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PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
Report No. HE 78-18,19,20,67-592

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
CONNERSVILLE, INDIANA

MAY 1979

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at the Ford Aerospace and Communications Corporation, Connersville, Indiana in response to four separate requests from the President, Local 919, International Union of Electrical Workers (IUE). Based on the results of atmospheric sampling conducted during the initial and follow-up surveys by NIOSH investigators on March 6-8, 1978, and September 26 and 27, 1978, it has been determined that:

1. Under normal operating conditions, with all general ventilation and local exhaust systems operating, condenser assembly line worker and degreaser operator exposures to trichloroethylene and carbon monoxide did not exceed exposure limits established by NIOSH as the evaluation criteria. The oil smoke, visible throughout the plant, was sampled and analyzed. Major components identified were trichloroethylene, toluene, xylene, and a series of hydrocarbons, mostly C_{10}-C_{12} alkanes. Results from personal atmospheric samples indicate that exposures to toluene, xylene, and alkanes are not significant.

2. The worker's exposure to methanol in the flux mixing room was below acceptable limits.

3. The dust emissions from vacuum brazing ovens contain magnesium oxide. Exposures to aluminum oxide were below the detectable limits of the sampling and analytical method. Under normal operation of the vacuum brazing ovens, dust emissions were below the evaluation criteria for nuisance dusts or magnesium oxide fume.

4. Results from air samples taken during a paint burn-off and stripping operation, and also near a condenser line dehydration oven were negative for the polynuclear aromatic hydrocarbons (PNA's): fluoranthene, pyrene, benzo(a)anthracene, chrysene, and benzo(a)pyrene.

   Personal and area samples were taken during a paint burn-off and stripping operation and analyzed for methylene chloride, trichloroethylene, toluene, xylene, total alkanes (C_{10}-C_{12}), total particulates, magnesium oxide (as magnesium), chromium, aluminum oxide (as aluminum), and chromium VI (hexavalent chromium). The sampling results indicate that the atmospheric concentrations of these substances are below the established NIOSH evaluation criteria or are below the detectable limits of the sampling and analytical methods used.

Recommendations have been offered in this report for continuous and periodic environmental monitoring of trichloroethylene vapor levels and carbon monoxide levels, and for controlling dust emissions during controlled burn-out of Ipsen vacuum brazing ovens.

II. DISTRIBUTION AND AVAILABILITY

Copies of this Determination 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 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) Ford Aerospace and Communications Corp., Connersville, Indiana
b) Authorized Representative of Employees
c) International Union of Electrical Workers, Washington, D.C.
d) U.S. Department of Labor - Region V
e) NIOSH - Region V

For the purpose of informing the approximately 750 "affected employees", the employer will promptly "post" the Determination Report for a period of thirty (30) calendar days in a prominent place(s) near where the affected 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 toxid effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such requests from an authorized representative of employees - International Union of Electrical Workers (I.U.E.), Local 919. The requestor had asked NIOSH to investigate complaints of throat and eye irritation from workers on the condenser assembly lines, who were exposed to excessive smoke and carbon monoxide (HE 78-18); complaints of excessive dust and smoke discharged directly into the work area from the Ipsen brazing ovens during controlled burn-outs (HE 78-19); solder flux (zinc chloride and methanol) fumes and mist from condenser line brazing ovens (HE 78-20); and the Paint Burn-Off Operator's exposure to dust and smoke when stripping and burning paint buildup from conveyer racks and hooks (HE 78-67).

IV. HEALTH HAZARD EVALUATION

A. Process Description - Conditions of Use

Ford Aerospace and Communications Corporation, at Connersville, Indiana, manufactures air conditioner components for Ford automobiles. The areas investigated in this survey were the: (1) condenser assembly lines, (2) evaporater vacuum brazing ovens, (3) flux mixing room, and (4) paint rack burn-off and stripping operation.

Approximately 244 condenser units are assembled on each of four production lines (north, south, center, and 4th automotive). Although each line produces a different type and size condenser, the assembly process for each line is the same. A 300 stroke per minute punch press manufactures the condenser fins which are stacked and laced with hairpin shaped tubes. The ends of the tubes are then flanged, and the assembly is placed on a conveyer and sent through a degreaser to remove the oils which coat the fins and tubes. After degreasing, the condenser tube openings are coupled together with U tubes. Solder rings are placed on the U tubes prior to installation. Flux is applied and the condenser assemblies are sent through a brazing oven. The liquid flux is pre-mixed in a special room. The flux is 70% zinc chloride flux and 30% methanol. The flux is brushed on, and workers wear protective gloves. After brazing, the condensers are sent through an external water wash, additional parts are installed, and the condensers are washed again both externally and internally. The condensers are then charged with air to 150 PSI and sent through a dunk tank and checked for leaks. The air pressure is then released and the condensers are dried, inside and out, in the dehydration oven (360°F). After drying, the condensers are painted and prepared for final assembly and shipping. Condenser line workers complained of smoke from the dehydration ovens which they believe was caused by drying condensers that were not properly degreased. Several women reported frequent mechanical breakdown and "overspills" from the degreasers, which had resulted in their being exposed to high concentrations of trichloroethylene.

Vacuum brazing ovens are used for the manufacture of evaporators. The evaporators are assembled in a clean room and loaded on conveyors and sent to one of seven brazing ovens. The evaporators are loaded onto special racks and sent through the oven. Brazing is accomplished under vacuum at 10^{-3} atmospheres. During normal operations the air quality around the vacuum brazing ovens was good. Employees were complaining that when the ovens were down for maintenance and cleaning, the controlled burn-out of magnesium deposits inside the ovens caused "massive" quantities of aluminum and magnesium oxide dust to be discharged into the plant.

The paint rack and paint hook burning and stripping process is a one-man operation. Racks and hooks, used to support condenser parts on the spray painting conveyer lines, are cleaned of excess paint build-up, by periodic burning or cold stripping. A fork lift truck is used to transport a load of paint racks to the burn-off oven. The oven door is opened using an electrically operated winch, and the operator then loads the racks into the oven using the fork lift. The door is closed, and the temperature in the oven is increased to approximately 1100°F. The oven was exhaust ventilated through a 2 foot diameter stack with a motor driven exhaust blower. Fresh air to the oven burners was provided through an 8 inch duct and centrifugal blower fan. The system was balanced to maintain a negative pressure inside the oven, even when the oven door was open. After the paint had been burned from the racks (15 minutes) the racks were removed from the oven and placed inside an exhaust ventilated cooling booth and hosed down with water. Conveyer hooks were cleaned by soaking the hooks in a tank of paint stripping solution containing methylene chloride. The dip tank was not exhaust ventilated but hooks were hosed down, along with the racks, inside the washer booth.

B. Evaluation Design and Study Progress

1. Initial Survey

NIOSH conducted an initial survey at the plant on March 6-8, 1978. NIOSH investigators were given a walk-through tour of the facility to observe current work practices and areas or processes where employees had complained of throat and eye irritation. NIOSH conducted confidential, non-directed interviews with 24 employees. The employees were randomly selected from work stations near the dehydration ovens, the condenser line brazing ovens, and the Ipsen vacuum brazing ovens. Typical complaints were sore throat, eye irritation, headache, sinus problems, skin rash caused by external

washer spray and mist, and mechanical problems with condenser line degreasers which had caused trichloroethylene spillovers. Twenty out of the 24 employees interviewed stated they had experienced health problems which they believed were work related.

General area bulk air samples of the oil smoke were collected at near roof level above the condenser lines and near the condenser line dehydration ovens. The air samples were collected on vapor adsorbing charcoal tubes and 0.8 micron AA prefilters using air sampling pumps set for maximum flow rate. The samples were sent to the NIOSH Measurements Support Branch Laboratory for qualitative analysis to identify any toxic substances collected. The charcoal tubes were desorbed with carbon disulfide and the extracts analyzed with a gas chromatograph (GC). The charcoal tubes contained a large number of organic extractable compounds but in each sample trichloroethylene was the major component. Other hydrocarbon compounds identified were toluene, xylene, and aliphatic C_{10}-C_{14} isomers. No volatile organics were identified in chloroform extracts from the pre-filters; however, certain filters were slightly discolored. Two bulk air dust samples were also collected above the Ipsen vacuum brazing ovens and analyzed for magnesium and aluminum by the NIOSH atomic adsorption method. Both samples contained magnesium; however, aluminum was not detected in the samples. Direct measurements were made for carbon monoxide, trichoroethylene, oxides of nitrogen, (including) nitrogen dioxide), sulfur dioxide, formaldehyde, methanol, and ozone, using colorimetric detector tubes. The levels of carbon monoxide (CO) as indicated on the detector tubes, exceeded 35 parts per million (PPM) in several locations near the dehydration ovens. The source or sources of the CO could not be determined.

2. Follow-Up Environmental Survey

Based on the finding of the initial survey and the qualitative analytical results from the general atmospheric samples collected, NIOSH conducted a follow-up environmental survey on September 26-28, 1978. The study was designed to investigate actual personal exposures to the substances identified in the atmospheric samples collected during the initial survey. The follow-up survey also required an environmental investigation of the paint burning and stripping operation (HE 78-67), which was included with the requests (HE 78-18, 19, 20) previously investigated.

Management representatives had asked NIOSH to postpone the follow-up investigation until after Ford had completed installation of a new makeup air ventilation system. Ford believed this new system would increase the efficiency of existing local exhaust systems and control personal exposures to carbon monoxide and trichloroethylene to levels acceptable to NIOSH. A delay was also required to allow time for a return to full employment and production schedules following a significant layoff of production workers during the spring and summer of 1978. The President of the I.U.E., Local 919, concurred with NIOSH's decision to delay the follow-up investigation.

During the follow up survey NIOSH monitored CO levels during first shift near the north and south condenser line dehydration ovens and measured average personal CO exposures for several assembly workers on the north, center and south condenser lines. One area was also sampled for CO on the 4th automotive line. Personal and general area atmospheric samples for trichloroethylene, tetrachloroethylene, xylene and toluene where taken on the condenser lines and near degreasing units. Personal and area samples for total suspended particulates and magnesium oxide (as magnesium) were taken in the Ipsen brazing ovens area. The flux mixing room was sampled for methanol vapor. The Flux Mixers' average personal exposure to methanol vapor was also evaluated. The paint burning and stripping operation was monitored by collecting personal and area samples for total particulates, magnesium, aluminum, chromium, chromium VI, and the PNA's: fluoranthene, pyrene, benzo(a)anthracene, chrysene, and benzo(a)pyrene. Bulk liquid samples of the paint stripper, and bulk air samples in the washing booth and above the cold stripper tank were collected for qualitative analysis to identify toxic substances present. Personal and area samples were collected for quantitative analysis of toxic substances identified in the bulk air samples.

C. Evaluation Methods

Bulk air samples were collected for qualitative analysis by drawing air through activated charcoal adsorption tubes or Florisil tubes using MSA* Model G air sampling pumps set at maximum flow rate in order to saturate the sampling tubes. The samples were analyzed qualitatively by desorbing with small amounts of various solvents (carbon disulfide, xylene, or ethyl acetate) prior to GC analysis. Because all bulk air charcoal tube samples displayed similar GC peak patterns, only one charcoal tube was analyzed by GC/Mass Spectrometry. No additional compounds were identified on the Florisil tube samples. Three charcoal tubes were saturated with the cold stripper solution taken directly from the conveyer hook paint stripper tank. The charcoal tubes were desorbed using carbon disulfide or xylene and analyzed qualitatively by GC/Mass Spectrometry to identify major components.

The air sampling and analytical methodology for the different types of atmospheric samples collected is shown in Table 1. Included in Table 1 are, for each substance evaluated, the collection device, the range of pump flow rates, the range of sample durations, the analysis method, the analytical detection limit, and where applicable, the reference for the detailed sampling and analytical method. The personal air samples are

*The mention of commercial trade names or products does not constitute endorsement by NIOSH

those for which the subject actually wears the air sampler with the collection device being pinned to shirt lapel or collar so as to obtain an air sample representative of what the subject is breathing. The area samples are obtained by placing the sampling apparatus in fixed locations thought to have air quality similar to that to which the the workers are exposed.

Air samples for particulates, metals and PNA's were collected using 37 mm diameter filters mounted in 3 piece plastic cassettes. Air flow through the filters was maintained by using battery operated air sampling pumps which had been adjusted and calibrated to determine the exact flow rate for each pump. Vapors were collected using small, glass, two section tubes, each containing 100 mg of adsorption material in the front section and 50 mg adsorption material in the backup section. The exact volume of the sampair sample pulled through the tubes was calculated from calibration data on each low flow air sampling pump used.

D. 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 standard.

In order that workers may better understand the potential health hazards associated with exposures to the two toxic substances of primary concern during this investigation, the following discussion is provided.

1. Carbon Monoxide

The symptoms of carbon monoxide poisoning include headache, nausea, vomiting, dizziness, drowsiness and collapse. CO exerts its harmful effect by binding with the blood hemoglobin forming carboxyhemoglobin. As a result, the hemoglobin is no longer able to transport oxygen to the cells of the body, causing tissue hypoxia. The intensity of the symptoms is dependent on the per cent of carboxyhemoglobin in the blood. Smokers usually have higher levels of carboxyhemoglobin than non-smokers (often 5 - 10% or more). The formulation of carboxyhemoglobin is a reversible process. Recovery from acute poisoning usually occurs without after effects unless tissue hypoxia was severe enough to result in brain cell degeneration. Long term low level exposure to CO may initiate or enhance deleterious myocardial alterations in individuals with restricted coronary artery blood flow and decreased myocardial lactate production.[15]

2. Trichloroethylene

Exposure to trichloroethylene vapor may cause irritation of the eyes, nose, and throat. The liquid, if splashed in the eyes, may cause burning, irritation, and damage. Repeated or prolonged skin contact with the liquid may cause dermatitis. Acute exposure to trichloroethylene depresses the central nervous system resulting such symptoms as headache, dizziness, vertigo, tremors, nausea and vomiting, irregular heart beat, sleepiness, fatigue, blurred vision, and intoxication similar to that of alcohol. Unconsciousness and death have been reported.[15] Consumption of alcoholic beverages may make the symptoms of trichloroethylene worse. Many workers exposed to trichloroethylene may develop an intolerance to alcohol. Some workers have experienced a condition known as "degreasers flush", which is caused by a vasodilation of the superfacial skin vessels, resulting in red skin blotches, mostly on the face, neck, shoulders, and back.

There is no known evidence which associates trichloroethylene exposure with an increased risk of cancer in humans. However, an animal bioassay conducted by the National Cancer Institute found evidence of cancer in mice, but not in rats, following an exposure to trichloroethylene through forced feeding. Other laboratory tests have demonstrated that trichloroethylene has a mild mutagenic potential. There is strong presumptive evidence that a highly reactive metabolite, trichloroethylene epoxide, is produced during the metabolism of trichloroethylene and is likely responsible for the carcinogenic and mutagenic activity of trichloroethylene. Although NIOSH has concluded that trichloroethylene has a carcinogenic potential in the workplace, it is not considered a potent carcinogen.[7]

E. Evaluation Results and Discussion

The levels of carbon monoxide monitored and recorded on the direct reading instrument located near the dehydration ovens are presented in Table 3. The average and peak CO levels recorded during each hour of monitoring are listed in the table for two consecutive days of sampling. At no time did carbon monoxide concentrations exceed 30 ppm. Personal time weighted average exposures to CO did not exceed 16 ppm (Table 4). It should be noted that personal samples were taken with long term detector tubes which were not certified for accuracy by NIOSH. However, a comparison of the levels shown by the detector tubes on Table 4 with levels recorded on the calibrated direct reading instrument, indicated that the detector tubes were accurate to within a few parts per million.

Major components found in the bulk air samples were trichloroethylene, toluene, xylene and a series of hydrocarbons, mainly C_{10}-C_{12} alkanes.

Bulk Air Sample Locations

1. Top of dehydration oven, center condenser line
2. High density materials handling area
3. Near brazing oven, 4th automotive line

Actual worker exposures to the substances identified in the bulk air samples, as determined from the results of personal samples collected, are listed in Table 5. All samples taken for trichloroethylene were below the NIOSH 25 ppm evaluation criteria. The sampling results also indicate that exposures to xylene, toluene and alkanes are not significant.

The results from sampling for dust emissions from the Ipsen vacuum brazing ovens are found on Table 6. The dust did contain magnesium oxide below the evaluation criteria, but the levels of aluminum oxide were below the detectable limits of the sampling and analytical method used. Dust concentrations during a controlled burn-out were not evaluated.

The results from atmospheric sampling for methanol vapor in the flux mixing room are presented in Table 7. Methanol exposures were well below acceptable environmental limits.

Methylene chloride, trichloroethylene, toluene, xylene, and C_{10}-C_{12} alkanes were identified in the bulk air samples taken inside the paint burn-off washer booth. PNA's were not detected in the bulk air samples. The compounds identified in the liquid sample of cold stripper, taken directly from the dip tank were: butyl cellosolve, butyl cellosolve acetate (suspected component), acetic acid, and methylene chloride. Although methylene chloride was not the major component in the liquid, methylene chloride vapor was detected in air samples collected above the open dip tank. Personal and area atmospheric sampling results for the paint burning and stripping operation are contained in Table 8. None of the substances detected in the samples exceeded the NIOSH evaluation criteria.

With regard to the health problems and symptoms reported during the employee interviews, most of these complaints were related to the excessive dust emissions during vacuum brazing oven controlled burn-outs or trichloroethylene "overspills" caused by breakdowns of the condenser line degreasers. Many of the employees interviewed believed their problems with throat and eye irritation were caused by the oil smoke. NIOSH has previously discussed the results of this investigation with representative of Ford Aerospace and I.U.E. Local 919. Union representatives have stated that the new ventilation systems have helped control the problems from oil smoke and that previously reported employee symptoms no longer appear to be a problem. The HHE requestor is also pleased that the Connorsville plant now has a full time industrial hygienist assigned.

F. Recommendations

1. Although the levels of carbon monoxide and trichloroethylene detected during this survey did not exceed the NIOSH evaluation criteria, it should be noted that atmospheric sampling was conducted in September. Newly installed make-up air systems were adjusted to deliver 100% outside air. It is possible that higher concentrations of CO and trichloroethylene might exist during the winter months when the make-up systems deliver a lower percentage of fresh outdoor air and a greater percentage of recirculated air. The company should closely monitor CO and trichloroethylene levels any time make-up air systems are readjusted. Environmental monitoring will be particularly important following changover from summertime to wintertime operations.

2. Make-up air system controls should be locked to prevent unauthorized adjustments.

3. If feasible, continuous monitoring systems should be installed which will sound an alarm or signal supervisory personnel when mechanical breakdown of condenser line degreasers result in spillover of trichloroethylene.

4. The procedure for controlled burn-out of magnesium in Ipsen vacuum brazing furnaces should be amended to require that dust emissions from the discharge vestibule are exhausted through the newly installed discharge vestibule exhaust system to the outside. The air through this system should not be directed into the plant during a controlled burn-out.

V. REFERENCES

1. P&CA Method No. 127, NIOSH Manual of Analytical Methods, Vol. 1 Publication No. (NIOSH) 77-157A, (April, 1977)

2. P&CA Method No. 173, NIOSH Manual of Analytical Methods, Vol. 1, Publication No. (NIOSH) 77-157A, (April, 1977)

3. P&CA Method No. 169, NIOSH Manual of Analytical Methods, Vol. 1, Publication No. (NIOSH) 77-157A, (April, 1977)

4. P&CA Method No. 247, NIOSH Manual of Analytical Methods, Vol. 1, Publication No. (NIOSH) 77-157A, (April, 1977)

5. Occupational Safety and Health Standards, 29 CFR Part. 1910 Subpart Z.

6. Criteria for a Recommended Standard-Occupational Exposure to Carbon Monoxide, DHEW (NIOSH) Publication NO. 73-11000, (August, 1972)

7. Special Hazard Review with Control Recommendations, Trichloroethylene, DHEW (NIOSH) Publication No. 78-130, (January, 1978)

8. Criteria for a Recommended Standard-Occupational Exposure to Tetrachloroethylene, DHEW (NIOSH) Publications No. 76-185, (July, 1976)

9. Criteria for a Recommended Standard-Occupational Exposure to Xylene, DHEW (NIOSH) Publication No. 75-168, May, 1975)

10. Criteria for a recommended Standard-Occupational Exposure to Toluene, DHEW (NIOSH) Publication No. 73-11023, (July, 1973)

11. Criteria for a Recommended Standard-Occupational Exposure to Methylene Chloride, DHEW (NIOSH) Publication No. 76-138, (March, 1976)

12. ACGIH: Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1978.

13. Criteria for a Recommended Standard-Occupation Exposure to Chromium (VI), DHEW (NIOSH) Publication No. 76-129, (December, 1975)

14. Criteria for a Recommended Standard-Occupational Exposure to Refined Petroleum Solvents, DHEW (NIOSH) Publication No. 77-192, (July, 1977)

15. Occupational Diseases, A Guide to Their Recognition, Revised Edition, DHEW (NIOSH) Publication No. 77-181, (June, 1977)

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TABLE 1

AIR SAMPLING AND ANALYSIS METHODOLOGY

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana

Substances	Collection Device	Flow Rate	Duration	Analysis	Detection Limit	Reference
Carbon Monoxide	Detector Tube	20 cc/min.	6-hrs.	Direct Reading	5 PPM	(a)*
Carbon Monoxide	Direct Reading Instr.		3-4 hrs.	Electrochemical Oxidation	1 PPM	(b)*
Trichloroethylene	Charcoal Tube(150 mg)	150 cc/min.	1-5 hrs.	Gas Chromatography	10 ug/sample	1
Tetrachloroethylene	" " "	"		" "	" "	1
Xylene	" " "	"		" "	"	1
Toluene	" " "	"		" "	30 ug/sample	1
Methylene Chloride	" " "	"	1 hr.	" "	10 ug/sample	1
Total Particulates	0.8u Membrane Filter(DM 800)**	1.75 l/min.	1-6 hrs.	Gravimetric	10 ug/sample	(c)*
Magnesium	" " " "	" "	"	Atomic Absorption	1 ug/sample	2
Aluminum	" " " "	" "	"	" "	20 ug/sample	2
Chromium, Total	" " " "	" "	"	" "	5 ug/sample	2
Chromium VI	5.0u PVC Filter	1.5 l/min.	1 hr.	Colorimetric	0.2 ug/sample	3
Methyl Alcohol	Silica-Gel Tube(150 mg)	20 cc/min.	6 hrs.	Gas Chromatography	10 ug/sample	4
PNA's Fluoranthene	Glass Fiber/Silver Membrane	1.5 l/min.	1-7 hrs.	HPLC	0.02 ug/sample	(d)*
Pyrene	" " " "				0.12 ug/sample	(d)*
Benzo(a)anthracene	" " " "				0.05 ug/sample	(d)*
Chrysene	" " " "				0.06 ug/sample	(d)*

*(a) Drager Long-Duration Detector Tube, Carbon Monoxide 50/a-1 with MDA Accuhaler^{tm} 808 air sampling pump
*(b) Ecolyzer Carbon Monoxide Monitor with Strip Chart recorder
*(c) Perkin-Elmer Balance AD-2
*(d) Reversed-Phase High Pressure Liquid Chromatography with Vydac 201TP column.

** DM 800 filters are manufactured by the Gelman Instrument Company. The filters are a copolymer of acrylonitrile and polyvinyl chloride

NOTE: Mention of commercial trade names or products does not constitute endorsement by NIOSH

TABLE 2

ENVIRONMENTAL EVALUATION CRITERIA

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana

Substance	Recommended Environmental Limit*	Source	Health Effects Considered	OSHA Standard (Ref. 5)
Carbon Monoxide	35 PPM	NIOSH (Ref. 6)	Hypoxia, Heart Effects	50
Trichloroethylene	25 PPM	NIOSH (Ref. 7)	Central Nervous System Depressant, Cancer Suspect	100 PPM
Tetrachloroethylene	50 PPM	NIOSH (Ref. 8)	Central Nervous System Depressant, Heart, Respiratory, Liver Effects	100 PPM
Xylene	100 PPM	NIOSH (Ref. 9)	Central Nervous System Depressant, Airway Irritation	100 PPM
Toluene	100 PPM	NIOSH (Ref. 10)	Central Nervous System Depressant	200 PPM
Methylene Chloride	500 PPM	NIOSH (Ref. 11)	Central Nervous System Effects, Carbon Monoxide Toxicity	75 PPM-To be lowered in presence of CO
Total Particulates (Nuisance Dusts)	10 mg/M^3	ACGIH (Ref. 12)	Skin or Muscous Membrane Irritation, Reduced Visibility	15 mg/M^3
Magnesium Oxide Fume	10 mg/M^3	ACGIH (Ref. 12)	Eye and Nasal Irritation, Metal Fume Fever	15 mg/M^3
Aluminum Oxide (Nuisance Dust)	10 mg/M^3	ACGIH (Ref. 12)	Skin or Muscous Membrane Irritation, Reduced Visibility	15 mg/M^3
Chromium	0.5 mg/M^3	ACGIH (Ref. 12)	Dermatitis, Possible Pulmonary Fibrosis	1 mg/M^3
Chromium VI	0.001 mg/M^3	NIOSH (Ref. 13)	Lung Cancer, Skin Ulcers	0.1 mg/M^3
Total Alkanes C_{10}-C_{14}	350 mg/M^3	NIOSH (Ref. 14)	Skin, Lung, and Nerve Irritation	None
PNA's	None		Cancer Risk	None

NOTE: All environmental limits are time weighted average exposures for a normal work day

TABLE 3

RESULTS OF AIR SAMPLING FOR CARBON MONOXIDE
WITH ECOLYZER AND RECORDER

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana

September 26, 1978
Near Dehydration, North Condenser Line

Time	Average CO Concentration (PPM)	Peak CO Concentration (PPM)
11:00-12:00	15	26 @ 11:10
12:00- 1:00	18	23 @ 12:50
1:00- 2:00	14	22 @ 1:25
2:00- 3:00	13	22 @ 2:15
TWA	15 PPM	

September 27, 1978
Near Dehydration, South Condenser Line

11:30-12:30	18	30 @ 11:31
12:30- 1:30	15	24 @ 12:52
1:30- 2:00	11	14 @ 1:30
TWA	15 PPM	

Evaluation Criteria (NIOSH Recommendation)	35 PPM (TWA)	200 PPM

PPM = Parts of carbon monoxide per million parts of air

TWA = Time Weighted Average

TABLE 4

AIR SAMPLING RESULTS FOR CARBON MONOXIDE
USING LONG TERM DETECTOR TUBES

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana
September 26, 1978

Job	Location	Sample No.	Type of Sample	Duration	Sample Volume (liters)	CO in PPM*
Stacking	North Condenser Line	CO-1	Personal	8:58-2:10	5.81	12
Assembly	North Line Brazing Oven	CO-2	Personal	8:55-2:13	5:48	16
Loader	North Line Dehydration Oven	CO-3	Personal	9:00-2:15	6:10	16
Leak Checker	Center Line Dunk Tank	CO-4	Personal	9:06-2:12	3:54	14
Removes Charge Valves	Center Condenser Line	CO-5	Personal	9:16-2:19	2:29	13
	4th Automotive Line Column R17	CO-6	Area	10:04-2:20	4:57	12
Transfers Condensers from Cooling Line to Final Line	South Condenser Line	CO-7	Personal	9:21-2:20	5:22	15

EVALUATION CRITERIA (NIOSH Recommendation) = 35
CURRENT OSHA STANDARD = 50

*Parts of carbon monoxide per million parts of air sampled (by volume).

TABLE 5

AIR SAMPLING RESULTS FOR SOLVENT VAPORS

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana
September 2, 1978

Job	Location	Sample No.-Type	Duration	Sample Volume (liters)	Tri	Tet.	Xy	Tol (PPM-TWA)
Assembly	South Condenser Line-Table between brazing oven and washer	C2-Personal	9:26-2:26	40.9	10	ND	ND	ND
Loading degreaser	South Condenser Line-Conveyor line from expander, Bay G-7	C3-Personal	9:29-2:27	44.3	5	ND	ND	0.2
Unloading degreaser	Center Condenser Line	C4-Personal	9:33-2:11	49.1	5	ND	0.1	0.3
Core Charging	North Condenser Line-North side of washer before dunk tank	C5-Personal	9:38-2:14	30	15	ND	0.7	0.3
Inspection	Tube and Fin Line-Dunk tank pit	C6-Personal	9:43-2:15	41	4	ND	0.2	1.6
N/A	Tube and Fin Line-Degreaser discharge end	C7-Area	9:44-2:15	48.9	16	ND	0.3	1.8
N/A	North Condenser Line-Degreaser, discharge end	C8-Area	9:46-2:47	47.5	11	ND	0.1	0.7
N/A	Center Condenser Line-Degreaser, discharge end	C9-Area	9:47-2:46	48.2	15	ND	ND	0.2

TABLE 5 (continued)

Job	Location	Sample No.-Type	Duration	Sample Volume (liters)	Tri	Tet.	Xy	Tol (PPM-TWA)
N/A	4th Auto Line-Degreaser, discharge end (degreaser was temporarily shut down during part of sample period)	C10-Area	9:56-2:35	38.5	1	ND	0.06	0.7
Operator	Small parts degreaser (east) Condenser fabrication,Bay F3	C11-Personal	10:19-2:43	40.6	4	ND	ND	0.1
Operator	Small parts degreaser (west) Condenser fabrication,Bay F3	C12-Personal	10:21-2:43	14.9	22	ND	0.3	1.2
N/A	Small parts degreaser area-Southwest side of Ranschoff washer	C13-Area	10:23-2:44	36.4	6	ND	0.1	0.4
		SEPTEMBER 27, 1978						
Inserting return bends	Heavy truck line	C15-Personal	7:39-2:20	58.1	4	ND	0.2	1.1
Transfering degreasers from degreaser line to return bend tube	South condenser line	C16-Personal	7:41-2:34	55.1	10	ND	0.94	0.2
N/A	Near B&B degreaser entrance	C17-Area	7:45-2:44	65	4	ND	ND	0.2
Operating fin machine	Near B&B degreaser	C18-Personal	7:46-1:35	53.2	4	ND	ND	0.2
N/A	Tube and fine line-Behind repair booth near north line degreaser	C19-Area	8:06-14:14	55.9	13	ND	0.3	1.7

TABLE 5 (continued)

Job	Location	Sample No.-Type	Duration	Sample Volume (liters)	Tri	Tet.	Xy	Tol
					(PPM-TWA)			
Blow out leak check	Near north line degreaser	C20-Personal	8:08-2:20	53.1	9	ND	0.3	1.8
	Current OSHA standards permissible exposure limits				100	100	100	200
	NIOSH Evaluation Criteria				25*	50	100	100

*Source-Trichloroethylene special hazard review, Feb. 28, 1978

Abbreviations: PPM TWA - Time weighted average concentration in parts per million
N/A - Not applicable
ND - Not detected
Tri - Trichloroethylene
Tet - Tetrachloroethylene
Xy - Xylene
Tol - Toluene

TABLE 6

AIR SAMPLING RESULTS FOR SUSPENDED PARTICULATE MATTER AND MAGNESIUM OXIDE

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana
September 26-27, 1978

Job	Location	Sample No.-Type	Duration	Sample Volume (liters)	Total Part. (Mg/M^3 TWA)	Mg
Unloading rack	Ipsen Furnace, #5	DM 303-Personal	9:40-1:38	416.5	0.36	0.01
Inspection	Brust box btw. Ipsen Furnace #3 and #4	DM 304-Personal	9:33-1:37	322	0.19	0.01
N/A	Top of Ipsen #4 Vacuum Pump	DM 305-Area	9:33-2:37	427	0.16	0.01
N/A	Top of Ipsen #5 Vacuum Pump	DM 306-Area	9:42-2:38	518	0.19	0.004
Unloading Condensers	South Condenser Line Dehydration Oven	DM 309-Personal*	7:52-2:36	705	2:38	0.003
N/A	South Condenser Line Dehydration Oven	DM 310-Area*	7:52-2:41	716	0.5	0.001

*Results were negative for concurrent sampling with glass fiber/silver membrane filters and subsequent HPLC (analysis for polynuclear aromatic hydrocarbons (PNA's).
Note: Aluminum or chromium was not detected in any of the samples.
Evaluation Criteria (ACGIH TLV's for nuisance particulates/and magnesium oxide fume) = 10 10

Abbreviations: N/A - Not applicable
ND - Not detected
Mg/M^3 TWA - Concentration in millgrams per cubic meter as time weighted average
HPLC - High Pressure Liquid Chromatography
Mg - Magnesium Oxide as Magnesium

TABLE 7

AIR SAMPLING RESULTS FOR METHANOL
FLUX MIXING ROOM

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana
September 27, 1978

Job	Location	Sample No.	Type of Sample	Duration	Sample Volume (liters)	Methanol (PPM-TWA)
Flux Mixing	Flux mixing room	SG-1	Personal	7:58-2:15	8.6	0.9
N/A	Mid-room opposite mixers	SG-2	Area	8:00-2:15	8.5	5.4
			Current OSHA Standard Permissible Exposure Level			200
			NIOSH Evaluation Criteria			200

Abbreviations: PPM TWA - Parts per million Time Weighted Average

TABLE 8

AIR SAMPLING RESULTS FOR PAINT
STRIPPING AND BURNING OF CONVEYOR RACKS

FORD AEROSPACE AND COMMUNICATIONS CORPORATION
Connersville, Indiana
September 27, 1978

Paint Burn-off Operator Personal Samples

Sample No.	Duration	Sample Volume	Sample Results	
C-21	8:50-9:46	8.8	Methylene chloride	4.0 PPM
			Trichloroethylene	2.5 PPM
			Toluene	0.3 PPM
			Xylene	None Detected
			Total Alkanes (C10-C12)	None Detected
DM 307	8:50-9:46	56	Total particulates	None Detected
			Magnesium	" "
			Chromium	" "
			Aluminum	" "

Area Sample Outside Washer Booth Near Cold Stripper Tank

C-22	8:51-9:56	9	Methylene chloride	18.2 PPM
			Trichloroethylene	2.4 PPM
			Xylene	None Detected
			Total Alkanes (C_{10}-C_{12})	" "
DM 308	8:51-9:56	65	Total Particulates	0.15 Mg/M^3
			Magnesium	0.003 Mg/M^3
			Chromium	None Detected
			Aluminum	" "
PVC-1	8:51-9:56	65	Chromium VI	" "
FG/SM-1	8:51-9:56	65	Polynuclear Aromatic	" "
			Hydrocarbons (PNA's)	" "

TABLE 8 (continued)

Substance	Current OSHA Standard PEL (Time Weighted Average)	NIOSH Evaluation Criteria (Time Weighted Average)
Methylene chloride	500 PPM	75 PPM
Trichloroethylene	100 PPM	25 PPM
Tolune	200 PPM	100 PPM
Xylene	100 PPM	100 PPM
Total Alkanes C_{10}-C_{14}	None	350 Mg/M^3 Refined Petrolum Solvents
Total Particulates	15 mg/M^3 (nuisance dust)	10 mg/M^3 (nuisance dust)
Magnesium oxide fume	15 mg/M^3 (as magnesium)	10 mg/M^3 (as magnesium)
Alminum oxide	15 mg/M^3 (nuisance dust)	10 mg/M^3 (nuisance dust)
Chromium	1 mg/M^3	0.5 mg/M^3
Chromium VI	0-1 mg/M^3	1 ug/M^3 or 25 ug/M^3
PNA's	None	Minimize exposure

Abbreviations: PPM-Parts Per Million
Mg/M^3-milligrams per cubic meter
PEL-Permissible Exposure Limit
ug/M^3-Micrograms per cubic meter

PNA's selected for quanitative analysis: Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(a)pyrene