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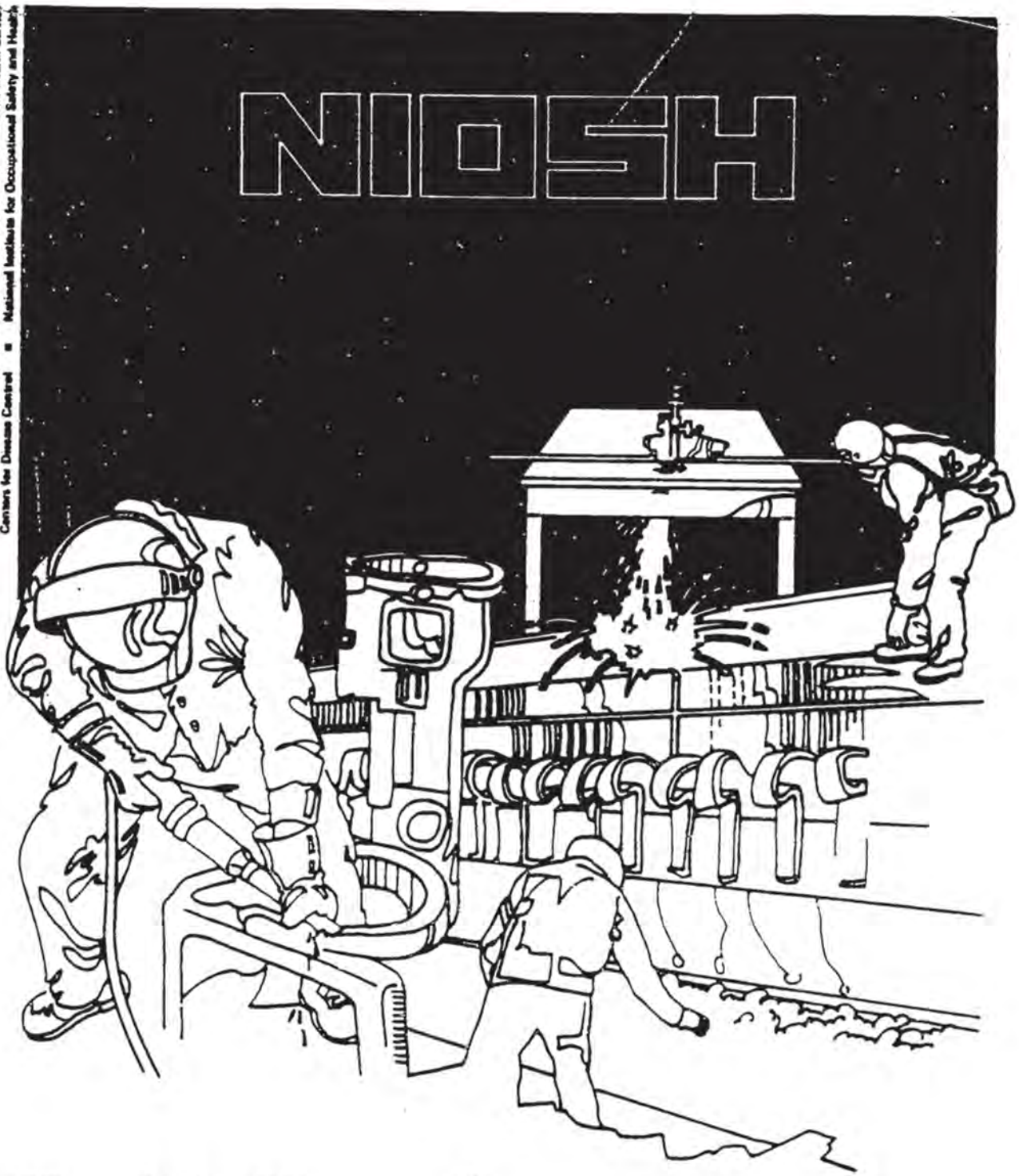

Health Hazard Evaluation Report

HETA 84-062-1552
FISHER BODY PLANT, ROOFING SITE
HAMILTON, 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.

HETA 84-062-1552
JANUARY 1985
FISHER BODY PLANT, ROOFING SITE
HAMILTON, OHIO

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I. SUMMARY

In November 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Union of Roofers, Waterproofers, and Allied Workers to evaluate the tear-off operations of an old coal tar pitch roof at the Fisher Body Plant, Hamilton, Ohio. NIOSH investigators conducted an industrial hygiene and medical evaluation at this site on December 7, 1983. Thirteen workers were involved in the tear-off, which included cutting, prying, scraping and removal of old coal tar pitch roof material.

Six breathing zone total dust samples were collected using pre-weighed teflon filters at a flow rate of 2 liters per minute. These personal samples were used to measure roofing workers' exposures to total dust, benzene-soluble fractions and polynuclear aromatic hydrocarbons (PNAs).

Total dust exposure measured during tear-off operations ranged from 2.1 to 13.1 mg/m^3 (environmental exposure limit recommended by the American Conference of Governmental Industrial Hygienists = 10 mg/m^3). Worker exposures, during the three-to-four hour sampling period, to the benzene-soluble fraction ranged from 0.6 to 5.3 mg/m^3. NIOSH recommends that workers not be exposed to coal tar products in concentrations greater than 0.1 mg/m^3 measured as the cyclohexane-soluble fraction averaged over an eight to ten hour workshift. The cyclohexane-soluble and benzene-soluble fractions are assumed to be comparable. NIOSH considers coal tar products carcinogenic, and this environmental limit should be regarded as the upper limit of exposure; conditions should be engineered to keep exposures as low as possible.

A medical evaluation of the 13 workers on the same day found a substantial proportion who suffered that day from acute eye symptoms such as burning (58%), redness (50%) and tearing (33%). Greater than 90% of the workers reported chronic eye and skin irritation that appeared to be due to coal tar pitch exposure. Due to cold temperatures and heavy clothing the prevalence of chronic skin lesions could not be completely evaluated.

Based on the data collected during the roof tear-off operation, workers were exposed to excessive levels of coal tar pitch dust containing PNAs. Recommendations for reducing worker exposure to roofing tear-off dust are made in Section VIII of this report.

KEYWORDS: SIC 1761 (Roofing and Sheet Metal Work); coal tar pitch, PNAs, benzene-solubles, phototoxic effects, eye irritation, dermatitis.

II. INTRODUCTION

In August 1981, the United Union of Roofers, Waterproofers, and Allied Workers submitted a request to NIOSH to evaluate exposures resulting from the tear-off of old coal tar pitch roofs. As a part of this study, in November 1983 they identified a site in Hamilton, Ohio, where workers were to remove an old, and apply a new, coal tar pitch roof. Environmental sampling and medical evaluation of tear-off operations were conducted at the Hamilton, Ohio roofing site on December 7, 1983. During most roofing site studies, the tear-off and application proceeded simultaneously. In contrast, the processes at this site afforded the opportunity to evaluate tear-off operations alone.

III. BACKGROUND

The tear-off operation started by removing loose gravel from the roof surface. A power cutter was then used to break up the pitch layer down to the insulation. The old roof material was pried and scraped from the surface with shovels, carted in wheelbarrows to the edge of the building, and discarded over the edge through plastic chutes. Lastly, small pieces of debris and dust were swept from the roof surface.

The application of the new roof involved laying a vapor barrier with a solvent-based adhesive, followed by a layer of insulation, then another layer of insulation applied with asphalt, then a layer of tar paper applied with coal tar pitch and gravel.

Thirteen workers were tearing-off the old roof and applying a new one on the day of this evaluation, and only the exposures during tear-off operations were evaluated.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Personal breathing zone samples for total particulates were collected on pre-weighed teflon filters at a flow rate of 2 liters per minute (lpm). Six personal breathing zone samples were collected on six workers and analyzed for total dust levels, benzene-soluble fractions and eight polynuclear aromatic hydrocarbons (PNAs). These three analyses followed NIOSH Technical Bulletin TB-001, issued December 1, 1982, with some modifications.

A bulk sample of the tear-off dust was analyzed for benzene-soluble fraction, PNAs, asbestos, silica and metals.

B. Medical

All 13 employees engaged in tear-off activities were evaluated. The evaluation included (1) a questionnaire to elicit symptoms reported over the past month, symptoms reported on the day of evaluation (coincident with personal air sampling), use of personal protective equipment, and factors thought to aggravate health effects; and a (2) limited physical examination of the eyes and exposed skin. This examination was, in fact, extremely limited by the very cold conditions at the time of the survey (approximately 25°F) and the resultant use of heavy clothing.

V. EVALUATION 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), and 3) the U.S. Department of Labor (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 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.

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 such as formaldehyde 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.

Listed below are the evaluation criteria for the sampled substances in this evaluation.

Substance	Environmental Exposure Limit		
	NIOSH	ACGIH	OSHA
Coal Tar Products - Cyclohexane-Soluble Fraction	0.1 mg/m^3	0.2 mg/m^3	0.2 mg/m^3
Total Nuisance Dust	--	10 mg/m^3	15 mg/m^3

Coal Tar Products

The term "coal tar product", as used in the NIOSH recommended standard[1], includes coal tar, coal tar pitch and creosote. Exposure to coal tar products has been reported to produce phototoxic effects, such as skin erythema, burning and itching of the skin, photophobia and conjunctivitis. 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 exposed workers. Coal tar products often contain identifiable components which, by themselves, are carcinogenic such as benzo(a)-pyrene, benzanthracene and chrysene.

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[1]. This limit was recommended because it was the lowest concentration that could be reliably detected by the recommended method of environmental monitoring. The benzene-soluble and cyclohexane-extractable fractions of a sample are assumed to be comparable. 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 at this time. 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 OSHA standard for coal tar pitch volatiles is 0.2 mg/m^3 averaged over the workshift.

Evidence indicates that the same recommended level, or a lower level, should apply to coal tar pitch tear-off dust produced during the removal of old coal tar pitch roofing material. Emmett et. al.[2] reported on a study designed to evaluate the carcinogenic potential on mouse skin of materials to which present day roofers are exposed, including traditional coal tar pitch, coal tar bitumen, standard asphalt, and dust produced during the removal of an old roof containing coal tar pitch. The results of the study demonstrated that tear-off pitch dust is strongly carcinogenic to mouse skin and under the circumstances of the experiment was associated with the shortest latent period from exposure to the appearance of cancer observed in any group of animals. There was no statistically significant difference between the carcinogenicity of the tear-off dust and the coal tar pitch from which it was presumably derived. An epidemiologic mortality study of members of the United Slate, Tile and Composition Roofers, Damp and Waterproof Worker's Association[3] found elevated death rates from lung cancer and cancer of several other sites. These roofers worked with coal tar pitch (removal and application) and asphalt. The study found a significantly elevated standardized mortality ratio for skin cancer (excluding melanoma) of 4.00.

Previous health hazard evaluations[4,5] have found that coal tar pitch dust from tear-off operations produces acute toxic effects similar to those of coal tar pitch. The effects include erythema (reddening of the skin), burning and itching of the skin, photophobia (abnormal intolerance of the eyes to light) and conjunctivitis (inflammation of the lining of the eyes). These effects can be phototoxic reactions involving an interaction between the polynuclear aromatic hydrocarbons (PNAs) in the coal tar pitch and ultraviolet radiation in sunlight.

VI. RESULTS AND DISCUSSION

A. Environmental

Analyses of the bulk coal tar dust found 430 milligrams of benzene-solubles per gram of bulk material (43%) and numerous PNAs. A free silica analysis showed the bulk dust to have 2.2% quartz and less than 1.5% cristobalite. No asbestos was detected in the bulk dust sample. Other components included calcium (5.4%), magnesium (2.0%) and iron (0.5%).

Total dust levels (Table 1) of six personal samples collected during tear-off operations ranged from 2.1 to 13.1 mg/m^3, with a geometric mean of 4.7 mg/m^3. Two samples for chute operators (10.3 and 13.1 mg/m^3) exceeded the ACGIH threshold limit value for total nuisance dust levels.

For six personal samples the benzene-soluble fractions ranged from 0.6 to 5.3 mg/m^3 (Table 2), with a geometric mean of 1.7 mg/m^3. NIOSH recommends that workers not be exposed to cyclohexane-solubles greater than 0.1 mg/m^3. (Benzene-solubles and cyclohexane-solubles are assumed to be comparable). Although sampling periods were less than 8 hours, and workers may perform tear-off operations for less than 8 hours per day, these measured levels would still exceed the recommended 0.1 mg/m^3 level on an 8-hour time-weighted average basis.

The concentrations of eight PNAs in six personal samples are shown in Table 3. The geometric mean concentrations in micrograms per cubic meter were as follow: fluoranthene, 48.1; pyrene, 37.1; benz(a)anthracene, 23.6; chrysene, 20.2; benzo(a)pyrene, 18.3; benzo(e)pyrene, 14.7; phenanthrene, 40.3; and benzo(ghi)perylene, 12.8. Because many PNAs are carcinogenic, no safe levels are known and exposure to them should be kept as low as technically feasible.

B. Medical

1. Demographic data

Ten (77%) of the 13 roofers were white, 3 were black. Their ages ranged from 22 to 50 (mean 34; median 29). Total duration of employment as roofers ranged from 3 to 24 years (mean 8; median 6.5). Hair color was black in four and brown in nine. Eye color was blue in eight, brown in three and hazel in two. On the day of the study, two were chutemen; all others performed tear-off and associated activities (power-cutting, sweeping, dumping tear-off materials over side of roof, and so on).

2. Symptoms

a. Symptoms reported during the month prior to the survey:

Symptoms most frequently experienced by the roofers during the month prior to the survey were skin irritation, reported by 13 (100%) and eye irritation, by 12 (92%) (Table 4). The eye irritation was described as burning, redness, tearing, and at times, grittiness. The skin irritation was characterized as redness like a sunburn, occassionally with peeling by the 3rd or 4th day. Affected areas included: face, lips, neck, arms, and hands. The eye irritation was attributed only to coal tar pitch (CTP) by

most; to CTP and asphalt, with CTP greater than asphalt by two; and to the sun reflecting off the aluminum-sided insulation by two. Symptoms associated with the tear-off operation were generally felt to be more severe than those associated with application. Skin irritation was attributed to CTP by all and to asphalt by none. Again, tear-off was generally felt to be worse than application by nine of 13.

b. Symptoms on the day of the survey (Table 5):

Of the 12 roofers evaluated at the end of the tear-off period, symptoms referable to skin were mild and few, while symptoms referable to eyes were frequent (burning by seven, grittiness by five, tearing by four). NIOSH personnel were also symptomatic, with tearing and burning of eyes noted by all three, mild skin burning by two, and marked redness and swelling of skin later in the evening by the third.

c. Aggravating factors:

Five workers felt symptoms associated with roofing work were more severe in whites than in blacks. All felt symptoms to be aggravated by windy days, bright days, and CTP rather than asphalt. During CTP work, tear-off was felt to be worse than asphalt. During asphalt work, which was not considered as bothersome as CTP, tear-off was felt to be worse than application by seven, no different by one; four felt neither tear-off nor application to have an effect.

d. Personal protective equipment:

Use of gloves was very common. Goggles were worn by six; sunglasses were worn by the others. An old, (non-NIOSH-certified) full-face respirator was used by one roofer, and a scarf was worn by another. Use of barrier creams was reported by only one. Four took their work clothes home. All took showers after work.

3. Signs of physical examination

Signs observed on physical examination can be classified into those possibly associated with pitch (acute or chronic); and those not attributable to pitch (chronic traumatic effects).

Attributed to pitch and asphalt:

Acute effects: Acute effects observed on the day of the survey were limited to observations of redness (tearing was also noticed but was recorded as a symptom if reported regardless of whether it was observed at the end of the day) (Table 5). Redness was observed in at least six roofers, as well as in two of the NIOSH personnel.

Chronic effects: Lesions possibly attributable to pitch were observed in four individuals: a large nodule on the cheek and red papules on the forehead; hyperpigmented keratoses (wart-like lesions) in the beard area; a large skin-covered nodule on the right upper eyelid; and reddish (burned) skin.

Not attributed to pitch:

Calluses were observed on the hands of one roofer. Folliculitis (of unknown etiology) was observed on the backs of the calves of another.

We have found a high prevalence of reported (chronic) eye and skin irritation which appeared to be due to coal tar pitch. These effects appeared compatible with photosensitivity reactions associated with the pitch. A substantial proportion of the workforce also suffered from acute eye symptoms and observed tearing and redness on the days of the study.

VII. CONCLUSIONS

The data collected during this study and supported by past evaluations indicate that workers were exposed to excessive levels of coal tar pitch dust during tear-off operations. Such exposures can result in acute health effects, photosensitization, and have a potential for long-term carcinogenic effects.

VIII. RECOMMENDATIONS

1. Water should be used to thoroughly wet and dampen the surface of the roof prior to and during tear-off operations.

2. The use of power brooms and power blowers to remove small debris and dust should be replaced with a vacuum system to reduce dust levels.

3. Workers should stay upwind of pitch dust whenever possible.

4. Workers should shower and wash thoroughly with soap and water at the end of each work shift and change into clean clothing. Clean work clothes should be worn daily. Clothing contaminated with coal tar pitch dust should be laundered separately from other family clothing.

5. Under ideal conditions, skin contaminated with pitch dust and fume should be washed promptly with soap and water. However, as this is not practical at the work site, waterless cleansers should be used.

6. Workers should wear long-sleeved shirts which are tightfitting at the wrists, full-length pants extending to the shoes and gloves.

7. Workers should wear safety goggles to prevent coal tar pitch dust exposure to the eyes and to protect workers from eye injury from flying debris during cutting operations.

8. It is possible that the use of sunscreens containing benzophenones such as Solbar (Person and Covey, Inc) can decrease the amount of UV radiation reaching the skin. These should be applied approximately one-half hour before work and at mid-shift break.

9. Highly exposed individuals should wear respiratory protection. Due to the effects on eyes, skin and the respiratory tract, along with the high temperatures encountered during the summer months, protection and comfort may best be provided by using powered air-purifying helmet respirators. Respirators should be selected, used and maintained in accordance with OSHA regulations (29 CFR 1910.134).

10. Roofers who are usually exposed to pitch fumes and dust should have access to periodic medical evaluations, particularly of the skin and eyes.

IX. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. United Union of Roofers, Waterproofers and Allied Workers, Washington, D.C.
2. Fisher Body Plant, Hamilton, Ohio
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 1

Coal Tar Pitch Roof Tear-Off

FISHER BODY PLANT, ROOFING SITE
HAMILTON, OHIO
HETA 84-062

DECEMBER 7, 1983

Total Dust Levels

Job	Sampling Period	Total Particulates (mg/m^3)
Power Cutter Operator	7:35-12:00 12:34-1:01	2.1
Shoveling and Carting	8:11-12:00 12:35-1:24	2.5
Shoveling and Carting	8:11-12:00 12:34-1:20	4.0
Shoveling and Carting	8:40-1:18	3.2
Chute Operator	8:27-12:00	10.3
Chute Operator	8:27-12:04	13.1

Table 2

Coal Tar Pitch Roof Tear-Off

FISHER BODY PLANT, ROOFING SITE
HAMILTON, OHIO
HETA 84-062

DECEMBER 7, 1983

Benzene-Solubles

Job	Sampling Period	Benzene-Solubles (mg/m^3)
Power Cutter Operator	7:35-12:00 12:34-1:01	0.6
Shoveling and Carting	8:11-12:00 12:35-1:01	0.9
Shoveling and Carting	8:11-12:00 12:34-1:20	1.5
Shoveling and Carting	8:40-1:18	1.1
Chute Operator	8:27-12:00	4.0
Chute Operator	8:27-12:04	5.3

Table 3

Coal Tar Pitch Roof Tear-Off

FISHER BODY PLANT, ROOFING SITE
HAMILTON, OHIO
HETA 84-062

DECEMBER 7, 1983

Polynuclear Aromatic Hydrocarbon Levels

Job	Sampling Period	Fluoranthene (ug/m^3)	Pyrene (ug/m^3)	B(a)A (ug/m^3)	Chrysene (ug/m^3)	B(a)P (ug/m^3)	B(e)P (ug/m^3)	Phenanthrene (ug/m^3)	Benzo(ghi) Perylene (ug/m^3)
Power Cutter Operator	7:35-12:00 12:34- 1:01	13.3	10.6	6.8	6.0	6.0	4.3	10.6	3.3
Shoveling and Carting	8:11-12:00 12:35- 1:24	21.6	17.3	11.5	9.9	9.4	6.8	18.0	6.1
Shoveling and Carting	8:11-12:00 12:34- 1:20	41.8	32.7	21.8	18.2	16.7	12.9	36.4	11.8
Shoveling and Carting	8:40- 1:18	28.8	21.6	14.2	12.6	12.4	9.2	23.4	9.7
Chute Operator	8:27-12:00	122.1	93.9	58.7	49.3	37.6	32.9	105.6	32.9
Chute Operator	8:27-12:04	186.6	140.6	82.9	71.4	59.9	64.5	161.3	43.8

Table 4

Symptoms Reported By Roofers During Month Prior to NIOSH Survey

FISHER BODY PLANT, ROOFING SITE
HAMILTON, OHIO
HETA 84-062

DECEMBER 1983

Symptoms	13 Roofers
Skin Irritation	13
Eye Irritation	12
Nose Irritation	8
Sore/dry Throat	5
Rash (in past yr)	3
Cough	1
Shortness of breath	1
Chest tightness	1

Table 5

Symptoms Reported and Signs Observed
On Day of Survey by 12 Roofers

FISHER BODY PLANT, ROOFING SITE
HAMILTON, OHIO
HETA 84-062

DECEMBER 1983

Skin			Eyes			
Burning	Tingling Sensation	Itching	Burning	Grittiness	Tearing	Redness on exam
1 + 1*	2	1	7	5 + 1*	4 + 1**	6 + 1*

* = slight
** = equivocal