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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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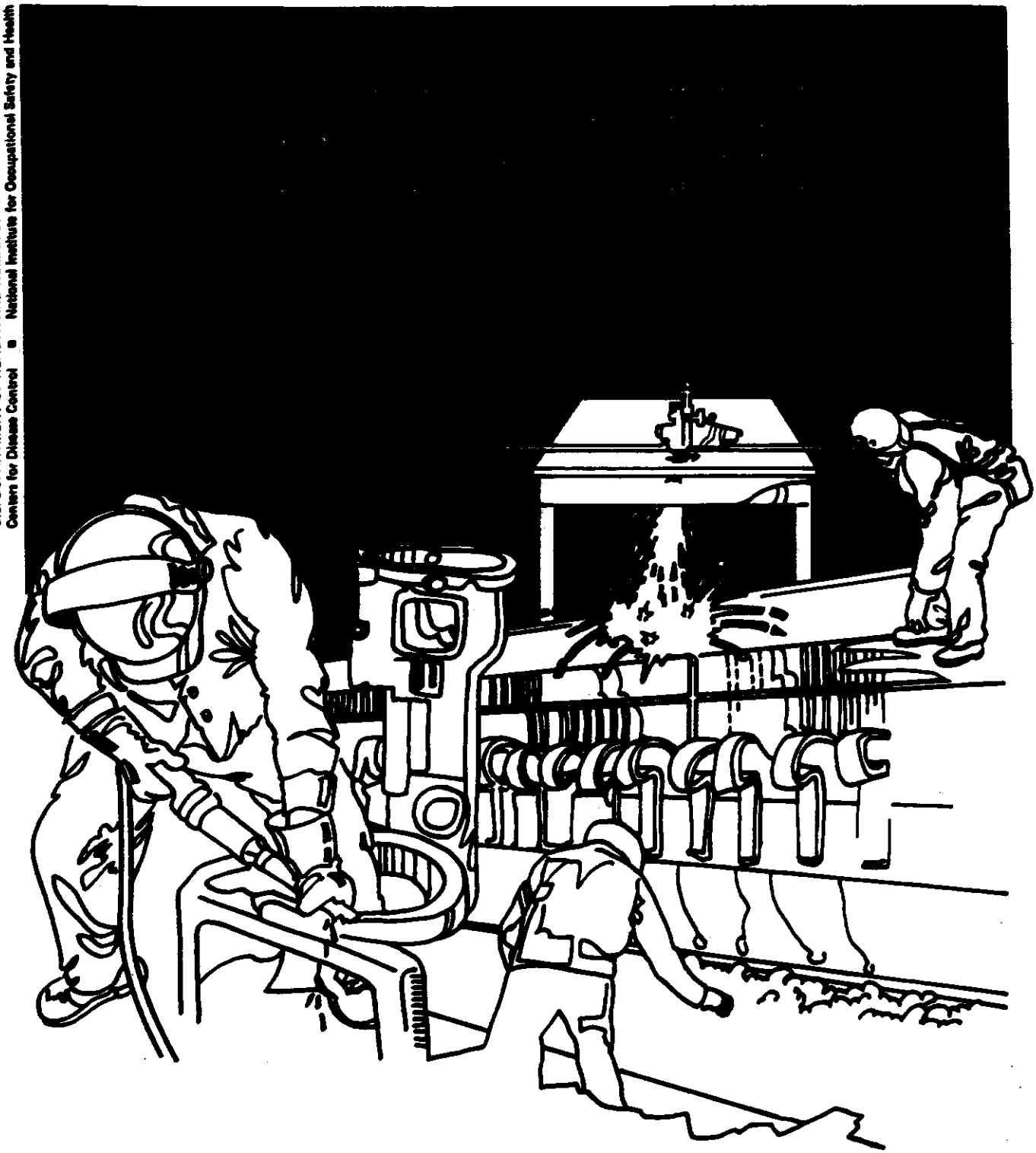

Health Hazard Evaluation Report

HETA 88-128-1947
SNAPTITE, INC.
UNION CITY, PENNSYLVANIA

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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 88-128-1947
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SNAPTITE, INC.
UNION CITY, PENNSYLVANIA

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I. SUMMARY

On January 20, 1988, the National Institute for Occupational Safety and Health (NIOSH) was requested to provide technical assistance to the Occupational Safety and Health Administration (OSHA) to evaluate a suspected cancer cluster among workers at Snaptite, Inc., Union City, Pennsylvania. The request indicated that approximately 45 current or former employees had developed cancer or skin lumps.

In March 1988, a NIOSH medical officer conducted an initial site visit and interviewed 38 individuals from a list of 45 prepared by union and management. Additional medical information was obtained from the individuals where possible, and a limited dermatological examination was performed on individuals with current skin lumps. The vast majority of the lesions were judged to be common entities such as lipomas and sebaceous cysts. Three cases of probable basal cell carcinoma were identified. Based on medical history, another individual had either a basal cell carcinoma or actinic keratosis. Another person had skin lesions which appeared to be a keratoacanthoma. One case of renal cell carcinoma and one case of colon cancer were reported among former employees in the secondary department. Because of the difficulty in obtaining accurate employment data, and the absence of historical environmental data, a formal cancer incidence study was not attempted. The duration of employment of employees with skin cancer was generally too short to have accounted for the malignancies. Two individuals developed skin cancer within 4 years of working. The other two had latency periods of between 28 and 31 years.

In July 1988, a NIOSH industrial hygienist conducted a site visit to evaluate past and present chemical exposures at the plant. At the time of this investigation, 8-hour time weighted average (TWA) personal breathing zone concentrations of Stoddard solvent were 36.5, 33.8, and 13.3 mg/m^3; all values were well below the NIOSH recommended exposure level of 350 mg/m^3 as an 10-hour TWA and the OSHA permissible exposure limit of 2950 as an 8-hour TWA. From observations of work practices at the plant, it is evident that there is the opportunity for skin absorption of Stoddard solvent. Excessive exposure to ambient air oil mist or aerosolized coolant concentrations did not appear likely, as there was no visible haze within the plant. Several operations (soldering, eletropolishing, trichloroethylene degreasing and nitric acid washing) were removed from the site over the past months to years. These operations used or generated hazardous chemicals. However, no data concerning the levels of exposure to these chemicals at the Snaptite plant are available.

On the basis of these data, NIOSH investigators have determined that a health hazard did not exist at the time of this investigation and that it is unlikely that the reported skin cancers, on the whole, were work related. Although applicable airborne exposure standards were not exceeded for Stoddant solvent, recommendations that will further reduce worker exposures to both dermal and inhalation exposures to Stoddard solvent, oil mist, and coolants, are included in Section IX of this report.

KEYWORDS: SIC 3451 (screw machine products), skin cancer, Stoddard solvent, oil mist, coolants.

II. INTRODUCTION

In response to a request to provide technical assistance to the Occupational Safety and Health Administration (OSHA) to evaluate a perceived excess of cancer among employees at Snaptite, Inc., Quick Disconnect Division, Union City, Pennsylvania, the National Institute for Occupational Safety and Health (NIOSH) conducted an initial site visit on February 9, 1988, a medical investigation on March 1-2, 1988, and an industrial hygiene survey on July 6-7, 1988. The findings of the medical investigation were described in detail in a letter dated March 17, 1988, to OSHA, management and representatives of the local union.

III. BACKGROUND

A. Present operations

Snaptite Inc., Quick Disconnect Division, employs approximately 135 production workers in the manufacturing of metal screw connectors. They are members of the United Steel Workers Union, Local 14661. Steel, stainless steel, brass, and aluminum are machined. In the "screw machine" area there are four machines called "hydromats" and twenty machines called "automatics". At any one time only half of the screw machines may be running due to maintenance activities or production work load. The "automatics" use a straight cutting oil. The "hydromats" use a synthetic cutting oil and coolant. Vancide®, a sodium salt solution of dimethyldithiocarbamic acid and 2-mercaptobenzothiazole, is added to the coolant. Adjacent to each machine are uncovered 2- to 5-gallon cans of Stoddard solvent. Approximately once every ten minutes the employees clean machine parts by submerging their unprotected hands into the solvent and subsequently air drying the part and their hands with an air hose.

In the "secondary" area, drilling, milling, debutting, and induction hardening operations are performed. There are six computer numerical control (CNC) machines which use water soluble cutting oils to machine the parts. Vancide® is added to the coolant. In the induction hardening operation, the part is heated and then quenched with water. During this operation, residual oil present on the parts is heated, forming a visible "smoke" cloud. This operation has a local exhaust ventilation system.

The plant has an assembly and shipping area. No hazardous chemicals are used in these areas.

The general ventilation system at this facility consists of three exhaust fans which run only in the summer. During the summer, the windows are kept open, and pedestal fans are used for comfort cooling.

B. Past Exposures

Previous operations at Snaptite included 1) soldering, with potential exposures to lead, discontinued approximately January 1988, 2) electroplating operations, with potential exposures to sulfuric and phosphoric acid, discontinued approximately November 1987, 3) the use of a trichloroethylene degreasing tank, discontinued in approximately 1983, and 4) cleaning stainless steel with nitric acid, discontinued in approximately 1978.

Historical exposure data are not available for any of the these operations. The employees interviewed noted the operators of the soldering station rotated job assignments because they found the fumes irritating. Local ventilation was present throughout the operation of the soldering station. OSHA observed the operation of the ventilation system, but did not collect air samples.

The employees interviewed also noted that the trichloroethylene degreasing tank malfunctioned on several occasions, causing overheating and the release of fumes into the work area.

IV. METHODS

A. Environmental

1. Stoddard Solvent

On July 7, 1988 air samples were collected to assess employee exposures to Stoddard solvent. Three personal breathing zone samples were collected using battery-powered pumps operating at approximately 200 cubic centimeters of air per minute. The pumps were attached via Tygon tubing to a charcoal tube collection media. The samples were collected over the course of the workshift (approximately 8-hours). The samples were analyzed for naphthas by NIOSH method 1550.[1] The limit of quantitation for this method, considering the sample volumes collected in this study, was approximately 0.3 mg/m^3.

2. Heat treating operation local exhaust ventilation

At the induction heat treating operation, the local exhaust ventilation system was evaluated by measuring face velocities with a hot wire anemometer. The hood's air flow patterns were visualized using smoke tubes.

B. Medical

According to company records, there are currently 136 employees in the production area, 49 office staff, and 12 corporate accounting personnel. On March 1 and 2, 1988, 38 present and past employees identified by management and union representatives as having problems with skin lumps were interviewed, and 36 completed a brief screening questionnaire that outlined medical and employment

histories. Brief dermatological examinations were conducted on several individuals to clarify some of the questionnaire responses. All individuals with skin lesions were referred back to their primary physician for further evaluation and treatment. Additional medical history was obtained on several individuals in order to ascertain the likelihood of a diagnosis of cancer.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by the 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 even though 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 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 Recommended Exposure Limits (RELs),[2] 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[3] and 3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA PELs. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA PELs. The OSHA PELs also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, 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 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 (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Stoddard Solvent

Stoddard solvent is a mixture of straight- and branched- chain paraffins, naphthenes (cycloparaffins), and aromatic hydrocarbons. It is a colorless liquid with a kerosene-like odor. The odor threshold is approximately 5 mg/m^3. Stoddard solvent is used as a degreaser and cleaner at Snaptite Tools, Inc.

Stoddard solvent can cause defatting and irritation of the skin; eye, nose and throat irritation; and dizziness. Studies of various groups of workers exposed to solvents (although not necessarily the specific constituents of Stoddard solvent), have shown chronic changes in peripheral nerve function and neurobehavioral effects.[5] These effects include fatigue, irritability, memory impairment, sustained changes in personality or mood (emotional instability and diminished impulse control and motivation), and impaired intellectual function (decreased concentration ability, memory, and learning ability).

A major route of entry for organic solvents such as Stoddard solvent is percutaneous (through the skin) absorption. Solvent uptake through the skin depends on (1) duration of contact, (2) skin thickness, perfusion, and degree of hydration, and (3) the presence of cuts, abrasions, or skin diseases. Skin exposure to straight oils and coolants is known to cause dermatitis. Sensitization to the biocides and trace metal contaminants such as nickel or chromium may occasionally produce rare cases of allergic contact dermatitis, thus, contributing to solvent uptake.

The current OSHA PEL for Stoddard solvent is 2950 mg/m^3 as an 8-hour TWA. The NIOSH REL is 350 mg/m^3 as a 10-hour TWA and 1800 mg/m^3 as a 15-min ceiling. The ACGIH TLV is 525 mg/m^3 as an 8-hour TWA. The TLV was based on the toxicities of Stoddard solvent's major ingredients, and was designed primarily to prevent the irritative and narcotic effects of the vapors.[6]

VI. RESULTS

A. Environmental

1. Stoddard solvent

The Stoddard solvent concentration measured in the breathing zone of the Hydromat screw machine operator was 13.3 mg/m^3. For the two operators of the Automatic screw machines sampled, the Stoddard solvent concentrations were 36.5 and 33.8 mg/m^3.

2. Induction heat treating local exhaust ventilation system

Face velocities measured on the four local exhaust ducts were 1300, 1200, 1000, and 900 feet per minute (fpm). Three-inch flexible pipe is used for the duct. The placement of the face of the local exhaust duct varies from 3 inches to 9 inches from the machine part being heat treated. Air flow patterns visualized using smoke tubes indicated adequate capture velocities.

B. Medical

The results of the interviews and questionnaires revealed three probable cases of basal cell carcinoma of the skin. Additionally, one individual had either a basal cell carcinoma or actinic keratosis (a precancerous lesion). Three of the four had worked in the secondary department for at least a short time, and two of the four had also worked at least a short time in the assembly department. Two of the workers had been present in the plant for less than 5 years prior to the diagnosis of skin cancer. In general, this period of time is too short to account for an occupational etiology of these cancers.

Most of the "skin lumps" examined were common entities such as lipomas (collections of fatty tissue) and sebaceous cysts. Six of the women interviewed reported medical histories compatible with fibrocystic breast disease (a non-malignant condition). (All are under the care of their personal physicians.) One skin lesion clinically resembled a keratoacanthoma; this is usually a benign lesion but it cannot be differentiated by superficial appearance from a skin cancer. This lesion occurred on an individual with a prior history of skin cancer.

VII. DISCUSSION

None of the samples collected indicated air concentrations of Stoddard solvent above the evaluation criteria. The most restrictive evaluation criterion is the 350 mg/m^3 8-hour TWA recommended by NIOSH. The highest Stoddard solvent result obtained at Snaptite Tools was 36.5 mg/m^3, for an operator of the Automatic screw machine. The results obtained on the operator of one of the Hydromat screw machines was approximately one-third of that obtained on the Automatic screw machine operators.

The cutting oils and coolants used could present potential airborne exposure problems, however, a visual inspection did not indicate a general haze throughout the plant. Thus, at the time of this investigation air sampling results for oil mists or particulates would probably be below the recommended evaluation criteria for these substances. Historical industrial hygiene data was reviewed. An insurance carrier sampled for airborne oil mist in January 1986 and reported all exposures were less than 50% of the ACGIH TLV of 5 mg/m^3 for oil mist.

Several operations (soldering, electropolishing, trichloroethylene degreasing, and nitric acid washing) were removed from the site over the past months to years. These operations used or generated hazardous chemicals; trichloroethylene, for example, is considered to be a suspect human carcinogen. However, no data concerning the levels of exposure at the Snaptite plant are available.

The remaining two cancers among former secondary employees included one renal cell carcinoma (kidney) and one colon cancer. There is no reason to suspect that these two diverse types of cancers would be due to a similar occupational exposure. Moreover, it is not possible to compute meaningful statistical interpretations with so few cases. In a previous study of 2485 male workers employed in machining operations that used cutting oils between 1938 and 1967, there was no overall increase in the cancer rates.[9] The workers were employed in jobs exposing them to cutting oils for at least 5 years. Although there was no overall excess of cancer, a twofold risk of stomach and large colon cancer was seen in individuals who had cutting oil mist exposure prior to 1938. Further information is needed, however, to determine if the different composition of the cutting oils played a role in the colon and stomach cancer excess. It should be mentioned that excess skin cancer rates are unlikely to be detected in this kind of study. Deaths from skin cancers (other than malignant melanoma) are relatively low because of the high cure rate. Many of the skin cancers are removed in either the pre-cancerous stage or in very early stages of malignancy.

Basal cell carcinomas are the most common form of skin cancer. According to American Cancer Society statistics,[7] it is estimated that 40-50 percent of all people who reach the age of 65 will develop at least one skin cancer in their lifetime. Second (additional) cancers, particularly other skin cancers, are common. The majority of basal cell carcinomas are thought to be due to excessive sunlight exposure. While one recent study has described an increased incidence of skin cancers due to cutting oils, these skin cancers were squamous cell carcinomas, a different type of cancer.[8] This investigation studied 682 turners for a 20-year period (1960-1980). Five cases of squamous cell carcinomas were identified. The authors noted that acid-refined mineral oils were used in the facility until 1975, when they were replaced by solvent-refined mineral oils. They further suggest that solvent-refined oils have a reduced amount of polycyclic aromatic hydrocarbons (PAH), which were believed to be the major carcinogenic compounds.

VIII. CONCLUSIONS

Although there were no overexposures to airborne levels of Stoddard solvent found in this investigation, Stoddard solvent can be absorbed through the skin. This route of entry was not studied in this investigation, but from observations of work practices, it is evident that there is the opportunity for skin absorption of Stoddard solvent.

The local exhaust ventilation system at the heat induction operation appeared adequate. However, modifications could be easily made to improve the efficiency of the local exhaust ventilation system.

Neither airborne oil mist nor aerosolized coolant concentrations at the time of this investigation appeared excessive. However, prevention of skin contact would reduce the potential of dermatitis.

It is unlikely that the skin cancers among Snaptite workers were due, on the whole, to exposure to cutting oils.

IX. RECOMMENDATIONS

A. Employee Education - Each worker must be made aware through regular training of the importance of the following:

1. Proper work practices and techniques to avoid contact between solvents or cutting fluid and the skin should be employed.
   a. To eliminate the need for hand contact, a dip wash system should be utilized to clean parts.
   b. When not in use, the solvent cans should be covered.
   c. The use of air hoses for drying parts should be eliminated.
   d. Covers on all screw machines should be repaired, modified or installed, as necessary, in order to reduce oil mist concentrations at the worker's breathing zone.

2. Protective clothing, gloves, splash guards, and work aprons should be provided to the workers in the assembly areas. Workers should receive instruction in the proper use and maintenance of all personal protective equipment.

3. Personal hygiene, including regular washing of hands, laundering of work clothes, and prompt removal of fluid-soaked clothing should be practiced. Eating should not be allowed at the work stations.

4. Any skin irritation or disorder should be immediately reported to the plant medical department.

B. Fluid Maintenance - The company should adhere to the following guidelines for maintaining the coolant supplies:

1. Central coolant systems and individual machines should be regularly inspected for contamination and replaced when necessary.

2. The addition of cutting fluids and additives should be restricted to those employees trained in their proper handling and mixing.

3. The toxicity of any fluid additive should be evaluated prior to introduction into the system.

C. Personal Protection - Barrier creams and protective clothing should be made readily available to employees to reduce the potential for skin contact with the fluid. The employees should be trained in the proper use of barrier creams.

D. Hand Care - Solvents and coolants should be washed off skin as soon as possible. After washing, especially with a hand cleaner, employees should use a moisturizing cream or lotion to prevent drying of the skin. "Barrier" creams do not effectively prevent skin contact by solvents or coolants but may facilitate their removal.

E. Ventilation System - Although no air sampling results were obtained for the heat induction operation, and a visual inspection indicated that the generation of particulates would not be expected to be above any evaluation criteria, however, the following recommendations would improve the efficiency of the local exhaust ventilation system:

a. Add a flange to the face of each duct.

b. Move the face of the duct closer to the part.

c. Establish a routine inspection and maintenance program for the local exhaust ventilation system.

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XII. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 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. Snaptite, Inc.
2. U.S. Department of Labor, OSHA - Region III
3. United Steel Workers Union, Local 14661

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.