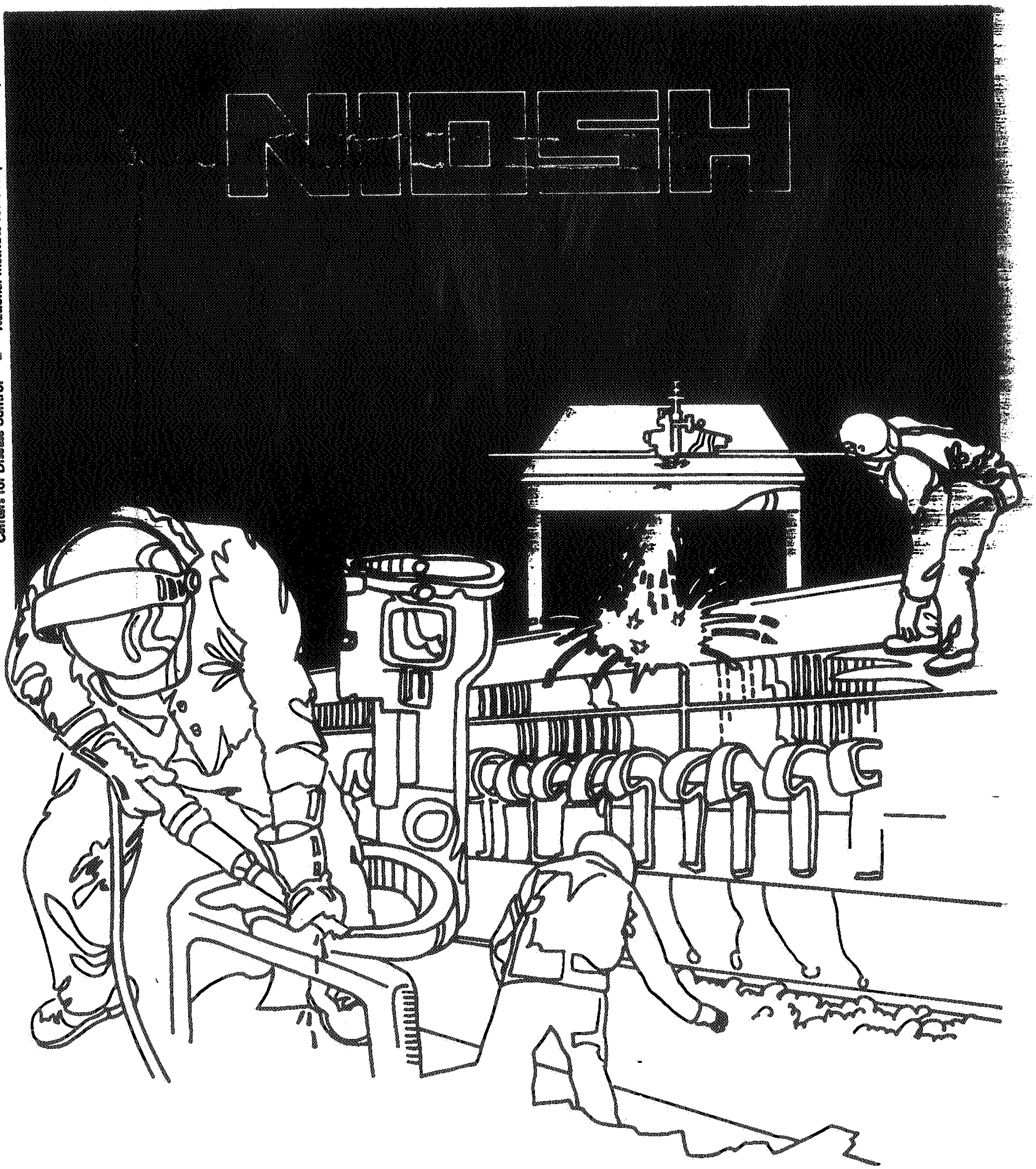
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 82-280-1407
HOOVER COMPANY
NORTH CANTON, 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.

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HOOVER COMPANY
NORTH CANTON, OHIO

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I. SUMMARY

On February 8, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate pulmonary effects of dust in foundry workers, and to determine exposures to various chemicals including methyl ethyl ketone (MEK) and perchloroethylene among employees of the Hoover Company, North Canton, Ohio.

On April 12-15, 1983, environmental and medical monitoring of the Main Plant of Hoover was conducted. Environmental samples collected at the plating line for measurement of occupational exposure to airborne hydrochloric acid, chromium VI, chromium, and nickel were reported as below the analytical limit of detection for all substances. At the pre-blend/pelletizing operation, airborne concentrations of cadmium and chromium (pigments) were less than detectable, while di(2-ethylhexyl)phthalate (DEPH) exposures ranged from below the analytical limit of detection to 0.05 mg/m^3, as compared to the OSHA standard of 5 mg/m^3. Concentrations of perchloroethylene at the degreasing operation ranged from 40.9 to 250 mg/m^3. NIOSH recommends that exposures be maintained at the lowest feasible level; the OSHA standard is 679 mg/m^3. Exposures to MEK were monitored in several assembly locations, with results ranging from 0.6 to 14.1 mg/m^3; the OSHA and the NIOSH recommended standard for MEK are both 590 mg/m^3. Airborne asbestos samples were collected from two assembly areas with results ranging from 0.04 to 1.88 fibers/cc. NIOSH recommends that exposures be maintained at the lowest feasible level; the OSHA standard is 5 fibers/cc. Samples collected for styrene, in the motor assembly area indicated concentrations of 1.5 mg/m^3, as compared to the OSHA standard of 425 mg/m^3. Exposures to butyl cellosolve in this area were below the limit of detection while ethylene glycol ethyl ether exposures ranged from 0.7 to 2.3 mg/m^3, as compared to the OSHA standard of 740 mg/m^3. In the foundry, sampling was conducted for metals and oil mist. Aluminum, iron, and phosphorous were determined to be the metals of highest relative airborne concentration, with exposures ranging generally < 0.1 mg/m^3. Exposures to oil mist in this area ranged from 0.28 to 15.3 mg/m^3 (OSHA standard of 15 mg/m^3). Oil mist samples collected in the area of the "automatics" ranged from 0.17 to 1.15 mg/m^3. Air samples obtained from welders indicated exposures to chromium, copper, manganese, lead and nickel all well within the appropriate OSHA or NIOSH recommended standards. Non-ionizing radiation measurments were obtained at radiofrequency (RF) heat sealers and injection molding pre-heaters. The average mean squared electric field strengths and the mean squared magnetic field strengths were well within OSHA standards.

Two areas of concern were identified in the main plant for medical evaluation. Foundry workers were administered a standardized questionnaire and pulmonary function tests were performed. The results showed no pulmonary function abnormalities or respiratory symptoms associated with increasing duration of employment in the foundry. Employees using or working near MEK were administered a standardized questionnaire focusing on occupational history and symptoms relevant to organic solvent exposure, and two venous blood samples (pre- and post-shift) were obtained from each worker. Systemic absorption was demonstrated in only one worker. Symptoms consistent with solvent exposure were no different between MEK exposed workers and a control group which had no solvent exposure.

Based on the environmental data collected during this evaluation, a potential health hazard exists from exposure to asbestos in the commutator machining area, to perchloroethylene at the degreaser, and to oil mist in the foundry. Recommendations to reduce exposures are contained in Section VIII of this report.

KEYWORDS: SIC 3630 (Appliance Manufacture) hydrochloric acid, sulfuric acid, nickel, chromium, chromium VI, butyl cellosolve, ethylene glycol ethyl ether, di(2-ethylhexyl)phthalate, styrene, perchloroethylene, asbestos, methyl ethyl ketone, aluminum, iron, phosphorus, oil mist, pulmonary function.

II. INTRODUCTION

On February 8, 1982, IBEW Local 1985 requested a health hazard evaluation of the Hoover Company, a manufacturer of vacuum sweepers, located in North Canton, Ohio. The request expressed health concerns regarding several agents including non-ionizing radiation, polyvinyl chloride, perchloroethylene, methyl ethyl ketone (MEK), nickel sulfate, nickel chloride, boric acid, sulfuric acid, and hydrochloric acid. There were also concerns regarding pulmonary effects of dust exposures among the foundry workers at this facility. On April 7, 1982, a NIOSH industrial hygienist and medical officer conducted a walk-through survey of the Main Plant and Industrial Park locations of Hoover to develop an environmental and medical study protocol. At that time, as a result of employee interviews and discussions with IBEW and Hoover representatives, several other areas of the facility were included in the evaluation. Due to the size of the work force and the number of manufacturing processes, the NIOSH officers elected to conduct two separate surveys, initially evaluating the Industrial Park facility and subsequently the Main Plant. The Industrial park facility was evaluated on June 5-8, 1982, and the findings and recommendations are presented in the NIOSH health hazard evaluation report HETA 82-127-1370. This document is the final report for the survey conducted at the Main Plant of Hoover. The follow-up, in-depth industrial hygiene and medical surveys of the Main Plant were conducted from April 12 to 15, 1983.

The purpose of the evaluation was to determine the extent of employee exposure to several chemical substances through environmental monitoring and to identify any ill-health effects resulting from these exposures through biological monitoring and employee interviews. Environmental monitoring was conducted for hydrochloric acid, nickel, chromium VI, and chromium (Plating Line); di(2-ethylhexyl)phthalate (DEHP) and pigments (Pre-blend/Pelletizing); butyl cellosolve, ethylene glycol ethyl ether, and styrene (electric motor assembly); perchloroethylene (degreasing); aluminum, iron, phosphorus, and oil mist (Foundry); metals (welding); methyl ethyl ketone (assembly areas); and asbestos (assembly areas). A non-ionizing radiation survey was also conducted, at the upright vacuum sweeper assembly location for the radiofrequency heat sealers, and in the injection molding area for the radiofrequency pre-heaters.

III. BACKGROUND

The Hoover Company produces vacuum sweepers of various sizes for commercial and home use at the North Canton, Ohio location, which employs approximately 2,200 workers. Essentially all of the component parts of the sweepers are manufactured and assembled on-site which requires numerous industrial processes, including a foundry operation, injection molding, spray painting, degreasing, plating, extruding, and numerous assembly line type operations. The Main Plant of Hoover was constructed in the early part of the century, and has undergone numerous structural enlargements. The manufacturing operations in this four-story building involved in the NIOSH evaluation included; injection molding, nickel plating line, PVC pelletizing, aluminum foundry, electric motor manufacturing, degreasing, automatic screw machines, and various assembly and maintenance tasks. Following are brief descriptions of the manufacturing areas investigated during the NIOSH evaluation.

A. Plating Line

The nickel-zinc plating line is used to plate various vacuum sweeper parts. The state of the art line uses robotics to contol the tumblers to the various acid and metallic solution tanks. All metal and acid tanks are locally exhausted using a push-pull system. The eight workers (four/shift) in this area are primarily concerned with loading and unloading the tumblers for the plating line, and "burnishing" the various parts.

B. PVC Blending and Pelletizing

Powdered PVC is blended and colored in this area. The PVC is blended with di(2-ethylhexyl)phthalate and pigments, heated, and the pelletized product is used at the injection molders. Commercial pellets are not used due to the variability in color. One worker is normally employed in this area.

C. Foundry

Aluminum housings and base plates for the vacuum sweepers are produced via mechanical casters. The die consists of a steel mold in which molten aluminum is manually poured, and a steel core which is hydraulically inserted. Subsequent to each cast, the die is sprayed with a water based emulsified oil. The foundry employs 48 workers, primarily over two shifts.

D. Degreasing

Various metallic parts are cleaned in an automatic perchloroethylene vapor degreaser prior to shipping, plating, or machining. A total of eight employees work at or near the degreaser over three shifts, including an operator, helper, and trucker.

E. Electric Motor Production

Electrical motor components are treated and assembled in departments 10 and 90. Armatures are coated with a vapor barrier varnish containing styrene, ethylene glycol ethyl ether, and butyl cellosolve in department 90. Stators are coated with a resinous electrical insulator in department 10.

F. Upright Vacuum Sweeper

In the upright vacuum sweeper assembly area, vacuum sweeper bags are assembled and subsequently sealed using radiofrequency (RF) heat sealers. Ten RF sealers in this area are normally operated by two workers each.

G. Automated Injection Molding

Six automated injection molding machines use RF pre-heaters to heat the plastic material prior to molding. Although the machines are automated, four to six set-up operators are stationed in this area.

H. Automatics

Fifteen screw machines or "automatics" are located in an open area of the first floor. Mineral oil is used in a continuous flow to lubricate the machines. Nine operators are present on the first shift, with six working the second and third shift.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

A walk-through survey of both the Main Plant and the Industrial Park facility was conducted on April 7, 1982. Environmental sampling at the Industrial Park facility was initiated on June 21, 1982, and continued through June 25. A report of the Industrial Park evaluation was released in November, 1983[1]. The environmental and medical evaluation of the Main Plant was initiated on April 12 and continued through April 15, 1983. Table I presents the sampling and analytical methodolgy used in collection and analysis of the environmental samples. For "breathing zone" samples, pre-calibrated sampling pumps were attached to the employee's belts which were connected to the sampling medium on the worker's collars, or breathing zone. General area samples were collected in the general work area or near particular work stations. Process samples were collected in close proximity to an emmission source and do not necessarily represent exposure levels.

RF measurements were made with a calibrated Holaday Model HI 3002 Broadband Field Strength Meter equipped with an electric (E) field probe and a magnetic (H) field probe. Measurements of both fields were made at areas directly adjacent to the heat sealers and in the operators work area in the upright department.

B. Medical

Two areas of concern were identified in the Main Plant for medical evaluation:

1. Foundry workers who are exposed to aluminum dusts and fumes

All 48 foundry workers were administered a standardized questionnaire focusing on occupational history, smoking experience, and respiratory symptoms. Determination of pulmonary function was performed once for each worker using an Ohio Medical Products Model 822 dry rolling seal spirometer. Indices of FEV_1 (Forced Expiratory Volume in 1 second), FVC (Forced Vital Capacity), and FEV_1/FVC ratio were determined and compared to standard predicted values for persons of the same age, sex, race, and height. The predicted values for black persons were calculated by multiplying the standard predicted values by 0.85.

2. Workers using or working near methyl ethyl ketone (MEK)

Ten employees in this category were identified. A standardized questionnaire was administered focusing on occupational history and symptoms relevant to organic solvent exposure. Experience of the following symptoms was determined: nausea, vomiting, dizziness, drowsiness, irritation of the nose, irritation of the eyes, headache, and sore throat. Two venous blood samples were taken from each worker, one at the beginning of shift and another at the end of shift. Both samples were analyzed for the presence of MEK. The difference between the beginning and end of shift samples would indicate the amount absorbed during the workday. The questionnaire returns, with symptom review relevant to the day of blood collection, were compared with those for a group of 10 workers not exposed to or working with any chemicals from the Hoover Industrial Park plant.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's)[2], and 3) the U.S. Department of Labor (OSHA) occupational health standards.[3] Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Table II presents the evaluation criteria for sampled substances along with a brief description of their major potential toxicities.

VI. RESULTS AND DISCUSSION

A. Environmental

The environmental portion of the survey was designed to evaluate numerous exposure situations toward a general characterization of the plant environment, rather than focusing on a single process for extensive, repeated sampling. As a consequence, the survey results are only suggestive of potential problem areas and do not give definitive degrees of over-exposure or, conversely, an absolute index of safe exposure. Results indicate excessive exposures to asbestos at the commutator machining operation, to oil mist within the foundry area, and to perchloroethylene at the degreaser. Table III presents a summary of the environmental results. Following is a more detailed discussion of the environmental sampling results by work area or by substance.

1. Plating Line

Health related complaints from employees at the plating line included irritation of the eyes, nose, and throat, and burning lips, which is consistent with effects from exposure to airborne acid mists and gasses. During the time of the health complaints, which occurred prior to the walk-through evaluation, windows located along the plating line were opened, causing cross drafts which probably interfered with the local exhaust ventilation located on the solution and acid tanks. Subsequent to the walk-through and prior to the environmental evaluation, the windows were sealed, and health complaints subsided. However, employee concerns for potential effects of long-term or chronic exposures to even relatively low levels of the materials used in the plating process warranted environmental monitoring. In addition to hydrochloric acid, samples were collected to measure potential exposures to chromium and nickel; substances used at the plating line in the metal solutions. Although the potential for the presence of chromium VI in the plating line solutions was low, concern for exposure to this highly toxic substance prompted monitoring.

Results of four personal, or breathing zone samples and one area sample for hydrochloric acid, (placed adjacent to the muratic acid tank), were below the analytical limit of detection, which corresponds to exposures of < 0.07 mg/m^3. The OSHA standard for hydrochloric acid is 7 mg/m^3, or 100 X the highest possible exposure. Results of three personal and four area samples collected for nickel were also below the analytical limit of detection, corresponding to airborne concentrations of < 0.004 mg/m^3, as compared to the NIOSH recommended standard of 0.015 mg/m^3, or roughly 4 X the highest possible exposure. One personal and two area samples were collected for chromium, again with analytical results below the detectable limit, which correlates to concentrations of < 0.002 mg/m^3. The OSHA standard for chromium is 1 mg/m^3.

Results of three area and one personal sample collected for chromium VI were below the analytical detection limit, indicating airborne concentrations of < 0.0002 mg/m^3. The NIOSH recommended standard is 0.001 mg/m^3. One general area sample was collected for sulfuric acid at the waste water treatment area, located near the plating line. Results indicated an airborne concentration of 0.11 mg/m^3, as compared to the OSHA standard and NIOSH recommended standard of 1 mg/m^3.

2. Pre-blend

One personal sample was collected from the operator and four general area samples were obtained for di(2-ethylhexyl)phthalate (DEHP) in the pre-blend area. The personal sample was reported at 0.03 mg/m^3, and one area sample, collected from the lower pre-blend area, was reported at 0.05 mg/m^3. The remaining area samples, collected at the PVC loading point, pigment storage area, and the weighing area, were below the analytical limit of detection, which correlates to < 0.03 mg/m^3. The OSHA standard is 5 mg/m^3. However, recent animal studies have shown significantly higher incidences of liver and testicular cancer as a result of exposure to DEHP at various concentrations.[4]

Due to the use of metal pigments in the pre-blend area, a personal sample was collected from the operator and analytically scanned for 31 metals. Results do not indicate any significant exposures to any of the metals.

3. Degreasing

One personal and three area samples were collected for perchloroethylene at the degreasing operation. Analytical results showed that the degreaser operator was exposed to an average of 86.1 mg/m^3 perchloroethylene. Because the tumbler operator declined to wear the personal sampler, a sample was obtained from his work area, indicating an airborne concentration of 250 mg/m^3. The remaining two area samples collected from the drying area and the degreasing operators' work area were reported at 100 and 40.9 mg/m^3, respectively. The OSHA standard for perchloroethylene is 679 mg/m^3, and the NIOSH recommended standard is 335 mg/m^3 based on non-carcinogenic health effects. However, since the release of the NIOSH criteria document,[5] NIOSH has published a Current Intelligence Bulletin on perchloroethylene (tetrachloroethylene) describing the potential carcinogenic effects from exposure and recommending that airborne concentrations be maintained at the lowest feasible level.[6] Observation of the degreasing process and conversations with the operator indicated that relatively higher exposures are perceived when "shafts" are degreased, and when increased production demands do not allow degreased parts to spend sufficient time in the locally ventilated drying area.

4. Methyl Ethyl Ketone

A total of ten personal samples were collected for MEK from six different work areas (Table IV). MEK exposures were a result of using the solvent as a glue, a cleaning agent, or using glues containing MEK. Of the four samples obtained from sheet metal workers, results ranged from less than the detectable limit (< 0.5 mg/m^3) to 169 mg/m^3. The remaining six samples, obtained from an employee working in handle repair, a bench operator, a bench assembler, a brush lacer, and two general assemblers, ranged from 0.59 to 14.1 mg/m^3. The NIOSH recommended standard[7] and the OSHA standard for MEK is 590 mg/m^3.

5. Asbestos

Commutators are molded, and subsequently machined in two areas. These plastic devices contain asbestos which is liberated during the machining operation. One personal and two area samples were collected in Department 2300 for airborne asbestos. The personal sample indicated an exposure of 1.2 fibers per cubic centimeter of air (fibers/cc) for the grinder operator. The area sample collected near the fabric dust collector for the abrasive machining operation showed an airborne concentration of 1.9 fibers/cc, and the area sample collected approximately 25 feet from the collector showed a concentration of 0.4 fibers/cc. These environmental data indicate that the fabric collector is not an efficient method of filtration. In addition, this method represents a type of recirculation of locally exhausted air, which is not advisable when toxic substances are contained in the air stream. Two area samples collected in Department 16, where the commutators are joined with a copper harness, were reported at 0.05 and 0.04 fibers/cc. The OSHA standard for asbestos is five fibers/cc (fibers greater than 5 um in length). NIOSH recommends that a new occupational standard be promulgated, designed to eliminate non-essential asbestos exposures, and which requires the substitution of less hazardous and suitable alternatives where they exist. Where asbestos exposures cannot be eliminated, they should be controlled to the lowest level possible.[8]

Although no sampling was conducted in the molding area for airborne asbestos, an operator was observed using high pressure air to clean the area surrounding the injection molding machine of the powdered resin containing asbestos.

6. Motor Assembly Area (Departments 90 and 10)

Resins containing styrene are applied to internal motor parts using automated "trickle machines". Two personal samples were collected for styrene exposures from the trickel machine operators. Results showed airborne concentrations of 1.1 and 1.8 mg/^{3}, as compared to the OSHA standard of 430 mg/m^3. Three personal samples were collected in Department 90 for butyl cellosolve and ethylene glycol ethyl ether which are contained in the varnish used to coat motor parts. All results for butyl cellosolve were below the analytical limit of detection, which corresponded to airborne concentrations of < 0.3 mg/m^3, as compared to the OSHA standard of 240 mg/m^3. Exposures to ethylene glycol ethyl ether measured on the same sampling tubes were reported at concentrations ranging from 0.7 to 2.3 mg/m^3. The OSHA standard for this substance is 740 mg/m^3.

7. Radiofrequency (RF) radiation

The concern for employee health when working with RF heat sealers is based on experiments in animals which suggest that absorbing excessive amounts of RF energy may result in changes in the eye, the central nervous system, conditioned reflex behavior, heart rate, chemical composition of the blood, and the immunologic system. Effects on reproduction and on the development of offspring of females exposed during pregnancy have also been reported.

RF measurements were obtained in the upright vacuum sweeper assembly area near the RF heat sealers and near the RF pre-heaters for the injection molders. Six of the ten RF heat sealers were monitored. In addition to measurements obtained at six individual locations (at the worker head and waist level), eight readings were obtained for both the electric and magnetic fields at positions near the source of each heat sealer monitored. Instrument readings were corrected to reflect duty cycles (the duty cycle is the RF on-time divided by the total process time). The average of the source measurements was 32,400 V^2/m^2 and 1.15 A^2/m^2 (electric field and magnetic field, respectively). Measurements obtained at the worker positions were much lower. The average of the worker measurements at head and waist level was 1,850 V^2/m^2 and 0.012 A^2/m^2. The OSHA standard, based on average measurements obtained over any six minute work period, is 4.0 X 10^4 or 40,000 V^2/m^2 (E-field), and 0.25 A^2/m^2 (H-field). Based on the RF data obtained during the NIOSH evaluation, average worker exposures are well within the standard. However, for continued worker protection a set of precautionary measures, developed for publication in a joint NIOSH/OSHA Current Intelligence Bulletin,[9] are presented in Appendix A.

Measurements obtained near the 12 RF pre-heaters in the injection molding area were much less. Approximate head and waist level measurements were made at each location. Because the machines are automated, measurements were made at locations where operators or set-up men would be positioned when needed. The average E-field measurements were 292 V^2/m^2, and the average H-field measurements were 0.0023 A^2/m^2.

8. Metals

Four breathing zone samples were obtained from maintenance welders for determination of exposures of metal fumes (Table V). A metal scan via ICP-AES analysis[10] was conducted on one of the samples to determine significant exposure. Results of this analysis indicated airborne concentrations of chromium at 0.003 mg/m^3, copper at 0.006 mg/m^3, iron at 3.48 mg/m^3, manganese at 0.43 mg/m^3, nickel at 0.002 mg/m^3, and lead at 0.019 mg/m^3. Based on this analysis, the three remaining samples were analyzed for these six compounds. Results showed exposures to copper from 0.001 to 0.004 mg/m^3, iron from 0.105 to 1.663 mg/m^3, and manganese from 0.004 to 0.132 mg/m^3.

Levels of nickel and chromium were below the analytical limit of detection, which correlates to generally less than 0.004 mg/m^3. Lead exposures ranged from 0.009 to 0.032 mg/m^3. The 0.032 mg/m^3 exposure is significant in light of the OSHA lead standard, effective November 14, 1978, and appended October 23, 1979[3]. The new standard makes provisions for an "action level" of 0.030 mg/m^3, requiring monitoring every six months for each exposed employee, and if exposures are above this level (0.030 mg/m^3) for more than 30 days a medical surveillance program is required including a medical examination and blood lead level testing.

A similar strategy was used to determine metal exposures in the foundry area (submission of one sample for metal scan for determination of significant exposures). Aluminum, iron, and phosphorus were analyzed on the remaining samples. Results of breathing zone samples for aluminum indicated exposures ranging from <0.004 to 0.014 mg/m^3, iron from <0.004 to 0.018 mg/m^3, and phosphorus from <0.005 to 0.008 mg/m^3. These exposures are well below the applicable evaluation criteria.

9. Oil Mist

Environmental sampling was conducted for oil mist in the foundry and Department 2400 (automatics). In the foundry, a water-based emulsified oil (Aqualube) is used to lubricate the dies on all but one die cast machine. Personal samples were collected from three operators, with concentrations ranging from 0.88 to 1.15 mg/m^3, one trucker (0.38 mg/m^3), and one maintenance worker supplying oil to the die casters (0.28 mg/m^3). Two area samples collected in the work areas of two die casters were reported at 0.48 and 0.98 mg/m^3. The personal sample collected from the operator of the die caster using Trimsol® (die cast machine #44334) was reported at 15.27 mg/m^3. Upon analysis of these samples, it was determined that these exposures should probably be considered as Trimsol® or Aqualube®, because these substances do not fulfill the definition of "oils". In the absence of any health related research on these substances, exposures would probably be regulated as inert or nusiance substances, which have an OSHA standard of 15 mg/m^3.

In Department 2400 (automatics) results of three personal samples for oil mist ranged from 0.17 to 0.27, averaging 0.22 mg/m^3. Two area samples collected in the general work area were reported at 0.15 and 0.20 mg/m^3.

B. Medical

1. Foundry Workers

The characteristics of the 48 foundry workers seen are as follows:

Sex: 47 males; 1 female
Race: 44 whites; 4 blacks
Age; 21 to 63 years (Mean age = 37 years; median age = 36 years)
Duration of employment in the foundry; less than one year to 37 years (Mean duration = 10 years; median duration = 6 years)
Smoking status: 22 non-smokers; 26 smokers

Several statistical analyses were done to assess the effect of smoking and duration of employment in the foundry on pulmonary function and respiratory symptoms in these foundry workers.

Univariate regressing analysis showed a statistically significant effect ($p<0.05$) for duration of employment in the foundry versus FVC and FEV_1/FVC ratio (corrected for smoking status). However, closer examination of the data showed that there was an improvement in these indices of lung function with increasing duration of employment in the foundry. This may be due to a spurious effect, employee turnover or due to some other extraneous factors which affect the measurements for which we have no data.

Respiratory symptoms asked for include the occurrence of morning cough, cough during the day, morning phlegm, phlegm during the day, breathlessness on walking at one pace, breathlessness on walking with people of similiar age, breathlessness on hurrying on level ground or up a slight hill, and wheezing. Only four symptoms were reported as positive to any appreciable degree. These were:

a) morning cough
b) morning phlegm
c) breathlessness on hurrying on level ground or up a slight hill
d) wheezing

These symptoms were analysed for an association with duration of employment in the foundry and smoking by categorizing years of employment in the foundry into two intervals; a) 0 to 5 years, b) more than 5 years, and smoking status into; a) current smokers, b) current non-smokers. The only significant association was between morning cough and smoking ($p<0.05$). There was no association between smoking and duration of employment in the foundry ($p = 0.2$). Mantel-Haenszel tests controlling for smoking indicated no significant relationship between duration of employment in the foundry with any of the four respiratory symptoms.

2. Methyl Ethyl Ketone (MEK) exposed workers

The ten MEK-exposed workers included five white males and five white females aged 30 to 61 years (Mean age = 46 years; median age = 48 years).

Laboratory analysis of the ten beginning-of-shift and ten end-of-shift blood samples showed the presence of MEK in only one end-of-shift sample. The blood level was 1.4 microgram/milliliter (ug/ml). The laboratory limit of detection was 0.02 ug/ml.

The symptom review for the day of blood collection showed that five of the ten workers (50%) had symptoms. Two had irritation of the nose and eyes, two had irritation of the nose alone, and one had drowsiness. The person with detectable MEK in the blood was symptom-free. Questionnaire returns from the ten employees in the comparison group (consisting of six white females and 4 white males aged 27 to 41 years) showed presence of symptoms in six of them (60%).

VII. DISCUSSION AND CONCLUSIONS

Exposure to aluminum dust and fumes have been linked to lung fibrosis, a condition for which the terms "aluminum lung" and "aluminosis" have been used.[11] The pathogenesis of this condition is unclear, and it is uncertain whether a specific pathological entity exists. This health hazard evaluation did not demonstrate any significant exposure to aluminum dust or fumes in the foundry. Oil mist levels were however detected at more than the OSHA standard of 15 mg/m^3 at one location. Pulmonary function tests showed no deterioration in lung function or presence of respiratory symptoms associated with increasing duration of employment in the foundry.

Exposure to MEK was detected in 8 of 10 personal samples. The MEK-in-air levels ranged from 4.8 to 169.7 mg/m^3. However, systemic absorption was demonstrated in only one worker. The blood MEK level in this one worker was 1.4 ug/ml, and was not related to the occurrence of symptoms. The health implications of such absorption in the absence of symptoms is uncertain. There was also no significant difference in occurrence of symptoms in the MEK-exposed group and the comparison group.

Asbestos monitoring indicated that the fabric collector used in Department 2300 is not an effective method of controlling airborne exposure. Measurable quantities of airborne asbestos were also obtained in Department 16, which warrents continued surveillance.

Airborne concentrations of Perchloroethylene at the degreasing operation ranged from 40.9 to 250 mg/m^3. Due to the carcinogenic potential of this substance, recommendations for exposure reduction are made in Section VIII of this report.

VIII. RECOMMENDATIONS

The following recommendations are based on the data collected and observations made during the evaluation, and are intended to reduce the potential for occupational disease.

1. Recirculation of the locally exhausted air from the commutator grinding operation should be discontinued, and the air should be routed to the outside. Efforts to minimize exposures at this location and at the joining operation should be initiated, along with periodic environmental monitoring for asbestos.

2. Efforts to minimize exposures to perchloroethylene at the degreasing operation should be initiated, including evaluation and improvement of the ventilation system, and an investigation of work practices during periods of increased production demands, toward avoidance of inadequate drying times under the existing local exhaust ventilation.

3. Workers at the pre-blend area should be made aware of the potential carcinogenic properties of DEHP, and efforts to minimize exposures to this substance should be continued.

4. An investigation of the die casting machine #44334 in the foundry area should be undertaken to determine the cause of excessive smoke generated during operation. Strategic positioning of the existing floor fans should help reduce exposures.

5. Injection molding machine purges should be conducted at temperatures specified by the manufacturer of the purge material. High temperature purges have caused excessive smoke generation in the past, as reported by numerous employees and observed by the NIOSH investigators during the site visit.

6. Industrial chemicals and food should not be stored in the same refrigerator. Where chemicals are kept in a refrigerator, a clear warning notice should be displayed indicating that the refrigerator concerned should only be used for the storage of chemicals and not for food or drinks.

7. It is advisable that food and drinks should not be consumed in areas of the factory where there is considerable usage of chemicals, such as near plating tanks and large vats and open containers of chemicals in liquid and powder form. Ideally a geographically separate area should be provided for the specific purpose of consuming food and drinks.

8. Old containers used to store chemicals different from what they originally contained should have the old labels replaced with new ones relevant to the present chemical. This avoids cautionary, first-aid and other information being confused as appropriate to the current chemical.

9. Solvent-soaked rags should not be disposed of in open containers kept in work areas. Industrial organic solvents can vaporize from such rags. Containers with lids may be more appropriate.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. Health hazard evaluation report no. HETA 82-127-1370. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1982.

2. American Conference of Governmental Industrial Hygienists. Threshold Limit Values for chemical substances and physical agents in the workroom environment with intended changes for 1982. Cincinnati, Ohio: ACGIH, 1982.

3. Occupational Safety and Health Administration. OSHA safety and health standards. 29 CFR 1910.1000. Occupational Safety and Health Administration, revised 1983.

4. National Toxicology Program, 1981. Carcinogenesis bioassay of di-(2-ethylhexyl)phthalate. Research Triangle Park, N.C.: NTP, DHHS Publication No. (NIH) 81-1773.

5. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to tetrachloroethylene (perchloroethylene). Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-121).

6. National Institute for Occupational Safety and Health. Current intelligence bulletin 20--tetrachloroethylene (perchloroethylene). Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHHS (NIOSH) publication no. 78-112).

7. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to ketones. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHEW publication no. (NIOSH) 78-173).

8. National Institute for Occupational Safety and Health. Workplace Exposure to Asbestos. National Institute for Occupational Safety and Health, 1980. (DHHS (NIOSH) publication No. 81-103).

9. National Institute for Occupational Safety and Health. Current intelligence bulletin 33--radiofrequency (RF) sealers and heaters: potential health hazards and their prevention. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1980. (DHHS (NIOSH) publication no. 80-107).

10. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 7, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 82-100).

11. Parkes WR. Occupational Lung Disorders: Butterworths & Co. (Publishers) Ltd., 1974.

12. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 4, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHEW (NIOSH) publication no. 78-175).

13. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 2, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW (NIOSH) publication no. 77-157-B).

14. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 3, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW (NIOSH) publication no. 77-157-C).

15. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 6, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1980. (DHHS (NIOSH) publication no. 80-125).

16. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 5, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1979. (DHEW (NIOSH) publication no. 79-141).

17. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 1, 2nd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW (NIOSH) publication no. 77-157-A).

18. Morgan WKC, Seaton A. Occupational lung diseases. Philadelphia: W.B. Saunders Company, 1975.

19. National Institute for Occupational Safety and Health. Occupational diseases: a guide to their recognition. Revised ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW (NIOSH) publication no. 77-181).

20. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to chromium VI. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976. (DHEW publication no. (NIOSH) 76-129).

21. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to inorganic nickel. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-164).

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SAMPLING AND ANALYTICAL METHODOLOGY

HOOVER COMPANY MAIN PLANT
NORTH CANTON, OHIO

APRIL 11-15, 1983
HETA 82-280

Substance	Collection Device	Flow Rate (lpm)	Analysis	Detection Limit mg./Sample	Reference
Metals (general)	AA filter	1.5	ICP - AES	0.001	NIOSH P&CAM 351[10]
Oil Mist	PVC filter	1.5	IR	0.025 - 0.125	NIOSH P&CAM 283[12]
Methyl ethyl ketone	Amber sorb	0.05	Gas Chromatography	0.01	NIOSH S-3[13]
Hydrochloric Acid	Silica gel	0.2	Ion Chromatography	0.004	NIOSH P&CAM 339[10]
Sulfuric Acid	Silica gel	0.2	Ion Chromatography	0.004	NIOSH P&CAM 339[10]
Nickel	AA filter	1.5	Atomic Absorption	0.002	NIOSH S-206[14]
Chromium	AA filter	1.5	Atomic Absorption	0.001	NIOSH S-323[14]
Chromium VI	FWSB filter	1.5	Visible Spectroscopy	0.0001	NIOSH P&CAM 319[15]
PNA's (17)	Fluoropore filter	1.5	HPLC Chromatography	0.00025/0.00005	TB 001
Butyl Cellosolve	Charcoal	0.1	Gas Chromatography	0.01	NIOSH S-361[16]
Ethylene Glycol Ethyl Ether	Charcoal	0.1	Gas Chromatography	0.01	NIOSH S-361[16]
DEHP	AA filter	1.0	Gas Chromatography	0.01	NIOSH S-40[13]
Styrene	Charcoal	0.1	Gas Chromatography	0.01	NIOSH S-30[13]
Perchloroethylene	Charcoal	0.1	Gas Chromatography	0.01	NIOSH S-335[14]
Asbestos	AA filter	1.5	Phase Contrast Microscopy	0.03 fibers/field	NIOSH P&CAM 239[17]

TABLE II

EVALUATION CRITERIA

HOOVER COMPANY MAIN PLANT
NORTH CANTON, OHIO

APRIL 11-15, 1983
HETA 82-280

Substance	Evaluation Criteria (mg/m^3)			Primary Health Effects
	NIOSH	OSHA	ACGIH	
Asbestos	LFL*	5 fibers/cc	0.5 fibers/cc	Asbestosis; Mesothelioma - Also, there is evidence that exposure to asbestos dust and smoking of cigarettes contribute synergisticaly to the development of lung cancer in man. Ingestion of asbestos fibers has recently been suspected of contributing to cancer in the gastrointestinal tract.[18-19]
Butyl Cellosolve	---	240	120	Excessive exposure may cause conjunctivitis and upper respiratory tract irritations. Symptoms from repeated overexposure to vapors are fatigue and lethargy, headache, nausea, anorexia, and tremor. Of particular concern are recent animal studies which suggest that exposure to derivitives of glycol ether are associated with skeletal malformations in the offspring of exposed females and testicular atrophy (dimishing size of organ) of exposed males.
Cadmium	0.04	0.2	0.05	Respiratory tract irritant; acute effects include cough, pain in the chest, sweating, and chills which resemble the symptoms of nonspecific respiratory infection. Chronic cadmium poisoning may result in emphysema.

(Continued)

TABLE II
(Continued)

Substance	Evaluation Criteria (mg/m^3) NIOSH	OSHA	ACGIH	Primary Health Effects
Chromium	---	1	0.5	May act as an allergen which causes dermatitis to exposed skin, and may cause pulmonary sensitization. In electroplating operations, workers may experience a variety of symptoms including lacrimation, inflammation of the conjunctiva, nasal itch and soreness, epistaxis, ulceration and perforation of the nasal septum, congested nasal mucosa and turbinates, chronic asthmatic bronchitis, dermatitis and ulceration of the skin, infalmmation of the laryngeal mucosa, cutaneous discoloration, and dental erosion. Hepatic injury has been reported from exposure to chromic acid used in plating baths, but appears to be rare.
Chromium VI	0.001	0.5	0.05	In addition to the effects listed above for chromium compounds, some chromium VI compounds have been associated an increased incidence of lung cancer.[20]
Di(2-ethylhexyl) phthalate	---	5	5	Although little adverse human toxicity data is available, recent rat and mouse exposure studies have shown significantly higher incidences of liver and testicular carcinoma.[4]
Ethylene glycol ethyl ether	---	740	185	The glycol ethers are only mildly irritating to the skin. Vapor may cause conjunctivitis and upper respiratory tract irritation. Temporary corneal clouding may also result and may last several hours. Acute exposure to high concentrations of these compounds results in narcosis, pulmonary edema, and severe kidniey and liver damage. Symptoms from repeated overexposure to vapors are fatigue and lethargy, headache, nausea, anorexia, and tremor. Anemia and encephalopathy have been reported with this substance.

(Continued)

TABLE II
(Continued)

Substance	Evaluation Criteria (mg/m³) NIOSH	OSHA	ACGIH	Primary Health Effects
Hydrochloric Acid	---	7 (c)**	7 (c)	Hydrochloric acid and high concentrations of hydrogen chloride gas are highly corrosive to eyes, skin and mucous membranes.
Nickel	0.015	1	1	Skin sensitization resulting in chronic eczema and irritation to the conjunctiva of the eye and the mucous membrane of the upper respiratory tract may occur. Elemental nickel and nickel salts may be carcinogenic, [illegible] passages. [illegible]
Methyl ethyl ketone	590	590	590	This class of solvents may produce a dry, scaly, and fissured dermatitis after repeated exposure. High vapor concentrations may irritate the conjunctiva and mucous membranes of the nose and throat, producing eye and throat symptoms. Narcosis is also possible at high concentratios, with headache, nausea, light headedness, incoordination, and unconsciousness.[7,18]
Oil Mist	---	5	5	While contact with the liquid may cause dermatitis, inhalation of mineral oil mist has rarely shown any toxic effects. Of concern in the past, was the addition of nitrosoamines to synthetic cutting oils to aid in prevention of bacterial growth. However, with increasing awareness of the toxicity of nitrosoamines, this practice is no longer continued. Another previous concern was for the presencs of polynuclear aromatic hydrocarbons (PNAs) in unrefined mineral oils. There are historical [illegible]

TABLE II
(Continued)

	Evaluation Criteria (mg/m^3)			
Substance	NIOSH	OSHA	ACGIH	Primary Health Effects
Perchloroethylene	LFL	679	335	Acute exposure to may cause central nervous system depression, hepatic injury, and anesthetic death. Signs and symptoms of overexposure include malaise, dizziness, headache, increased perspiration, fatigue, staggering gait, and slowing of the mental ability. Direct contact with the skin can cause burns, blistering, and erythema due to the "degreasing" effect. Recent animal studies indicate an increased risk of liver cancer following exposures to perchloroethylene. NIOSH considers perchloroethylene as a suspect carcinogen and believes that neither the current OSHA standard or the NIOSH recommended standard may be low enough to provide adequate protection from the potential carcinogenic effects.[5-6]
Styrene	---	420	210	Acute exposure to high concentrations may produce irritation of the upper respiratory tract, nose, and mouth, followed by symptoms of narcosis, cramps, and death due to respiratory center paralysis. Effects of short-term exposure to styrene under laboratory conditions include prolonged reaction time and decreased manual dexterity.

* LFL = Lowest Feasible Limit
** c = ceiling value

TABLE III

SUMMARY OF ENVIRONMENTAL RESULTS WITH EVALUATION CRITERIA

HOOVER COMPANY MAIN PLANT
NORTH CANTON, OHIO

APRIL 11-15, 1983
HETA 82-280

Area	Substance	Concentrations mg/m^3	NIOSH mg/m^3	OSHA mg/m^3
Plating Line	Hydrochloric Acid	< 0.007	---	7.0
	Chromium VI	< 0.0002	0.0001	0.5
	Chromium	< 0.002	---	1.0
	Nickel	< 0.004	0.015	1.0
Waste Water	Sulfuric Acid	0.11	---	1.0
Pre-Blend	Cadmium	< 0.001	0.04	0.2
	Chromium	< 0.003	---	1.0
	Di(2-ethylhexyl)phthalate	< 0.03 - 0.05	---	5.0
Degreasing	Perchloroethylene	40.9 - 250	LFL*	679
Glue Lines	Methyl ethyl ketone	0.6 - 14.1	590	590
Assembley	Asbestos	0.04 - 1.88**	LFL	5.0
Motor Assembly	Styrene	1.5	---	425
	Butyl Cellosolve	< 0.3	---	240
	Ethylene Glycol Ethyl Ether	0.7 - 2.3	---	740
Foundry	Aluminum	< 0.1	---	---
	Iron	≤ 0.1	---	10.0
	Phosphorus	≤ 0.1	---	1.0
	Oil Mist	0̄.28 - 15.27	---	15.0
Automatics	Oil Mist	0.17 - 1.15	---	15.0
Welding	Chromium	< 0.003	---	1.0
	Copper	0̄.001 - 0.006	---	0.1
	Iron	0.105 - 3.48	---	5.0
	Manganese	0.004 - 0.433	---	1.0
	Nickel	< 0.002	0.015	1.0
	Lead	0̄.009-0.032	0.050	0.050

LFL = Lowest Feasible Limit

TABLE IV

METHYL ETHYL KETONE EXPOSURES

HOOVER COMPANY MAIN PLANT
NORTH CANTON, OHIO

APRIL 11-15, 1983
HETA 82-280

Sample #	Duration	Operation	Exposure Concentration (mg/m^3)
MK 1	07:23-14:15	Sheet Metal	<0.53
MK 2	07:25-14:15	Sheet Metal	8.10
MK 3	07:31-14:15	Sheet Metal	169.71
MK 4	07:33-14:15	Sheet Metal	<0.51
MK 5	07:59-14:35	Handle Repair	4.81
MK 6	08:08-14:53	Bench Operator (1300)	14.06
MK 7	08:10-14:40	Bench Assembler (55)	7.41
MK 8	08:26-14:40	Brush Lacer (1900)	12.36
MK 9	08:43-14:45	Assembler (55)	8.59
MK 10	08:45-14:45	Assembler (55)	0.59

TABLE V

METAL EXPOSURES; WELDING

HOOVER COMPANY MAIN PLANT
NORTH CANTON, OHIO

APRIL 11-15, 1983
HETA 82-280

Sample #	Duration	Concentration (mg/m3)					
		Chromium	Copper	Iron	Manganese	Nickel	Lead
W-1	06:53-14:40	0.003	0.006	3.478	0.433	0.002	0.019
W-2	06:54-14:55	<0.004	0.003	1.663	0.132	<0.004	0.032
W-3	06:55-14:40	<0.004	0.001	0.105	0.004	<0.004	0.009
W-4	06:57-14:55	<0.004	0.004	1.004	0.075	<0.004	0.018

TABLE VI

METAL EXPOSURES; FOUNDRY

HOOVER COMPANY MAIN PLANT
NORTH CANTON, OHIO

APRIL 11-15, 1983
HETA 82-280

Sample #	Duration	Type	Operation	Concentration (mg/m³) Aluminum	Iron	Phosphorous
A-1	08:52-14:18	BZ*	Trucker	0.011	0.010	0.007
A-2	08:55-11:33	BZ	Oiler	<0.008	<0.008	<0.008
A-3	08:59-14:24	BZ	Die Caster	<0.004	<0.004	0.005
A-4	09:02-14:22	BZ	Die Caster	0.006	0.002	0.006
A-5	09:28-14:24	BZ	Die Caster	0.013	0.011	0.008
A-6	09:24-14:22	Area**	Die Cast #56	0.020	0.151	0.078
A-9	09:09-14:27	Area	Die Cast #51	0.017	0.018	0.005
A-101	10:55-14:29	BZ	Die Cast	0.014	0.011	0.007

* Breathing Zone Sample
** General Area Sample

APPENDIX A

Recommendations for RF Hazard Control

Immediate Actions

Control of the emission of RF energy from RF sealers and heaters should rely on the application of properly designed and installed shielding material. The shielding should be placed on or around the equipment so as to minimize occupational exposure due to emissions of stray RF energy. All shielding material should be properly grounded. Shielded conductors should be used for conveying RF current, and path impedance should be minimized by using good conductor materials.

The distance between the worker and the source of RF energy emission should be maximized. Examples of means to accomplish this include the use of automatic feeding divices, rotating tables, and remote materials handling.

The RF sealing ana heating equipment should be electronically tuned to minimize the stray power emitted.

Whenever possible, equipment should be switched off when not being used. Maintenance and adjustment of the equipment should be performed only while the equipment is not in operation.

After the performance of maintenance or repair, all machine parts, including cabintry, should be reinstalled so that the equipment is intact and its configuration is unchanged.

Warnings and Information

Access to the vicinity of RF sealers and heaters where there may be stray RF energy should be limited as much as possible to the operator and necessary assistants, maintenance personnel, and industrial hygiene or safety personnel. Use of the RF equipment should be restricted to properly trained personnel.

Areas in which exposures to RF energy have been determined to be appreciable should be posted. Any signs should be of such size as to be recognizable and readable from a distance of three meters. All warning signs must be printed in English and in the predominant languages of non-English-reading workers, ana should conform to the desing recommended by OSHA.

Areas in which the RF energy is present at levels higher than the permissible exposure limit also should be posted. The warning signs should contain the following additional information: HAZARD -- DO NOT ENTER. The sign must be readable from a distance of three meters. The perimeter of the restricted area should be clearly demarcated with signs visible to all personnel approaching the area.

Medical Monitoring

A medical surveillance program, tailored to the expected degree of employee use of RF equiment and potential for exposure to RF energy, should be developed. The program should include preplacement examination of all new-employees and an initial examination of all present employees subject to occupational exposure to RF energy, annual examinations should be considered for workers who may be exposed to RF energy on a regular, long-term basis. Work histories should be included in all examinations.

Medical histories and physical examinations should have particular emphasis upon target organs potentially affected by RF energy including the eye (cataracts), the central nervous system, the blood (decreased leukocyte count), the immune defense system, and the reproductive system. Adverse reproductive effects may involve both maternal and paternal exposure. For persons occupationally exposed to RF energy, medical records including health and work histories should be maintained throughout the period of employment and for an extended period after termination of employment.

Exposure Measurements

Areas in the occupational environment where levels of RF energy have been determined to be appreciable should be surveyed at regular intervals. Immediately following a physical or electronic alteration of the equipment or an alteration in the process, a complete survey should also be performed. If measurments taken during a survey indicate that occupational exposure exceeds the permissible exposure limit, a second survey should be made on the next workday. If the limit is still exceeded, the use of RF equipment producing excessive values should be prohibited until appropriate controls have been instituted. The survey data sheets should contain all information pertaining to the survey, and should include the date and time of measurement, the type of monitoring equipment used, the employees' names, and the remedial actions taken, if any. These records should be maintained for an extended period of time.

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