the day before. Carbon monoxide was found in the air being supplied to the toe-in pits.

Passenger roll test area: The average carbon monoxide levels at four different locations in the area were 42 to 64 ppm. (Individual samples ranged from 30 to 80 ppm). The ventilation systems were worked on by maintnenance on 10/18/72. The ducts were cleaned, belts adjusted, and the fan speed increased. Generally, the levels were lower on the 19th after the ventilation system had been worked on.

Commercial toe-in adjust and roll test area: The average carbon monoxide levels at four different locations in the area were 22 to 35 ppm. (Individual samples ranged from 20 to 35 ppm) which are below existing standards. Carbon monoxide was found in the air being supplied to the toe-in pit.

V CONCLUSIONS

The results of the investigation indicates that approximately 40 employees (20 per shift) at the end of the passenger assembly line and the passenger roll test area are exposed to potentially toxic concentrations of carbon monoxide. At 9 of the 12 sampling locations in these areas, the

IV EVALUATION (continued)

B. Environmental Evaluation (continued)

not able to be determined. When painting inside the van, the combined solvent exposure will appraoch the standard and when painting outside the van, the exposure is approximately 10% of the standard. It would be a good practice for the painter to wear an approved respirator, for use with paint vapor and mists, when painting inside the van, as this is when the paint exposure is highest.

c. Carbon monoxide in passenger assembly line and toe-in adjust: The carbon monoxide level measurements are listed in Table III, Section VIII. The average carbon monoxide concentration at six of the seven different sampling locations in this area ranged from 35 to 80 ppm (individual samples ranged from 70 to 90 ppm). One sampling location, the area vetween the assembly line and the toe-in adjust machine averaged 100 ppm (individual samples ranged from 70 to 140 ppm). No one works full time in the latter area, however, the driver drives thru this area 60 times per hour and walks thru it another 60 times per hour. The remainder of time he is at the end of the assembly line where the average was 43 ppm. The ventilation systems were worked on (e.g., belts adjusted, dusts cleaned) by maintenance 10/18/72. The carbon monoxide levels were lower on 10/19/72. This was probably due to maintenance performed on the ventilation system the day before. Carbon monoxide was found in the air being supplied to the toe-in pits.

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Commercial toe-in adjust and roll test area: The average carbon monoxide levels at four different locations in the area were 22 to 35 ppm. (Individual samples ranged from 20 to 35 ppm) which are below existing standards. Carbon monoxide was found in the air being supplied to the toe-in pit.

V CONCLUSIONS

The results of the investigation indicates that approximately 40 employees (20 per shift) at the end of the passenger assembly line and the passenger roll test area are exposed to potentially toxic concentrations of carbon monoxide. At 9 of the 12 sampling locations in these areas, the

V CONCLUSIONS (continued)

average carbon monoxide concentrations were 42 ppm or higher, three were 50 ppm and higher, and one was 100 ppm. The recent NIOSH Criteria Document for Carbon Monoxide recommends that the eight hour time-weighted average standard be lowered to 35 ppm.

All the nuisance dust levels measured, except one, were 20% or less than the existing federal standard. Skin and upper respiratory tract irritation can occur at the levels measured due to the fact that the dusts contain fibers which, by mechanical action, could cause an itch or irritation.

It is judged that the substances; acetone, toluene, xylene, mineral spirits and methyl chloroform are not toxic in the concentrations measured in the workers environment. This is based on the fact that the individual solvent concentration and or the combined solvent exposures (where two or more solvents were present) were approximately 10% or less than the existing standard.

VI RECOMMENDATIONS

1. Downdraft local exhaust ventilation is installed behind the toe-in station and along the sides of the assembly line. The exhaust systems ends about 20 ft. from the end of the assembly line and is not effective since the cars are usually started beyond this point. The exhaust by the toe-in adjustment is about 8 ft. behind where the car is during the toe-in adjustment. In this location, it does not appear to capture the exhaust as it leaves the vehicle. Additional local exhaust ventilation, installed at both of these locations (a lateral exhaust system might be preferred to a down draft system) would place the auto exhaust under the influence of the local exhaust system during a large percentage of time that the engine is running in this area. This should reduce the average concentration of carbon monoxide.

2. Dilution ventilation is used as a control at the end of the passenger assembly line area, the passenger roll test area, and the commercial assembly and roll test area. All the air used for dilution should be fresh, tempered air.

3. Fresh, tempered make up air should be supplied to the toe-in pits in both the passenger and commercial assembly lines. During the sampling period, carbon monoxide was present in the air being supplied to the pits.

4. The station wagons have their exhaust pipe coming out the side, just behind thre rear wheels. During the roll test, a baffle is used to stop the lateral force of the exhaust and direct it to the ventilation system. One can visually see that the capture at this point is not adequate. The local exhaust system on the roll test could be modified to capture the exhaust gases from the station wagons.

5. An improved housekeeping program should be initiated where insulation pads are installed under the dash of passenger cars and where pads are sprayed

VI RECOMMENDATIONS (continued)

and installed in the econoline vans, as lint and dust from these pads is collecting on the fans, beams, etc., and can become airborne again.

6. It is good practice for the painters to wear an approved respirator (Federal Register Part II, Section 1910, 132 and 134) for use with paint vapor and mists when painting inside the vans as the highest exposure levels will occur during this operation.

7. Provide a maintenance program that will insure that the ventilation systems used to control vapors, mists, and gases are operating at designed capacities.

8. Environmental monitoring should be conducted at the areas where employees are significantly exposed to carbon monoxide. Blood analysis for carboxyhemoglobin should be performed on persons exposed in these work areas as biologic samples are useful in evaluating exposures to carbon monoxide.

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VIII TABLES

TABLE I
ATMOSPHERIC EXPOSURES TO DUSTS
(BREATHING ZONE DUST CONCENTRATIONS)

	OPERATION & LOCATION	TWA** RESPIRABLE DUST mg/M3*	TWA TOTAL DUST mg/M3
1.	Installing synthetic and cotton pads in econoline van roof COL M-11	0.13	1.2
2.	Installing synthetic & cotton pads under the passenger car dash boards COL W-7	0.15	2.3
3.	Inside fenced-in room by dash pad installation COL W-7	----	0.23
4.	Installing fiberglass pad inside of vans COL G-13	0.12	10.9
5.	Paint refinishing COL H-1 and H-2 paint sanders and blow off man.	0.27	1.3

* Milligrams per cubic meter of air
** TWA - 8 hour time-weighted average

TABLE II
ATMOSPHERIC EXPOSURES TO
SOLVENT VAPORS

LOCATION	CONTAMINANT	TWA* CONCENTRATION PPM**
1. Vinyl top installation COL U-13		
a. Spraying glue on top of car	Acetone	54
	Toluene	3
b. Spraying glue on back of vinyl fabric	Acetone	89
	Toluene	3
c. Placement of vinyl fabric on car top	Acetone	91
	Toluene	4
2. Spraying glue on pads and installing in van roof COL M-11	Mineral Spirits	6
	Toluene	11
3. Spraying glue inside econoline van COL G-13	Mineral Spirits	1
	Toluene	1
4. Spraying grease on door & trunk hinges COL AA-8	Methyl Chloroform	39
5. Econoline spray paint booth 2nd floor		
a. Painting inside & outside of van (Painting is done on the inside of the van on an irregular basis so these levels do not represent time-weighted averages but are indicative of the exposure level during this operation only)	Toluene	18
	Xylene	88
	Acetone, Methyl Ethyl Ketone, Methyl Isobutyl Ketone	< 10
b. Painting outside of van	Toluene	8
	Xylene	3
	Acetone, Methyl Ethyl Ketone, Methyl Isobutyl Ketone	< 10

*TWA - 8 hours time-weighted average
**PPM - parts of vapor per million parts of contaminated air at 70°C and 760 mm Hg pressure

TABLE III
ATMOSPHERIC EXPOSURES TO
CARBON MONOXIDE

LOCATION	TOTAL SAMPLE TIME OVER 3 DAYS (MIN)	CARBON MONOXIDE PPM
A. Passenger assembly line toe-in & headlight adjust COL P-5 to P-6		
1. 20 ft. from end of assembly line on left side (occasionally an employee works a few minutes here)(driver starts car here and drives it to the toe-in area)	44	43
2. 20 ft. from end of assembly line, right side (one or two employees work here)	42	50
3. 40 ft. from end of assembly line, right side (employees work in this area)	9	35
4. Halfway between end of assembly line and toe-in adjust. (One employee passes back and forth thru this area 60 times/hour)	45	100
5. Left headlight adjust (One employee per shift)	39	37
6. Right headlight adjust (One employee per shift)	29	45
7. Passenger toe-in pit (One employee per shift)	15	35

TABLE III (continued)

LOCATION	TOTAL SAMPLE TIME OVER 3 DAYS (MIN)	CARBON MONOXIDE PPM
B. Passenger roll test COL M-4 (6-8 employees per shift)		
1. Roll test-rear between test station 1 & 2	34	64
2. Roll test-rear between test station 2 & 3	71	45
3. Roll test by front fender, between test station 2 & 3	35	42
4. Repair area 15ft. west of #3, roll test station	33	42
C. Commercial assembly line toe-in adjust and roll test COL L-5 (4-6 employees per shift)		
1. Left front fender by roll test (engine is off during roll test)	16	25
2. 20ft. from right side of roll test station	32	35
3. Toe-in pit	31	25
4. Right headlight adjust	51	22