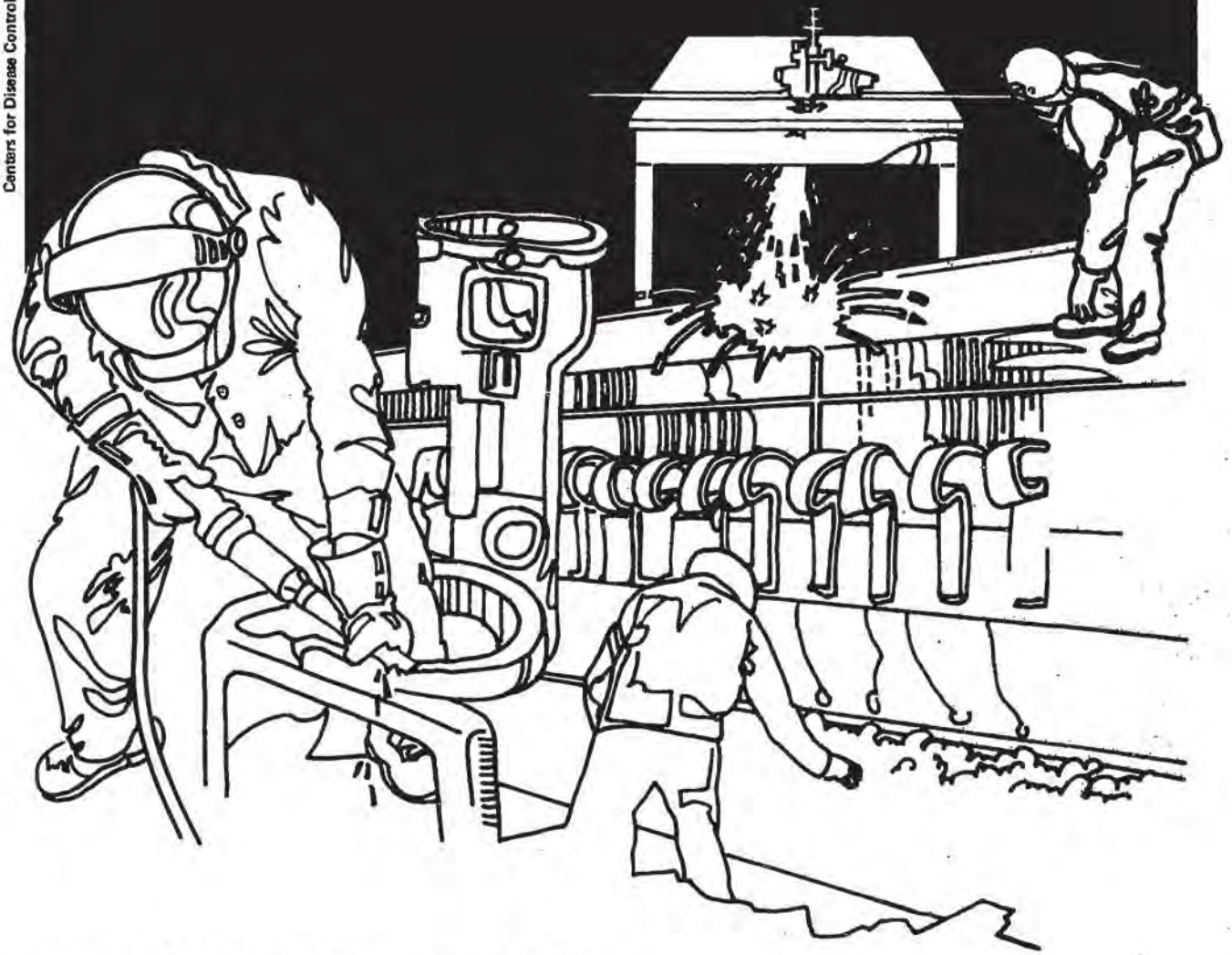
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 81-384-1443
FMC CORPORATION
TIPTON, INDIANA

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.

HETA 81-384-1443
March 1984
FMC CORPORATION
TIPTON, INDIANA

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I. SUMMARY

In July 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate occupational exposures to paint mist in the primer parts spray paint booth and to airborne dust in the sanding area of the FMC Fire Apparatus Facility in Tipton, Indiana.

NIOSH investigators conducted an environmental survey at the plant on September 28 - October 1, 1981. Personal breathing zone and area air samples were collected for measurement of employee exposure to solvents, metals, particulates, and polynuclear aromatic hydrocarbons (PNA's) during the sanding and painting of fire vehicles. Analysis of the air samples produced the following ranges of concentrations which are compared with their respective exposure criteria (EC): (solvents) cellosolve acetate, 4.9-6.1 mg/m^3 (EC - 27 mg/m^3); coal tar naphtha, 55.2 - 128 mg/m^3 (EC - 400 mg/m^3); toluene, 73.1 - 123 mg/m^3 (EC -375 mg/m^3); VM&P naphtha, 68.4 - 209 mg/m^3 (EC - 350 mg/m^3); and xylene, 29.2 - 46.1 mg/m^3 (EC - 435 mg/^{3}); (metals) chromium, nondetectable (N.D.) - 65.6 ug/m^3 (EC - 500 ug/m^3); cobalt, 5.5 -5.7 ug/m^3 (EC - 50 ug/m^3); lead, 8.6 - 48.6 ug/m^3 (EC - 50 ug/m^3); (particulates) respirable particulates, 0.9 - 3.2 mg/m^3 (EC - 5.0 mg/m^3); total particulates, 5.1 - 36.3 mg/m^3 (EC - 10 mg/m^3); (PNA's) PNA's, N.D. - 4.1 ug/m^3; cyclohexane solubles, N.D. - 968 ug/m^3 (EC - 100 ug/m^3). The measured concentrations to individual solvents were below NIOSH and ACGIH recommended levels and OSHA standards. However, one worker had potential overexposures to solvents based on the additive effect of the solvent vapor mixtures. Although the spray painter did wear a respirator, the protection afforded the painter using the respirator was inadequate as noted by the inefficient operating conditions of respiratory use as well as the types and concentrations of contaminants measured.

A medical questionnaire was administered to 9 employees (one full-time and one part-time primer parts spray painters, and 4 full-time and 3 part-time sanders). Review of the responses revealed occasional eye and upper respiratory irritation, and among the painters, these symptoms coincided with the use of the bitumastic coal tar paint. The seven sanding employees reported no symptoms thought to be occupationally related.

On the basis of the data obtained during this investigation, NIOSH has determined that a health hazard existed at the FMC Corporation due to overexposures to total particulates, to mixtures of organic solvents, and to coal tar paint containing PNA's. To improve workers safety and health, recommendations to reduce exposures are included in Section VIII of this report.

KEYWORDS:SIC 7535 (Paint Shops) 3711 (Motor Vehicles), spray painting, organic solvents, particulates, PNA's, cyclohexane solubles, pyrene, fluoranthene, phenanthrene, chrysene, benz(a)anthracene, benzo(e)pyrene, benzo(a)pyrene, benzo(k)fluoranthene, benzo(g,h,i)perylene

II. INTRODUCTION

On July 13, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Steel Workers of America, Local #2166, to evaluate employee exposures in the primer parts spray paint booth and sanding area of the FMC Corporation, Tipton, Indiana. The request was prompted because of the concern regarding exposures to paint mist particulates in the spray paint booth and to particulates in the sanding area.

NIOSH investigators conducted an environmental survey on September 28 - October 1, 1981. Interim Report #1 which included a brief work process description and a synopsis of the air sampling performed was distributed in December, 1981. Although no sampling results were reported, preliminary recommendations were given concerning respiratory and other personal protective equipment.

III. BACKGROUND

The FMC fire apparatus facility has been involved in manufacturing custom fire trucks since 1966. The total plant workforce, nearly 200 employees, consists of 70 administrative and clerical staff, 125 production workers, and 3 maintenance employees.

A. Primer Parts Spray Paint Booth

The primer parts booth, located in the southwest corner of the plant, is a relatively new (June 1981), open-face, "Binks Dynaprecipitor Water Wash" spray-paint booth. Incorporated in the paint booth are upper and lower centrifugal wash chambers supplied by a manifold-deflector plate assembly which disperses water uniformly across the curtain face.

There are three types of paint materials and solvent thinners used in the primer parts spray-paint booth:

1. An acrylic primer-surfacer paint, mixed with a toluene-based thinner in ratios of about 2:1, which is applied using a "Bink's 62" compressed air-atomizing gun fed from a 55 gallon reservoir drum. This primer paint is applied to various metal components of the fire trucks.

2. A "bitumastic" coal tar cut back, corrosive-inhibiting paint mixed with a coal tar solvent in ratios of about 11:1, is applied using a "Grayco bull dog" (airless equipment) pump at approximately 3000 PSI fluid pressure at the nozzel. This material is used on various sizes of fire truck water tanks and side cabinets.

3. A zinc-chromate based alkyd enamel primer paint is manually applied using a paint roller to the fire truck side cabinets.

Almost all painted items air-dry adjacent to and outside the primer-parts spray-paint booth.

The single employee spray-painting processes usually operate on a one shift, 5-day, 9-hour per day schedule with occasional 6-day operations.

B. Sanding Area

The sanding area, located in the northwest corner of the factory, adjacent to the truck masking area and the primer truck spray-paint booth, operates on a one shift, 5-day, 9-hour per day schedule. Four full-time and 2-3 part-time sanders work in this area sanding steel components of the fire trucks or entirely assembled fire trucks which have previously been primed or sometimes finish painted. Various grades of grit # sandpaper are used with hand held orbital, or oscillating pneumatic sanders.

IV. EVALUATION DESIGN AND METHODS

During the NIOSH survey on September 28 - October 1, 1981, long-term personal breathing zone and area air samples were collected for measurement of exposure to respirable and total particulates and metals in the sanding area, and coal tar products, solvents, metals, and total particulates in the primer parts spray paint booth. Bulk samples were collected to aid in the air sample analyses. The sampling and analytical methodology for these substances, including collection device, flow rate and referenced analytical procedures are presented in Table I.

On September 30, 1981, ventilation measurements were made in the primer parts spray paint booth using a Kurz velometer. All exhaust systems were operating while air tests were made.

To assess potential health effects, a non-directed medical questionnaire covering symptoms, chemical exposure, and medical and occupational history was administered to four full-time and 3 part-time sanders and 1 full-time and 1 part-time replacement primer parts spray painters.

V. EVALUATION CRITERIA

Environmental Criteria and Toxicological Effects

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 not usually 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)®, and 3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) occupational health standards. 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 exposure 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 required legally 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.

A. Chromium

Chromium compounds can cause an allergic dermatitis in some workers. Acute exposure to chromium dust and mist may cause irritation of the eyes, nose, and throat. Chromium exists as chromates in one of three valence states: 2+, 3+, and 6+ Chromium compounds in the 3+ state are of a low order of toxicity. In the 6+ state, chromium compounds are irritants and corrosive. This hexavelent form may be carcinogenic or non-carcinogenic. Workers in the chromate-producing industry have been repoted to have an increased risk of lung cancer (Bidstrup and Case, 1956).[2] ACGIH has adopted an 8-hour TLV of 0.5 mg/m^3, for chromium (3+) compounds[3] whereas the OSHA standard for chromium metal and insoluble salts is 1.0mg/m^3,[4]. NIOSH's recommended standard for carcinogenic chromium (6+) compounds is 0.001 mg/m^3. NIOSH also recommends a standard of 0.025 mg/m^3 for non-carcinogenic hexavalent chromium compounds, along with a 15-minute ceiling level of 0.05 mg/m^3.[5]

B. Coal tar naphtha[6]

Coal tar naphtha vapor is narcotic. Rats survived continuous exposure at 3200 ppm for two months; at 1800 ppm some animals showed damage to the liver and kidneys; above 1000 ppm there was evidence of narcotic action. Rats exposed at 567 ppm and 312 ppm for 18 to 20 hours a day for 7 days had some reduction in blood leukocytes, possibly the result of the presence of benzene. There are few if any well documented reports of industrial injury resulting from the inhalation of naphtha. However, exposure to high concentrations might be expected to cause lightheadedness, drowsiness, and possibly irritation of the eyes, nose, and throat. Repeated or prolonged contact with the liquid may result in drying and cracking skin due to defatting action. The current federal OSHA standard for coal tar naphtha is 100 parts of coal tar naphtha per million parts of air (ppm), (400 milligrams per cubic meter of air, mg/m^3) averaged over an eight-hour work shift.

C. Cobalt[6]

Cobalt metal fume and dust cause upper respiratory tract irritation, and skin sensitization. Chronic interstitial pneumonitis has been reported in workers in the cemented carbide industry, and cobalt has been conditionally implicated as the etiologic agent by a process of elimination of the other materials used in the industry. Symptoms range from shortness of breath, cough, dyspnea on exertion to permanent disability or death in some cases. Among 12 workers exposed to cobalt engaged in manufacture of, or grinding with, tungsten carbide tools, who developed interstitial lung disease, there were 8 fatalities; serial chest roentgenograms over a period of 3 to 12 years revealed gradually progressive densities of a linear and nodular nature which gradually involved major portions of both lungs, cough, dyspnea on exertion, and reduced pulmonary function occurred early in the course of the disease. The disease has features of hypersensitivity; only a small percentage of people exposed are affected and with little evidence of dose-response relationship. Cobalt and its compounds produce an allergic dermatitis of an erythematous papular type, which usually occurs in skin areas subjected to friction, such as the ankles, elbow flexures, and sides of the neck.

The current OSHA standard for cobalt metal fume and dust is 0.1 milligrams per cubic meter of air for an 8-hour time-weighted average. ACGIH has recommended an 8-hour TLV® of 0.05 mg/m^3 for cobalt metal fume and dust.

D. Lead

Inhalation of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposre is associated with infertility and with fetal damage in pregnant women. The current federal OSHA standard for airborn exposure to lead is 50 ug/m^3, calculated as an 8-hour time-weighted average (TWA) for daily exposures.[7]

E. Particulates and Respirable Dusts

In contrast to fibrogenic dusts which, when inhaled in excessive amounts, cause scar tissue to be formed in the lungs, so-called "nuisance" dusts are stated to have little adverse effect on lungs and do not produce significant organic disease or toxic effects when exposures are kept under reasonable control. The "nuisance" dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the exent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung tissue reaction caused by inhalation of "nuisance dusts: has the following characteristics: 1) the architecture of the air spaces remains intact; 2) collagen (scar tissue) is not formed to a signficant extent; and 3) the tissue reaction is potentially reversible.

Excessive concentrations of dusts in the workroom air may seriously reduce visibility, may cause irritation of the eyes, ears, and nasal passages or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedures necessary for their removal.[3]

Respirable dusts, called such due to their size characteristics and ability to be inhaled, include particulates with more restrictive size range parameters than total nuisance dusts. In general, particulates between 5 and about 0.5 microns in size are deposited in the alveoli and respiratory bronchioles and some types of dust of such sizes can cause pulmonary fibrosis. Most of the particles five microns and larger are collected in the upper respiratory passages. Like nuisance dusts, the overall effects of respirable particulates are dependent on their site of deposition and on their toxic and antigenic properties.[8]

OSHA's standard for inert or nuisance dusts (less than 1% crystalline silica) is 15 mg/m^3 (50 mppcf) and for total dust, and 5 mg/m^3 (15 mppcf) for respirable dusts.[3] ACGIH has a TLV® of 10 mg/m^3 for total dust (less than 1% quartz) and 5 mg/m^3 for respirable dust.

F. Organic Solvents
(Cellosolve acetate, xylene, and toluene)

These solvents as a group have some common systemic effects. They can cause fatigue, headache, drowsiness, nausea, vomiting,

dizziness, loss of coordination and other central nervous system effects. Irritation of the eye, mucous membranes and the respiratory tract can also occur. Liver damage can result, with increase in blood levels of liver emzymes such as alanine aminotransaminase, aspartate aminotransaminase and gamma glutamyl transpeptidase. Cellosolve acetate causes central nervous system depression in animals and similar effects may be expected in humans with severe exposure.[9] Animals exposed to 2-ethoxyethanol, a glycol ether, have shown significant increases in embryonic deaths, fetal abnormalities, testicular atrophy and microscopic testicular changes, altered behavioral test results, and changes in brain neuro-chemical concentrations. Preliminary test results of some compounds structurally related to glycol ethers such as cellosolve acetate (2-ethoxyethyl acetate) indicate that they may have the potential for causing adverse reproductive effects similar to 2-ethoxythanol.

Listed below are the environmental evaluation criteria for three solvents for which NIOSH collected air samples.

Environmental Evaluation Criteria[1]

Substance	NIOSH Recommended Standard (mg/m^3)	ACGIH TLV® (mg/m^3)	OSHA Standard (mg/m^3)
Cellosolve Acetate	---	27[2]	540
Toluene	375	375	750
Xylene	435	435	435

1. All air contaminants are time-weighted average (TWA) exposures for a full workday, 40-hour workweek.

2. From the ACGIH[3] TLV® Notice of Intended Changes for 1983-84.

G. Coal Tar Products

The term "coal tar products" as used in the NIOSH recommended standard, includes coal tar, coal tar pitch, and creosote. Coal tar, coal tar pitch, and creosote derived from the destructive distillation of bituminous coal, often contain identifiable components which by themselves are carcinogenic, such as benzo(a)pyrene, benzanthacene, and chrysene. Other chemcials from coal tar products such as anthracene, fluoranthene, and pyrene may also cause cancer, but these causal relationships have not been adequately documented. Exposures to coal tar products have been reported to produce phototoxic effects, such as skin erythema (irritation), burning and itching of the skin, photophobia (visual intolerance to light), and conjunctivitis (eye inflammation). From the epidemiologic and experimental toxicologic evidence on coal tar products, NIOSH has concluded that they are carcinogenic and can increase the risk of lung and skin cancer in workers.[10]

Coal tar pitch volatiles (CTPV's), particulate polycyclic organic material (PPOM), and polynuclear aromatic hydrocarbons (PNA's) are terms frequently encountered in dealing with coal tar and its products. CTPV refers to the volatile matter emitted into the air when coal tar, coal tar pitch, or their products are heated, and may contain several PNA's (also referred to in the literature as PAH's). PPOM refers to condensed ring aromatic hydrocarbons normally arising from pyrolysis of organic matter. PNA's in the occupational environment can result from coal tar, heavy petroleum fractions, PPOM, and other materials. PNA's contain many substances often thought or known to be carcinogenic. Some of the PNA's that have been identified in coal tar, coal tar pitch, or creosote include benz(a)anthracene, benzo(k)fluoranthene, benzo(g,h,i)anthracene, and phenanthrene.[6,10]

NIOSH recommends that occupational exposure to coal tar products be controlled so that workers are not exposed to coal tar, coal tar pitch, creosote or mixtures of these substances at concentrations greater than 0.1 mg/m^3 of the cyclohexane-extractable fraction of the sample as a time-weighted average (TWA) concentration for up to a 10 hour shift in a 40-hour workweek. The rationale in choosing the 0.1 mg/m^3 TWA limit for cyclohexane extractable fraction is chiefly based on the fact that it is the least concentration reliably detected by the current method of air sampling and laboratory analysis. If the sampling and analytical methodolgy is refined further, resulting in an increase in the sensitivity, the NIOSH recommended standard may be reviewed and

revised as necessary. NIOSH has stated that while compliance with the limit should reduce the incidence of cancer, no absolute safe concentration can be established for a carcinogen. Therefore, the recommended limit should be regarded as an upper limit of exposure and every effort should be made to keep exposures as low as is technically feasible. The federal OSHA standard for coal tar pitch volitiles, is 0.2 mg/m^3 averaged over an eight-hour workshift.[4,6,10]

H. VM&P Naphtha

Varnish Makers' & Painters' Naphtha is a clear, flammable liquid with a typical composition of 55.4% paraffins, 30.3% monocycloparaffins, 2.4% dicycloparaffins, 0.1% benzene, 11.7 % alkylbenzenes, 0.1% indans and tetratins. This refined petroleum solvent is used as a diluent for paints, coatings, resins, printing inks, and rubber and cements. There was no dosage related significant difference between the controls and the rats or the beagles which inhaled 500 ppm (2333 mg/m^3) for 30 hours weekly for 13 weeks (65 days). There was no evidence of latent and chronic effect. Seven human subjects had upper respiratory tract irritation in 15 minues at 800 ppm (3733 mg/m^3). Also eye irritation was experienced by 3 and transient olfactory fatigue occurred.

No studies have been found on the effect of dermal exposure to VM&P naphtha, but it is evident that, since C5-C8 alkanes, stoddard solvents, and mineral spirits are primary irritants VM&P naphtha, whose boiling range overlaps the ranges of these solvents, has solvent properties similar to these other solvents. VM&P naphtha is accordingly, also considered to be a dermal irritant.[12]

The current NIOSH recommended standard for occupational exposure to VM&P naphtha is 350 mg/m^3 (approx. 75 ppm) for a time-weighted average for up to a 10-hour work shift, 40-hour workweek.[12]

VI. RESULTS

Environmental

A. Primer Parts Spray Paint Booth

It should be noted that the workforce in the primer parts paint booth wore half-facepiece respirators with dual charcoal chemical cartridges.

1. Bulk analysis of the bitumastic coal tar paint:

   a. Total Cyclohexane solubles: 230 milligrams of cyclohexane solubles per gram of bulk material or 23%

   b. Specific PNA's analyzed quantitatively:
   (in parts per million (ppm))

   fluoranthene 16,500 ppm (limit of detection 400 ppm)
   pyrene 12,400 ppm (LOD 800 ppm)
   benz(a)anthracene 8040 ppm (LOD 200 ppm)
   chrysene 4700 ppm (LOD 800 ppm)
   benzo(a)pyrene 5930 ppm (LOD 200 ppm)

   c. PNA's identified but not quantitated:

   phenanthrene
   benzo(c)pyrene
   perylene
   anthracene
   dibenz(a,h)anthracene
   benzo(g,h,i)- perylene

2. Environmental Air Samples for Polynuclear Aromatic Hydrocarbons

   Results of the personal breathing zone and stationary area, air sampling performed during spray painting operations for PNA's are presented in Table II. Individual concentrations of PNA's ranged from nondetectable (N.D.) to 4.1 ug/m^3. The cyclohexane soluble fractions from the individual air samples ranged from N.D. to 968 ug/m^3. Both personal and two of three area full shift TWA air samples for cyclohexane solubles were well in excess of the NIOSH recommended standard (100 ug/m^3) and OSHA standard (200 ug/m^3).

3. Environmental Air Samples for Metals, Particulates, and Solvents

   Results of the personal and area air samples taken during spray painting operations for assessment of exposures to lead, chromium, cobalt, and total particulates are presented in Table III. The air samples for metals and particulates revealed the following concentrations: lead, 16.5-18.9 ug/m^3; chromium, nondetectable (N.D.); cobalt, 5.5-5.7 ug/m^3, and total particulates, 14.8-30.2 mg/m^3. All measured concentrations of individual metals were within NIOSH recommended standards ACGIH TLVs®, and OSHA standards. Total particulates levels 14.8 mg/m^3 (area sample), 28.9 mg/m^3 and 30.2 mg/m^3 (personal samples), were in excess of the ACGIH TLV® of 10

mg/m^3. The air sample results for toluene, xylene, cellosolve acetate, VM&P naphtha, and coal tar naphtha are presented in Table IV. The air samples for individual solvents revealed the following concentrations: toluene, 73.1-123 mg/m^3; xylene, 29.2-46.1 mg/m^3; cellosolve acetate, 4.9-6.1 mg/m^3, VM&P naphtha, 68.4-209 mg/m^3; and coal tar naphtha, 55.2-128 mg/m^3.

Measured concentrations of individual solvents were within NIOSH recommended standards and federal OSHA standards. However, when two or more hazardous substances having similar health effects are present, exposure to the combination, in addition to each individual substance, should be considered. That is, the sum of the fractions, actual concentration divided by the exposure limit for each substance ($C_1/T_1 + C_2/T_2 + \ldots + C_n/T_n$) should not exceed unity (must equal 1.0 or less).[3] Using this concept, potential overexposures based on the additive effect of the solvent vapor mixtures were found in the primer parts spray paint booth (1.4 & 0.96)). In calculating the sum of the fractions, however, there are some assumptions. One must assume that the stationary area air samples for VM&P naphtha and coal tar naphtha obtained in the paint booth at the employee's work station during spray painting operations, were representative of the employee's exposure, and, as such, are included in the calculations for mixtures of solvents.

4. Ventilation

As stated previously, ventilation readings were made by NIOSH personnel on September 30, 1981 in the primer parts spray paint booth. A booth face velocity of 100-150 FPM (which exceeds the minimum OSHA requirements of 100 FPM) was measured. It was noted, however, that there is no make-up air supplied to the primer parts booth area and that a garage-type side door, located along the south wall adjacent to the booth, usually open (weather permitting) and a portable "box" fan results in drafts causing disruptive air currents at the booth face. This problem was compounded by poor work practices such as the positioning of the painter with respect to the workpiece. The workpiece is aligned parallel to the direction of the airflow but often times not entirely within the booth. The improper orientation of the painter results in the hood pulling the paint overspray through breathing zone areas and some particulate-mist drifting out of the booth. Recommendations, some of which address these issues are included in Section VIII.

B. Sanding Area

The findings of the air samples collected in the Sanding Area are presented in Tables V and VI. The employees in the sanding area were provided with non-certified (NIOSH/,MSHA) half-face piece (dust) respirators. Personal breathing zone air samples obtained for respirable particulates showed a range of concentrations, 0.9-3.2 mg/m^3, all of which were below the OSHA standard and ACGIH TLV® of 5.0 mg/m^3. The seven personal airborne lead samples collected ranged from 8.6-48.6 ug/m^3 and did not exceed the OSHA standard of 50 ug/m^3. Only two were above 50% of the standard at 31.9 ug/m^3 and 48.6 ug/m^3 (63.8 and 97.2 percent respectively of the present OSHA lead standard). Air sample results for chromium ranged from N.D.-65.6 ug/m^3, well below the ACGIH TLV® of 500 ug/m^3. Total particulate concentrations ranged from 5.1-36.3 mg/m^3, with 3 of 7 personal samples in excess of the ACGIH TLV® of 10.0 mg/m^3 at 10.2 mg/m^3, 30.1 mg/m^3, and 36.3 mg/m^3.

Medical

On the NIOSH survey, a non-directed medical questionnaire was administered to 9 employees, 5 of which also participated in the environmental evaluation by wearing personal air sampling devices. Both painters, one full-time and one part-time replacement primer parts spray painters were administered the questionnaire. Review of the responses revealed occasional eye and upper respiratory irritation, and, among the painters, these symptoms coincided with the use of the bitumastic coal tar paint.

Seven employees of the sanding area were interviewed by the NIOSH industrial hygienist. Of the 4 full-time and 3 part-time sanders none reported experiencing any symptom thought to be work-related.

VII. DISCUSSION

Overexposures to the cyclohexane extractable fraction of the personal breathing zone and area air samples and to PNA's was confirmed by the sample results. Improved respiratory protection is necessary to initially control the employee overexposures. The respirators currently in use by the workforce in the primer parts paint booth (half-facepiece respriators with dual charcoal chemical cartridges) are not appropriate for cyclohexane solubles and PNA's of the magnitude measured. Since both personal and two of three area full shift TWA air samples for cyclohexane solubles were well in excess of the NIOSH recommended 0.1 mg/m^3 standard and OSHA 0.2 mg/m^3 standard, the use of the Type C continuous flow, supplied-air respirators with full facepiece, operated in a positive pressure mode is recommended.

Worker overexposures to total particulates during sanding operations was confirmed by the personal breathing zone air samples collected. The disposable half-face piece respirators (for dusts) provided for the sanding employees does not have certification and approval by NIOSH/MSHA. Feasible engineering control of the excessive particulates, such as that as described in Appendix I (Extractor Hood For Disc Sander[13]) should be attempted. In the interim period while engineering controls are being implemented, the use of disposable half-face piece respirators for dusts with NIOSH/MSHA certification is recommended.

During the NIOSH survey deficiencies in the use of personal protective equipment as well as poor work practices and process controls, and a lack of proper equipment maintenance were recognized. The respiratory program was inadequate as evidenced by the lack of standard operating procedures on respirator use, instruction, fit testing, maintenance, and storage. The spray painter is provided with and uses wrist length cotton gloves for hand protection. Saturation of the gloves with the paints and solvents, however, was observed. There were no emergency eye wash stations/showers in the primer parts paint booth area. Spray painting equipment is maintained on a breakdown basis only. The two electrostatic air cleaners located near the ceiling in the sanding area reportedly were not functional prior to the NIOSH survey. In addition, some of the sanders routinely use a compressed air hose to disperse particulates from their clothing and/or sanded objects. Recommendations regarding these deficiencies are included in Section VIII.

VIII. RECOMMENDATIONS

In view of the findings of the environmental investigation, the following recommendations are made to ameliorate existing or potential hazards, for the employees covered by this determination.

1. The ultimate reduction of the employee overexposures must be accomplished by the implementation of improved engineering control of workplace contaminants such as substitution of less hazardous process materials, automation, redesign or replacement of existing mechanical ventilation systems, better work practices or a combination of these measures.

2. Employee exposure to excessive cyclohexane solubles and PNAs, within the primer parts paint booth should be reduced to the lowest level possible. This in turn will also further reduce exposures to total particulates and solvent mixtures. Painters should be instructed to properly position themselves with respect to airflow so as to prevent paint overspray from being pulled through

breathing zone areas. Articles to be spray painted should be placed entirely within the booth and if possible parallel to the direction of airflow. To help prevent disruptive air currents, discontinue use of fans near the face of the paint booth. The regulator pressure on the paint reservoir pump should be set to the lowest figure which provides adequate atomization. Periodic preventive maintenance should be performed on the spray painting equipment. Supplied-air respirators (described previously) as a means of control should be used in addition to the above mentioned actions.

3. The recommendations and guidelines found in DHEW (NIOSH) Publication No. 78-107, "Coal Tar Products", Criteria for a Recommended Standard,[10] should be followed during operations involving the use of the bitumastic coal tar paint. These recommendations/guidelines cover environmental concentrations, medical surveillance, labeling and posting, personal protective equipment, informing employees of hazards from coal tar products, work practices, sanitation, and monitoring/recordkeeping.

4. Provide personal protective equipment for the hands and forearms of the primer parts painters. Ascertain that the gloves provided are of sufficient length and are impervious to the paints, solvents and other materials used.

5. Provide suitable facilities for quick drenching or flushing of the eyes within all spray painting areas.

6. Eating and drinking should be prohibited in the primer parts paint booth area. Painters should wash their hands before eating, drinking, or smoking.

7. The primer parts painters should shower and wash thoroughly with soap and water at the end of each work shift. Clean work clothes should be worn daily. Clothing contaminated with coal tar products should not be laundered at home with other family clothing.

8. Construct and enforce a respiratory program consistent with the guidelines found in DHEW (NIOSH) Publication No. 76-189, "A Guide to Industrial Respiratory Protection", and the requirements of the General Industry Occupational Safety and Health Standards (29CFR 1910.134). In addition, ascertain that all compressors used for supplying air are equipped with the necessary safety and standby devices and meet minimum air quality specifications.

9. Provide vacuum cleaning equipment in the sanding area for use in collecting particulate debris instead of the current method of dispersing particulates by using compressed air.

10. In the sanding operations, feasible engineering control of the excessive particulates (see Appendix I)[13] should be attempted. In the interim period, the use of disposable half-face piece respirators for dusts with NIOSH/MSHA approval, is recommended.

11. A continuing education program conducted by a person or persons qualified by experience or special training, should be instituted to ensure that all employees have current knowledge and understanding of job safety and health hazards, proper work practices and maintenance procedures, and that they know how to use respirators correctly. Current Material Safety Data Sheets and all available information concerning products used, including health effects should be obtained and made available to all personnel.

12. FMC should conduct periodic environmental evaluations of employee exposures to coal tar products, organic solvents, and total particulates to assure that the extent of implementation of the above recommendations are adequate to protect the affected employees.

VIII. REFERENCES

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12. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to refined petroleum solvents. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-192).

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. FMC Corporation, Tipton, Indiana
2. United Steel Workers, Local 2166
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

Air Sampling and Analysis Methodology
FMC Corporation
Tipton, Indiana
HETA 81-384

Substances	Collection Device	Flow Rate (liters per minute)	Analysis	References*
Chromium	Tared PVC Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Cellosolve Acetate	Charcoal Tube	0.05	Gas Chromatography	NIOSH P&CAM 127 with modifications*
Coal Tar Naphtha	Charcoal Tube	0.05	Gas Chromatography	NIOSH P&CAM 127 with modifications
Cobalt	Tared PVC Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Lead	Tared PVC Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Respirable Particulate	Tared PVC Filter	1.7	Gravimetric	---
Total Particulates	Tared PVC Filter	1.5	Gravimetric	---
Polynuclear Aromatic Hydrocarbons (airborne)	Glass Fiber/Silver Membrane Filter	2.0	Liquid Chromatography	---
(bulk)	Bulk Sample Vial	---	Cyclohexane Extraction & Gravimetric	NIOSH P&CAM 217 with modifications
Toluene	Charcoal Tube	0.05	Gas Chromatography	NIOSH P&CAM 127 with modifications
Xylene	Charcoal Tube	0.05	Gas Chromatography	NIOSH P&CAM 127 with modifications

* The modifications included sample preparation, instrument condition settings, and column selection.

TABLE II

Environmental Concentrations of Total Cyclohexane Solubles and Polynuclear Aromatic Hydrocarbons
Primer Parts Spray Paint Booth
FMC Corporation
Tipton, Indiana
HETA 81-384

Sample Location	Date/Time	Sample Volume (liters)	ANTH	PHEN	FLUOR	PYR	B(c)Ph	BaA	CHRYS	BeP	BKF	BaP	DBA	IghiPR	Total CYC/SOL	Total CYC/SOL TWA
Personal Sample Spray Painter	9/29/81 0656-1120	528	N.D.	0.2	0.3	1.7	N.D.	0.1	N.D.	0.1	N.D.	0.2	N.D.	N.D.	511.4	451.9
	& 1120-1525	490	N.D.	N.D.	3.5	3.5	N.D.	2.7	2.2	2.2	1.0	1.8	N.D.	1.2	387.8	
Area Sample on North Wall of Paint Booth	9/29/81 0730-1129	478	N.D.	0.6	1.2	3.0	N.D.	0.7	0.6	0.5	N.D.	N.D.	N.D.	N.D.	732.2	439.9
	& 1129-1550	522	N.D.	N.D.	N.D.	0.4	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	172.4	
Personal Sample Spray Painter	9/30/81 0737-1150	506	N.D.	0.2	N.D.	2.4	N.D.	N.D.	N.D.	N.D.	N.D.	0.2	N.D.	N.D.	968.4	680.4
	& 1150-1543	464	N.D.	0.6	3.4	4.1	0.3	2.8	1.9	2.4	1.1	2.2	N.D.	1.3	366.4	
Area Sample on North Wall of Paint Booth	9/30/81 1301-1652	462	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
Area Sample on North Wall of Paint Booth	10/01/81 0709-1552	1046	N.D.	N.D.	N.D.	0.6	N.D.	N.D.	N.D.	N.D.	N.D.	0.1	N.D.	N.D.	239.0	239.0

(continued)

Table II
Continued

Sample Location	Date/Time	Sample Volume (liters)	ANTH	PHEN	FLUOR	PYR	B(c)Ph	BaA	CHRYS	BeP	BKF	BaP	DBA	BghiPR	Total CYC/SOL	Total CYC/SOL TWA
Evaluation Criteria (normal workday, 40 hr/wk time-weighted average)			*	*	*	*	*	*	*	*	*	*	*	*	100	100
Laboratory analytical limit of detection (ug/sample) corresponds to a 25 UL/injection size			0.4	0.1	0.08	0.16	0.04	0.04	0.12	0.04	0.08	0.04	0.04	0.08	20	
Range of limits of quantitation per PNA (ug/sample)(due to variations in analytical instrumentation interferences, injection size and dilutions). These should be regarded as maximums values.			0.5-4.1	0.1-1.0	0.1-0.2	0.3	0.1-0.4	0.1	0.1-0.3	0.1	0.1-0.4	0.1	0.1-0.4	0.1-0.4	43.3	

* PNA's are potential human carcinogens. Because it is not possible to establish a safe exposure level for a carcinogen, NIOSH recommends that exposures be kept as low as is technically feasible.

All concentrations are time-weighted averages for the period sampled and are given in micrograms of substances per cubic meter of air (ug/m^3) unless otherwise indicated.

N.D. = nondetectable cencentrations. N.D. samples may have had detectable concentrations which reflect the limits of quantitation.

TWA = time-weighted average

(ANTH) Anthracene, (PHEN) Phenanthrene, (FLUOR) Fluoranthene, (PYR) Pyrene, (B(c)Ph) Benzo(a)phenanthrene, (BaA) Benz(a)anthracene, (CHRYS) Chrysene, (BeP) Benzo(e)pyrene, (BkF) Benzo(k)fluroanthene, (BaP) Benzo(a)pyrene, (DBA) Dibenz(a,h)anthracene, (BghiPR) Benzo(g,h,i)perylene, (CYC/SOL) cyclohexane solubles.

TABLE III

Results of Environmental Air Samples for Lead, Chromium, Cobalt, and Total Particulates
Primer Parts Spray Paint Booth

FMC Corporation
Tipton, Indiana
HETA 81-384

Sample Location	Date/Time	Sample Volume (liters)	Lead (ug/m^3)	Chromium (ug/m^3)	Cobalt (ug/m^3)[1]	Total Particulates (mg/m^3)[2]
Personal Sample Spray Painter	9/29/81 0655-1525	530	18.9	N.D.[3]	5.7	28.9
Personal Sample Spray Painter	9/30/81 0737-1542	728	16.5	N.D.	5.5	30.2
Area Sample North Wall of Paint Booth	10/01/81 0709-1552	785	---	---	---	14.8
Evaluation Criteria (normal workday, 40 hr/wks time-weighted average)			50	500	50[4]	10[5]
Laboratory analytical limit of detection (ug/sample)			3	3	1	

All concentrations are time-weighted averages for the period sampled.

1. ug/m^3 = micrograms per cubic meter of air.
2. mg/m^3 = milligrams per cubic meter of air.
3. N.D. = nondetectable concentration. N.D. samples may have had detectable concentrations but were lower than the analytical limits of detection.
4. From the ACGIH TLV Notice of Intended Changes for 1983-84.
5. ACGIH TLV based on toxic impurities, e.g. quartz less than 1%.

TABLE IV

Results of Environmental Air Samples for Solvents
Primer Parts Spray Paint Booth

FMC Corporation
Tipton, Indiana
HETA 81-384

Sample Location	Date/Time (minutes)	Sample Volume (liters)	Toluene (mg/m^3)	Xylene (mg/m^3)	Cellosolve Acetate (mg/m^3)	VM&P Naphtha (mg/m^3)	Coal Tar Naphtha (mg/m^3)
Personal Sample Spray Painter	9/29/81 0657-1139 & 1139-1525	27.1	73.1	29.2	6.1	---	---
Personal Sample Spray Painter	9/30/81 0737-1151 & 1154-1542	16.5	123.6	46.1	4.9	---	---
Area Sample North Wall of Paint Booth	9/29/81 0734-1129 & 1129-1550	9.8	---	---	---	209.8	---
Area Sample North Wall of Paint Booth	9/30/81 0752-1156 & 1203-1652	29.8	---	---	---	68.4	---
Area Sample North Wall of Paint Booth	9/29/81 0734-1128 & 1128-1550	23.3	---	---	---	---	128.9
Area Sample North Wall of Paint Booth	9/30/81 0752-1200 & 1203-1652	29.0	---	---	---	---	55.2
Evaluation Criteria (normal workday, 40 hr/wk time-weighted average)			375	434	27[1]	350	400
Laboratory analytical limit of detection (mg/sample)			0.01	0.01	0.05	0.1	0.1

TABLE V

Results of Environmental Air Samples For Respirable Particulates
Sanding Area

FMC Corporation
Tipton, Indiana
HETA 81-384

Sample Location	Date/Time	Sample Volume (liters)	Respirable Dust[1] (mg/m^3)
Personal Sample Sander	9/29/81 0703-1154 & 1252-1538	797	2.6
Personal Sample Sander	9/29/81 0706-1154 & 1251-1532	784	1.0
Personal Sample Sander	9/29/81 0709-1154 & 1253-1535	780	0.7
Personal Sample Sander	9/30/81 0714-1149 & 1250-1538	754	1.3
Personal Sample Sander	9/30/81 0718-1146 & 1258-1536	725	3.2
Personal Sample Sander	9/30/81 0725-1149 & 1302-1536	711	0.9
Personal Sample Sander	9/30/81 0722-1148 & 1300-1537	719	1.2
Evaluation Criteria (normal workday, 40 hr/wk time-weighted average)			5.0[2]

1. The concentrations are time-weighted average for the period sampled.
2. ACGIH TLV based on toxic impurities, e.g. quartz less than 1%.

TABLE VI

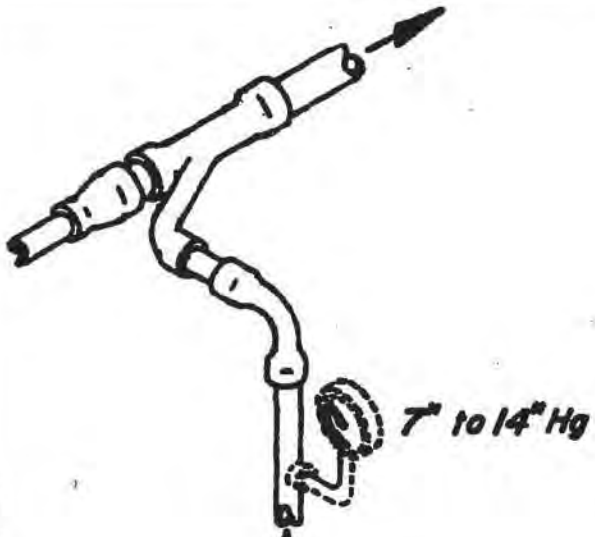
Results of Environmental Air Sample for Lead,
Chromium, and Total Particulates
Sanding Area

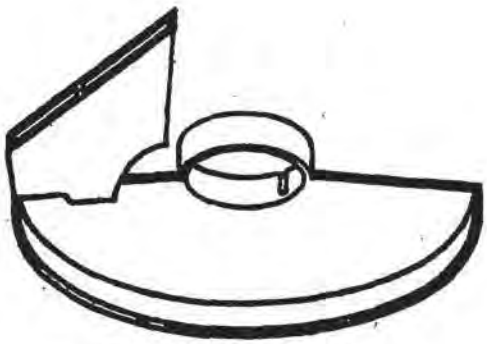
FMC Corporation
Tipton, Indiana
HETA 81-384

Sample Location	Date/Time	Sample Volume (liters)	Lead (ug/m^3)	Chromium (ug/m^3)[1]	Total Dust (mg/m^3)[2]
Personal Sample Sander	9/29/81 0705-1154 & 1252-1538	701	8.6	65.6	30.1
Personal Sample Sander	9/29/81 0707-1154 & 1251-1532	690	10.2	N.D.[3]	5.1
Personal Sample Sander	9/29/81 0709-1154 & 1253-1535	689	16.0	N.D.	4.7
Personal Sample Sander	9/30/81 0715-1149 & 1250-1538	663	9.1	N.D.	10.2
Personal Sample Sander	9/30/81 0719-1146 & 1258-1536	638	48.6	14.1	36.3
Personal Sample Sander	9/30/81 0725-1149 & 1302-1536	627	31.9	8.0	6.6
Personal Sample Sander	9/30/81 0722-1148 & 1300-1537	645	15.5	N.D.	8.7
Evaluation Criteria (normal workday, 40 hr/wk time-weighted average)			50	500	10[4]
Laboratory analytical limit of detection (ug/sample)			3	3	

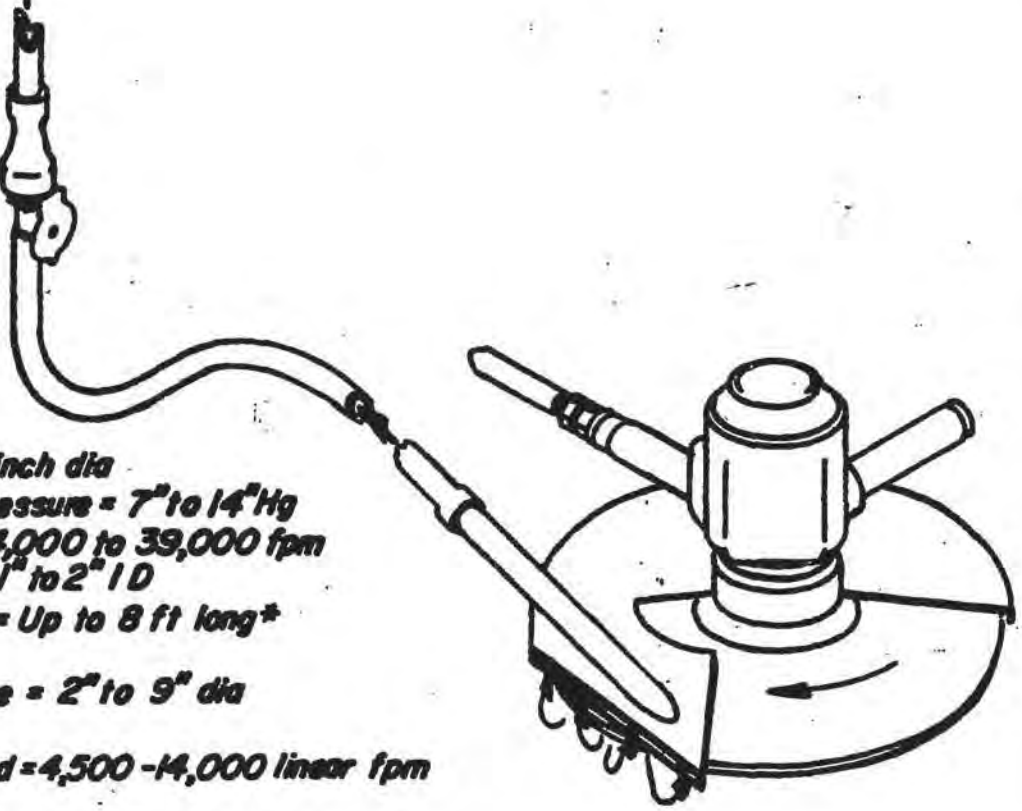
All concentrations are time-weighted averages for the period sampled.

1. ug/m^3 = micrograms per cubic meter of air.
2. mg/m^3 = milligrams per cubic meter of air.
3. N.D. = nondetectable concentration.
4. ACGIH TLV based on toxic impurities, e.g. quartz less than 1%.





Bottom view of extractor hood



Q = 10-30 cfm/inch dia
Branch static pressure = 7" to 14" Hg
Slot velocity = 24,000 to 39,000 fpm
Flexible hose = 1" to 2" ID
Extension hose = Up to 8 ft long*

Sanding disc size = 2" to 9" dia

Peripheral speed = 4,500 -14,000 linear fpm

*Hose lengths may be extended up to a maximum of 50' by using larger sizes between the tool hose and the tubing system.

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