U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 79-91-660

DEFIANCE SCREW MACHINE
DEFIANCE, OHIO

FEBRUARY 1980

I. SUMMARY

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at Defiance Screw Machine in Defiance, Ohio, on October 2, 1979 to evaluate reported skin problems resulting from contact with cutting oils and coolants. Eighty-one employees from the day shift were evaluated by a short questionnaire and a complete dermatological examination. This group included 51 employees regularly exposed to cutting fluids and 30 who were not regularly exposed. Of the 51 exposed employees, only eight gave a history of current skin disease or complaint. In contrast, 21 (41%) were observed to have skin lesions on examination. Within this group of 21 workers, 14 were from Department 1 which employs 15 men. Cutting fluids were felt to be the cause of the skin problems in all these cases. All except 2 employees had minimal involvement and most were unaware of their lesions. Abnormal cutaneous findings were also found by examination in some of the 30 workers not regularly exposed to cutting fluids.

The data collected during this investigation indicate that a variety of skin problems exist at Defiance Screw Machine. Exposure to cutting oil was found to be a major cause of these problems. With the exception of two employees, all workers had minimal involvement and most were unaware of their lesions. Although current adverse dermatological effects are minimal, recommendations for improving work practices are presented on page 8.

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970*, NIOSH investigates the toxic effects of substances found in the workplace. On May 7, 1979, NIOSH received a request to conduct an investigation at Defiance Screw Machine from an authorized representative of employees. The investigation was requested to evaluate skin problems resulting from exposure to cutting oils and coolants.

III. BACKGROUND

Defiance Screw Machine is a precision metal parts fabricator. They deal in a variety of products, many of which are associated with the automotive industry. The plant has been in existence since 1912 and employs approximately 200 workers. The average length of employment is about 17 years. The plant is divided into various machining areas which include the use of automatic screw machines, chuckers and internal and external grinders. The various machining processes use cutting oils and coolants. The type of cutting fluid used depends on the particular characteristics required for the job. The plant also maintains a pickling department, heat treat area, inspection department and a shipping department.

IV. EVALUATION DESIGN AND METHODS

An initial walk-through survey was conducted at Defiance Screw Machine on June 7, 1979. Information on the processes and materials used in the plant was obtained. Between June and October, when the follow-up evaluation was scheduled, OSHA conducted a complete environmental survey of the plant. Based on an exchange of information concerning their evaluation, NIOSH personnel decided to concentrate on a medical evaluation of skin problems and not to repeat the environmental air sampling which had been conducted by OSHA.

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* Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an 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 follow-up study at Defiance Screw Machine was conducted on October 2, 1979. A survey of ten work areas was conducted immediately before employees from each area were medically evaluated. Subjective assessments of personal and work-area hygiene were made. Attention was made to the handedness of both machine and worker. For each machine identified as using an industrial fluid, particular attention was made to those parts of the skin regularly contaminated because of machine design or employee work habits.

Eighty-one employees from a single shift (day shift) were evaluated by a short questionnaire and a complete cutaneous examination. Evidence of past and present skin disease was assessed by these means. No laboratory tests were performed. Employees absent from the day shift and those from two other shifts (evening and night) were not interviewed or examined.

Prior to the medical evaluation, NIOSH personnel recorded employee identifying information, including current department. The examining physician administered the short questionnaire. The purpose of the questionnaire was to obtain the following information:

a. Prevalence of dermatologic problems prior to employment - to determine employee's predisposition to potential adverse dermatological effects in his environment and to identify skin diseases that might be confused with work-related disease.

b. Prevalence of dermatologic problems while employed at Defiance Screw Machine - to determine processes or employees frequently associated with skin disease.

c. History of current skin disease - to determine employee's perception of what constitutes a skin problem.

d. History of skin disease in the employee's immediate family (relatives and other persons living in the same residence); to determine evidence of a communicable or familial cause of skin disease, e.g., Fifth Disease.

In addition to the above questions, where appropriate, employees were also asked if they felt their dermatologic problem was work-related, and if they had consulted a health professional for treatment or evaluation.

During the cutaneous examination, morphological patterns and affected sites were noted. Pertinent endogenous (i.e., not work-related) skin disease was recorded, e.g., acne vulgaris, psoriasis, and atopic dermatitis.

An employee was designated as having dermatitis caused by an industrial fluid if the following conditions were met:

1. there was history of exposure to industrial fluids;

2. the process used resulted in skin contamination by industrial fluids whether through machine design and/or employee hygiene; and

3. lesions characteristically caused by industrial fluids were observed in areas contaminated by industrial fluids, e.g., forearms, arms, face, upper chest, anterior thighs, nails and skin underlying pockets or trouser belt line.

V. EVALUATION CRITERIA

In general terms, mineral oil affects the skin in relation to the amount and duration of exposure and to the type and grade of oil used. The term "mineral oil" includes all mineral oils such as light oils (motor spirits), paraffin (kerosene), gas oils, heavier burning oils, diesel oils and lubricating and cutting oils. These oils produce "oil acne," which is an inflammatory skin condition characterized by the presence of blackheads, pimples and pustules due to oil blocking and irritating the pores of the skin which is followed by septic infection from germs entering from the skin surface. More rarely an acute inflammatory condition occurs, generally on the hands and forearms, such as might be produced by any powerful skin irritant with redness, much local swelling and blister formation. The arms are most affected, but skin lesions may occur on any part of the body where there is contact with oil or oily clothing.

Long exposure to mineral oil can result in warts and ulcers of the skin.

Cutting oils also damage the skin by degreasing it. Where the natural protective fat is constantly being removed from the skin (degreased), it will become dry, cracked and sore.

Slight injuries to the skin, such as those caused by metallic particles and abrasive fragments removed by cutting or grinding tools which are in the oil, make the occurrence of rashes more likely.

Soluble cutting oils are essentially a mixture of two incompatible materials, oil and water. Several additives are required to maintain this mixture and to fulfill the technical needs of the machinist. Cutaneous problems can result from major and minor components:

Oil - sterile folliculitis (noninfective inflammation of hair follicles), comedones (plugging of excretory ducts), and papules (plugging of air follicles).

Solvents - xerosis (defatting action)

Water - maceration

Anticorrosive agents Emulsifying agents Pour-point depressants Antimicrobials Deodorizers Plasticizers	> irritant and/or allergic contact dermatitis (dependent on individual ingredients)

VI. RESULTS AND DISCUSSION

Eighty-one employees representing ten different departments and/or job descriptions were examined. Of these, fifty-one employees worked regularly with cutting fluids in seven departments designated as "production" departments (Table I).

Discussion of the results will therefore concentrate on employees from these seven areas.

Eight of 51 production employees gave a history of current skin disease (Table II, Column I); all eight attributed their disease to work (Column II). However, only one employee in eight sought medical care for his problem (Column VIII). Positive respondents were not grouped in any one department. Only four of this group had notable disease judged by the extent of involvement and the density of observed lesions; in two, medical management was felt advisable. Of interest, these latter two employees had active acne vulgaris prior to working at Defiance Screw Machine.

Twenty-one (41%) of 51 employees examined (Column III) had one or more abnormal skin findings. In contrast to the small number of employees who reported a positive history of current skin disease, almost four times that number were found to have skin lesions on examination. The greatest portion of these employees were in Departments 1 and 2. For example, in Department 1, 22 individual diagnoses were made on 14 employees (Column IV). Twenty diagnoses were judged attributable to cutting oils by the examiner. The specific findings for this department were as follows:

Two diagnoses of oil folliculitis, 7 of oil acne, 2 of oil warts and 6 of comedones. It should be noted that a single employee was responsible for 5 diagnoses and 2 employees had two diagnoses each. Without attributing diagnoses to individual examinees, the fact that most employees only had a single abnormal finding would not be appreciated.

Cuts from metal shavings retained in laundered wiping rags and incidental trauma to the nails were the only work-related noncutting oil skin problems observed (Column IV). These findings were inconsequential to the employee and caused little morbidity.

Endogenous (i.e., nonwork-related) skin disease observed included seborrhea dermatitis, acne vulgarus (scars and active disease), benign dermal and epidermal tumors and psoriasis (Column VII).

Table III lists those areas of the body most frequently affected. They correspond with areas contaminated by oils observed during the plant walk-through, e.g., extensor forearms exposed on automatic machines in Department 1.

As mentioned previously in this report, Table IV tabulates abnormal cutaneous findings in the 30 non-product employees examined. A large proportion of employees in Inspection had nonspecific findings. Their lesions could not definitely be attributed to their work environment because of the cursory nature of the evaluation.

Shipping, Heat Treatment and Inspection areas provide opportunities for contact with skin irritants; this observation is notably true in Maintenance. The following industrial fluids are used in these areas: solvents (naptha), anti-rust agents (lanolins), and other liquids (quenching oils). Besides these chemical materials one must be aware of factors which can damage the skin with prolonged exposure. Extremes of temperature are an example; the effect depending, of course, on the season. Close contact with radiant heat, as seen in Heat Treatment, is another example. Employees in these areas, however, similarly tolerated most observed cutaneous problems; an observation that is applicable to all 81 employees examined.

In several departments the machining process necessitates an employee inserting an ungloved hand into the stream of cutting fluid to check dimension and accuracy of the machined part or to insert or remove the part. This maneuver results in repeated exposure. The usual custom of wiping off excess oil with a cotton rag, kept in a pocket or waistband, leads to cumulative contamination of subjacent skin and clothing. In other departments, indirect contamination from aerosolized oil

occurred when compressed air/cutting oil mixtures were used to flush metal shavings away from the machined part. Conceivably this mist could be deposited on exposed skin and absorbent clothing. With chronic exposure, irritant eczematous dermatitis, oil dermatitis or hyperpigmentation might ensue. Minor trauma from metal shavings imbedded in rags used to wipe the forearms and hands, is also common in such operations. It should be noted that adverse skin effects can occur in nonproduction departments also. This situation arises when employees handle finished products coated with the residue from earlier processes or materials added for protection while parts are in storage or in transport.

VII. SUMMARY OF EVALUATION FINDINGS

1. Operations in Department 1 afford repeated opportunities for exposure to soluble cutting oils due to machine design. Contact occurs through immersion and may occur by aerosolized oil in other departments.

2. Eighty-one employees were examined and interviewed (two employees refused to participate in the survey). This group included 51 "production" employees regularly exposed to soluble cutting oils and 30 who are not regularly exposed.

3. Of 51 "production" employees seen, only eight gave a history of current skin disease or complaint. In contrast, 21 were observed to have an abnormal skin finding.

4. Within this group of 21 workers, 14 came from Department 1 which employs 15 men on the day shift. Soluble oils were felt to be the etiology in all cases. All except two employees had minimal involvement and most were unaware of their lesions. Participants in Departments 2, 3, and 6 were also minimally affected. No skin lesions were noted in employees from Departments 4 and 11.

5. No evidence was obtained through history or physical exam to support a diagnosis of Fifth Disease. (The Fifth Disease had been mentioned early in the study as a possible cause of observed skin problems in the plant.)

6. Employees regularly exposed to the following soluble oils were free of skin disease on examination:

    Cool Tool, Texaco Soluble Oil C and Wheelmate 811 and 464.

7. There was no correlation between age, duration of employment and presence of abnormal skin findings.

Listed below are several recommendations for both employer and employees to follow to help eliminate skin problems.

VIII. RECOMMENDATIONS

1. Although the current soluble oil use in Department 1 was not associated with adverse cutaneous effects, machine operations make intimate contact with industrial fluids impossible to avoid. Should engineering needs result in selecting a more potent irritating or acnegenic cutting oil, the prevalence and severity of resultant oil or other contact dermatitis would significantly increase. The ultimate solution in prevention of any type of exogenously-caused skin disease would be to minimize skin contact through redesign of machinery.

2. Employees presently employed in Department 1 who have severe active acne vulgaris should be removed on a trial basis and their disease observed. Consideration should be made in the future, during pre-employment physical examinations, to place workers in areas where exacerbations of endogenous disease will not be caused through chronic contact with implicated industrial fluids.

3. Work clothes should be changed and washed frequently.

4. Workers should not wipe oil off the skin with oily cloths as abrasions may be caused by metal particles. Disposable paper towels should be used.

5. A system should be developed for removal of metal particles from the oil which does not require the employees to use their hands and submerge their arms in the oil.

6. Adequate washing facilities should be provided. Solvents should not be used to remove oil from the skin. Solvents defat the skin making it dry, cracked and sore.

7. The use of barrier creams should be continued. It provides a barrier against the oil and facilitates its removal after work.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this report are currently available, upon request, from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

1) Defiance Screw Machine
2) United Auto Workers, Local #638
3) United Auto Workers International
4) U.S. Department of Labor, Region V
5) NIOSH, Region V

For the purpose of informing the "affected employees," the employer shall promptly "post" the determination report for a period of 30 days in a prominent place near where the exposed employees work.

TABLE I
CUTTING OIL USE BY TYPE AND DEPARTMENT
DEFIANCE SCREW MACHINE
DEFIANCE, OHIO

DEPT. No./Name	MACHINE/PROCESS	INDUSTRIAL FLUID(S)	NUMBER EMPLOYEES (DAY SHIFT)	
1	Automatics	Mobile soluble oil and additive	15	19%
2	Chucker	Dubois soluble cutting fluid and cool tool	4	5%
11	Tool Room	Cool tool	4	5%
10	Steel Room	-	3	4%
7	Heat Treatment	Sodium cyanide and quenching oil	5	6%
6	Various	Dubois soluble cutting fluid	13	16%
Maintenance	-	-	6	7%
Trucker Lab	-	-	2	3%
3	Grinders	Milacron Cimcool and Cimfree soluble oils	11	14%
Shipping	-	Naptha and rust inhibitor (Lanolin oil)	7	9%
Inspection	-	-	6	7%
4	Grinders	Texaco soluble oil C and Wheelmate 811 & 464	4	5%
		TOTAL	81	100%

TABLE I
SKIN DIAGNOSES IN EMPLOYEES E. JSED TO CUTTING OILS

DEFIANCE SCREW MACHINE
DEFIANCE, OHIO

October 1979

Department	History of Dermatoses	History of Work-related Dermatoses	Dermatoses on Examination	Total Numbers of Skin Diagnoses on Examination	Cutting oil-related Diagnoses on Examination	Noncutting oil-related Diagnoses on Examination	Nonwork-related Diagnoses on Examination	Previous Medical Consultation Sour
1	3/15	3	14/15	22	20	-	2	1
2	3/4	2	2/4	4	2	1	1	-
3	2/11	2	2/11	6	3	-	3	1
4	0/4	-	0/4	-	-	-	-	-
6	1/13	1	3/13	5	4	1	-	-
11	0/4	-	0/4	-	-	-	-	-
Total	8/51	8/8	21/51	37/21	29/37	2/37	6/37	2/51

TABLE III

CUTTING OIL SKIN DISEASE
SITES OF INVOLVEMENT

DEFIANCE SCREW MACHINE
DEFIANCE, OHIO

October 1979

Department	Fingertips	Interdigital spaces	Hand dorsum	Hand Palm	Wrist	Forearm extensor	Forearm flexor	Forearm Fossae	Thigh anterior	Buttocks	Face	Neck
1	1	-	1	1	2	10	2	-	2	2	-	-
2	-	-	-	-	-	1	-	-	-	-	-	-
3	-	-	-	1	-	1	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	1	-	3	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	1	-	1	3	2	15	2	-	2	2	-	-

TABLE IV
NONCUTTING OIL ! MATOSES
DEFIANCE SREW MACHINE
DEFIANCE, OHIO

October 1979

Department Number	History Dermatoses	History Dermatoses Work-related	Examination Dermatoses	Examination Total Number Diagnoses	Examination Dermatoses Work-related	Examination Nonwork related	Medical Consultation Sought
Inspection	3/6	2	5/6	6	1?	5?	2
Maintenance	2*/5	1	2*/5	2	1	1	1
Shipping	0/7	-	2/7	2	-	2	-
Trucker, Lab	0/2	-	0/2	-	-	-	-
Heat tx(7)	0/5	-	5/5	7	7	-	-
Steel Room (10)	1*/2	1	2/2	3	3	-	-

* Refused exam/history

? Further evaluation needed to confirm