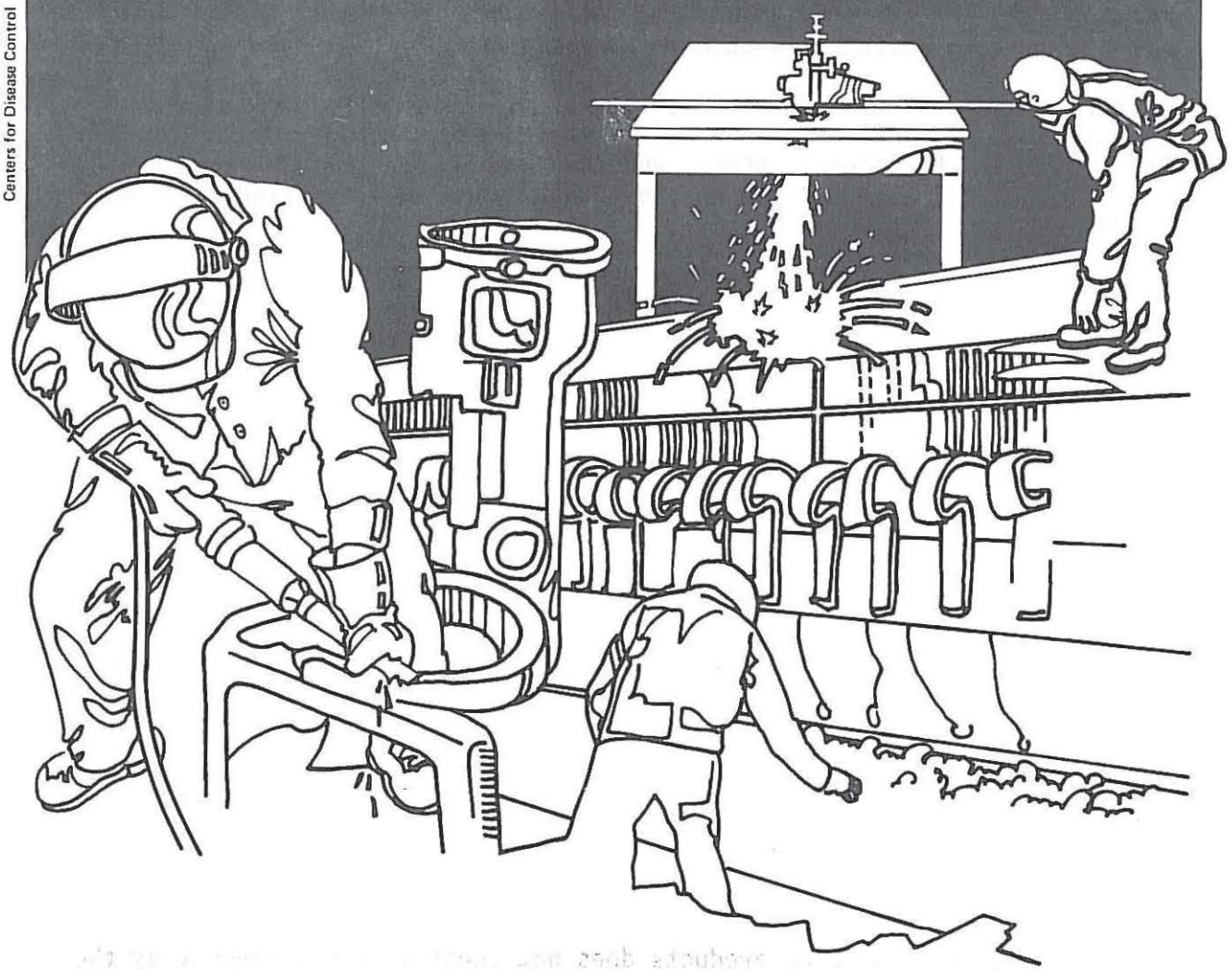
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HHE 80-060-868
ITT GRINNEL CORPORATION
COLUMBIA, 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.

HE 80-060-868
May 1981
ITT Grinnel Corporation
Columbia, Pennsylvania

NIOSH INVESTIGATORS:
Steven A. Lee, IH
Paul Schulte, MS

I. SUMMARY

In January 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from workers at the ITT Grinnel plant, Columbia, Pennsylvania for health hazard investigations of the following: (1) the lung cancer death of a battery testing employee, (2) oil mist concentrations in the Tapping Department, (3) skin rashes among Testing Department employees, and (4) heart attacks in the Core-Making Departments. In March 1980, a walk-through investigation was conducted in the above area (1), and environmental samples were taken in areas (2) and (3). In August 1980, a medical questionnaire, designed to study cardiovascular disease, was mailed to individuals in area (4) plus a control group.

Our investigations yielded the following findings and assessments:

1. There was no apparent carcinogen in the working environment of the battery testing worker.

2. Tapping department workers were exposed to oil mist levels ranging from non-detectable (less than 0.5 mg/M^3) to 3.0 mg/M^3 with a mean of 1.0 mg/M^3. The OSHA permissable exposure limit (PEL) for oil mists is 5.0 mg/M^3. Nitrosamine formation from use of the cutting fluid was considered unlikely by NIOSH due to the absence of amines and nitrites in the fluid.

3. Hydraulic testing fluid in the Testing Department contained triethanolamine (a skin irritant) and possibly an irritating bacteriacide. No pathogenic bacteria were found.

4. The questionnaire survey showed that six cases (16.6% of core workers) had a history of heart disease compared with two cases (4%) in the Tapping and Testing Departments. Of the cases, 50% of the Core-Makers were in the age group 30-34, compared with none in that age group in the reference group. While the rate of heart disease was more than four times greater in the Core Department workers, the numbers of cases were not large enough for this to be statistically significiant at p 0.05. Prior exposure to crystalline silica by workers in the Core-Making Department may have been related to the findings of increased rate of heart disease.

On the basis of the environmental survey, it is concluded that skin irritation among Testing Department workers probably occurred from exposure to irritating hydraulic fluids.

The Core-Making Department's heart disease excess is not definitive but is suggestive that this group may have an elevated risk of heart disease. More studies are needed to confirm this finding.

Recommendations for achieving more healthful working conditions at ITT Grinnel are found in Section VII of this report.

KEYWORDS: SIC 3325 Steel Foundries, battery maintenance, sulfuric acid, machining operations, cutting fluids, nitrosamines, dermititis, triethanolamine, Pseudomonas paucimobilis, cardiovascular disease, silicosis.

II. INTRODUCTION

In January 1980, the National Institute for Occupational Safety and Health (NIOSH), received a request from employees of Local 376, International Molders and Allied Workers Union, for a health hazard evaluation at ITT Grinnel Corporation in Columbia, Pennsylvania. They requested that NIOSH investigate: (1) the cancer death of a battery testing employee, (2) oil mist concentrations in the Tapping Department, (3) skin rashes among Testing Department employees, and (4) heart attacks in the Core-Making Departments.

On March 13, 1980, a walk-through investigation was conducted in the Battery Testing Department, and environmental samples were taken in the Tapping and Testing Departments.

In June 1980, a complete report of environmental results and recommendations was sent to the company. The report included plans for studying the possibility of excess cardiovascular disease in the core-making departments. In August 1980, a medical questionnaire, designed to study cardiovascular disease, was mailed to core-making workers. Employees in the Tapping and Testing Departments were used as a control group.

III. BACKGROUND

The ITT Grinnel plant in Columbia manufactures pipe fittings. During the NIOSH study, the plant was comprised mainly of three ferrous foundries and employed 1300 workers. The scope of the health hazard evaluation included the following four areas.

1. Fork-Lift Garage

The fork-lift garage contained a battery-testing area that was maintained by one employee. He had worked in the plant, primarily as an electrician, for 30 years before he died of lung cancer. For his last six or seven years of employment he had the responsibility for checking and maintaining the batteries that were used in the fork-lifts.

2. Tapping Department

There were 125 workers in the Tapping department. They operated 106 tapping machines to tap the threads into pipe fittings of various shapes and sizes. This operation used over 800 gallons of a naphthenic-based (C_5-C_{10} cycloalkanes) cutting fluid per week.

3. Testing Department

In this department, pipe fittings were immersed in a triethanolamine solution and tested for leaks under pressure. The area employed 42 workers and contained 16 testing machines. Frequent skin contact with the solution occurred as pipe fittings were manually loaded and immersed into the testing tanks.

4. Core-Making Departments

Each of the three foundries at ITT Grinnel has a separate core-making department. There were five workers in a shell-core department, 17 in an oven-bake core department, and 46 in a hot-box core department.

The Occupational Safety and Health Administration (OSHA) conducted an extensive 4-month industrial hygiene investigation in the latter part of 1978. They documented 77 overexposures to noise and 28 overexposures to silica. In some operations, such as cleaning up or cupola relining, workers were exposed to silica levels that were more than five times the OSHA permissible exposure limit (PEL). In general, the Core-Making departments were cleaner than other parts of the foundries and most silica levels were within the PEL. Because of litigation over the alleged violations and required engineering abatements, the NIOSH study did not overlap areas of the OSHA investigation. Therefore, NIOSH did not take environmental measurements in the Core-Making Departments.

IV. EVALUATION DESIGN AND METHODS

Fork-Lift Garage

NIOSH medical and industrial hygiene representatives conducted a walk-through of the garage and battery testing operations on March 13, 1980, to observe working conditions and potential environmental exposures. Environmental sampling was not feasible since there weren't any regular or full-time battery testing workers. Garage workers in the adjacent area were interviewed to determine whether irritating levels of sulfuric acid mists occurred during long periods of battery testing and recharging.

Tapping Department

Ten personal breathing zone air samples for oil mist were taken in this department. They were collected on mixed cellulose ester filters using battery powered sampling pumps operated at 1.5 liters per minute for about one hour. Samples were extracted with carbon tetrachloride and analysed by fluorescence measurement (NIOSH Method No. 272).

The manufacturer of the oil was contacted to obtain information on chemical composition of the oil.

Testing Department

Bulk samples of the solutions from each of the 16 testing machines were collected in sterile containers. Cultures were grown and tested for Staphylococcus, Streptococcus, and Pseudomonas bacteria because these are common skin pathogens.

Core-Making Departments

A medical questionnaire was mailed to the residence of each employee in the Core-Making departments and to each employee in the Tapping and Testing departments. The Tapping and Testing departments were used as a reference group. Mailing addresses were supplied by the company management. Included in the package sent by NIOSH was a letter from the president of Local Union No. 376 of the International Molders and Allied Workers Union, written to encourage that the questionnaire be completed and returned in the stamped self-addresses envelope provided. Four months after mailing returned questionnaires were analyzed.

V. EVALUATION CRITERIA

Sulfuric Acid

Exposure to sulfuric acid mist may occur during the charging and testing of batteries. Such exposure may cause irritation of the eyes, nose, throat, and lungs. The mist also etches, and may erode, teeth.[1] There is presently no evidence that implicates sulfuric acid as a carcinogen.

Cutting Fluid

The oil used in the Tapping Department is essentially biologically inert. Slight irritation of the skin or eyes may occur but the OSHA PEL of 5 milligrams per cubic meter (mg/M^3) is primarily designed to prevent oil mists from reaching nuisance levels.

A more serious consideration has been the possibility of nitrosamine formation in cutting fluids. Nitrosamines are some of the most potent animal carcinogens. Cutting fluids that contain triethanolamine and nitrites have been found to produce nitrosamine, specifically diethanol-nitrosamine.[2] Cutting fluids that contain any type of amines and nitrites should be considered a potential source of nitrosamines.

Microbial Contamination of Metalworking Fluids

Many water-based metalworking fluids are capable of growing large varieties of microorganisms which can deteriorate the fluids and corrode machinery. In addition, the generation of slime and foul odors can cause unpleasant working conditions. Fortunately, gram-positive pathogens such as Staphylococcus aureaus survive poorly in metalworking fluids, and there hasn't been much concern about disease from exposure to microbes in these fluids. The dominant bacterial group found are the Pseudomonas species. Some of these are "opportunistic pathogens", due to their ability to produce infections in people with depressed immune response systems. Most are not capable of invading healthy individuals. Therefore, the purpose for controlling bacteria in fluids, usually, is to protect the fluid and not the workers. Some biocides that are used for this purpose, however, are toxic and corrosive to skin.[3]

Occupationally Related Heart Disease

Various substances and conditions in the workplace can have effects on the cardiovascular system. The mechanisms by which agents can act on the cardiovascular system can be grouped into four categories: (1) direct effects on the myocardium, (2) direct effects on the blood vessels, (3) effects on the oxygen-carrying capacity of the blood, (4) secondary effects on the cardiovascular system resulting from primary effects on another related system.

A number of known or suspected environmental risk factors for cardiovascular disease can be found in foundries and particularly in core-making departments. These include dusts, carbon monoxide, heat, and noise. Of particular concern is the presence in the core-making departments of silica, known to cause restrictive lung disease. Less conclusive, but supported by a number of studies is the association between decreased pulmonary function and coronary atherosclerotic heart disease.

VI. RESULTS AND DISCUSSION

Fork-Lift Garage

There was no apparent carcinogen in the battery-testing area.

Tapping Department

Oil mist concentrations are listed in Table I. Workers were exposed to oil mist levels ranging from non-detectable (less than 0.5 mg/M^3) to 3.0 mg/M^3 with a mean of 1.0 mg/M^3. The OSHA PEL for oil mists is 5.0 mg/M^3 averaged over an 8-hour workday.

Nitrosamine formation from the cutting fluid was considered unlikely by NIOSH. The oil, "Seco", manufactured by Sun Oil Company, consisted of 80% naphthenic-based oils, 14% sodium salts of sunaptic acid, 5% emulsifier and rust inhibitor (petroleum sulfanates) and 1% hexylene glycol. Sun Oil informed NIOSH that there were no amines of any kind present, nor were there any nitrates or nitrites in the oil.

Testing Department

About half of the day-shift workers in this area were observed by NIOSH to have some mild dermititis on their wrists. Some workers were concerned about the formation of a "greenish-brown scum" on top of fluids in tanks that were not being emptied and cleaned often enough. Consequently, there was speculation that skin problems were being caused by bacterial infection. The bacterial species that was identified by NIOSH, however, is not a pathogen (See Table II).[5]

Skin irritation may have been caused by the testing fluid itself and/or the bacteriacide ("Grotan", manufactured by Lehn & Fink, Inc.) that was added to the fluid. The testing fluid ("Hamikleer"), contained 25% triethanolamine, which can irritate skin, and 10% boric acid. Also, many bactericides are known to be skin irritants (See Table III). Most of the workers were wearing protective gloves during the NIOSH survey but the gloves were not long enough to protect the wrists.

Core-Making Departments

Questionnaires were received from 50% of the core department workers and from 48% those in the Tapping and Testing Department (Table IV).

For comparative purposes only the white males could be evaluated. Cases of cardiovascular disease in black males or females could not be evaluated due to the small number in those groups.

Evaluation of the questionnaires showed that the prevalence of heart disease, defined as a history of a heart attack or angina, was four times greater in the Core-Making Departments than in Tapping and Testing. A total of six cases (16.6%) were found in white males in the Core Department, compared with two cases (4%) in Tapping and Testing. This difference, however, was not statistically significant at $p<0.05$.

These small numbers were difficult to assess on a more specific basis, such as by age. Yet when the age specific rates of heart disease were calculated it was found that 3, or 50% of the cases in the Core departments were in the relatively young age group of 30-34 (Table V). This represented a rate of 37.5% among all the Core Department workers aged 30-34. No cases were found in the corresponding age group for the Tapping and Testing. To ensure that different age distributions of the two groups were not responsible for the rate differential, direct adjustment of rates was performed using the 1970 population of Lancaster Pennsylvania. The adjusted rates were 5.2% for the core makers compared with 1.6% for the tapping and testing department. This is almost a four-fold difference which is consistent with that found with the unadjusted rates.

A comparison of smoking histories showed that all cases from both groups had reported smoking at least 100 cigarettes in their lives. The overall rate for smoking either currently, or ever, were greater in the Tapping and Testing departments than in the Core departments. Currently the prevalence of smoking was 36.1% for the Core Department compared with 55.5% for Tapping and Testing, and the corresponding rates for ever-smoked 100 cigarettes were 80 and 87%, respectively.

A history of high blood pressure was reported by 30% of core makers compared with 22% of the tapping and testing workers.

While the rates of heart disease are not statistically significantly different for the core-makers compared with the tappers and testers they are still almost four times greater. The lack of significance is a function of the small numbers, six cases out of 36 people compared with two out of 49. This result is biologically plausible since core workers have had exposures to silica, and silicosis or reduced pulmonary function has been associated with cardiovascular disease. The data is not definitive but highly suggestive of an occupational risk factor.

VII. RECOMMENDATIONS

A. Sulfuric acid mist concentrations should always be kept below irritating levels in the Fork-Lift Garage. Garage workers, upon interview, stated that acid mists were not a problem most of the time. However, occasional break-down of the exhaust fan had been known to cause irritating acid mist concentration in the past. Preventive maintenance of exhaust systems should be used to ensure sufficient ventilation in the fork-lift garage at all times.

B. All cutting fluid products in the Tapping Department should be kept clean and continuously monitored for amines and nitrites for the purpose of evaluating their potential to form nitrosamines. Any additives that are incorporated should also be carefully evaluated for amine and nitrite content.

C. Product substitution and personal protective equipment should be used to prevent skin irritation in the Testing Department. Different combinations of testing solutions and bactericides should be substituted while noting manufacturer's data concerning skin irritation. In the interim, workers should wear gloves that are long enough to protect their wrists.

Particular attention should be given to the cardiovascular and respiratory systems of Core-Making workers during regular physical examinations.

VIII. REFERENCES

1. Criteria for a Recommended Standard ... "Occupational Exposure to Sulfuric Acid", U.S. Department of Health and Human Services, NIOSH Publication No. 74-128, 90 pp., 1974.

2. Current Intelligence Bulletin 15, "Nitrosamines in Cutting Fluids", U.S. Department of Health and Human Services, NIOSH Publication No. 78-127, 4 pp., 1976.

3. Rossmoore H.W.: Antimicrobial Agents for Water-Based Metalworking Fluids. JOM 23:247-254, 1981.

4. Rosenman K.D.: Cardiovascular Disease and Environmental Exposure. Br. J. Ind. Med. 36:85-97, 1979.

5. Holmes B., R. J. Owens, A. Evans: Pseudomonas paucimobilis, a New Species Isolated from Human Clinical Specimens, the Hospital Environment, and Other Sources. Int. J. Syst. Bacterial. 27:133-145, 1977.

IX. ACKNOWLEDGEMENTS

Evaluation Conducted and Report Prepared by:	Steven A. Lee, M.S. Industrial Hygienist Industrial Hygiene Section Paul Schulte, M.S. Epidemiologist Medical Section
Field Assistance:	Bruce A. Hollett Industrial Hygienist Industrial Hygiene Section
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Evaluations and Field Studies Cincinnati, Ohio
Report Typed by:	Jackie Woodruff Clerk/Typist Industrial Hygiene Section

X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this complete Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. 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. International Molders and Allied Workers Union, Local 376
2. ITT Grinnel Corporation
3. Department of Labor (OSHA), Region III
4. NIOSH, Region III

For the purpose of informing the approximately 200 effected employees, the employer should promptly post this Determination report in a prominent place(s) near the work of the affected employees for a period of thirty (30) calandar days.

TABLE I

ITT Grinnel Corporation
Columbia, Pennsylvania
March 13, 1980
HE 80-60

Results of Personal Breathing Zone Samples for Oil Mists
as Milligrams Per Cubic Meter of Air (mg/M^3)*

Location/Machine	Time	Concentration mg/M^3
Automatic Pottstown	12:45-1:45pm	1.1
2-inch Cleveland	12:49-1:49pm	1.8
Manual Pottstown	12:52-1:25pm	N.D.**
3/4-inch Grinnel	12:58-1:58pm	N.D.
1-inch Cleveland	1:04-2:04pm	1.2
Automatic Pottstown	1:47-2:43pm	3.0
2-inch Cleveland	1:50-2:45pm	2.4
Manual Pottstown	1:54-2:46pm	N.D.
1-inch Cleveland	2:00-2:47pm	N.D.
1-inch Cleveland	2:05-2:48pm	N.D.

* OSHA Permissible Exposure Limit 5.0
** Concentration was below detectable levels (approximately 0.5 mg/M^3)

TABLE II

ITT Grinnel Corporation
Columbia, Pennsylvania
March 13, 1980
HE 80-60

Bacterial Analyses of Testing Fluid

Location	Date When Machine Was Last Cleaned	Growth Concentration* (Colonies/Milliliter)
Machine #2	2/5/80	-------
Machine #3	2/5/80	1×10^4
Machine #4	2/11/80	9×10^3
Machine #5	2/11/80	1×10^4
Machine #6	2/27/80	1×10^3
Machine #7	2/27/80	1×10^3
Machine #8	2/27/80	-------
Machine #9	2/5/80	-------
Machine #12	2/5/80	-------
Machine #13	2/27/80	-------
Machine #14	2/22/80	-------
Machine #15	2/22/80	5×10^3
Machine #16	2/11/80	5×10^3
Machine #17	2/11/80	1×10^4
Machine #18	2/5/80	6×10^3
Machine #19	2/5/80	-------

*$< 1 \times 10^3$ = light growth
1×10^3 to 1×10^4 = moderate growth
$> 1 \times 10^4$ = heavy growth

The bacterial strain was identified as belonging to Pseudomonas CDC group II K-1 or Pseudomonas paucimobilis. A detailed treatise of this organism is found in the International Journal of Systematic Bacteriology, Vol. 27, pp. 133-146, 1977. The authors state that there is no evidence that any strains of P. paucimobilis have been incriminated in any infection in man.

TABLE III

Acute Toxicology Profiles on Metalworking Fluid Biocides*

Trade Name	Acute Oral LD_{50}	Acute Dermal LD_{50}	Acute Primary Dermal Irritation	Acute Primary Eye Irritation	Acute Inhalation LC_{50}
Dowicil 75	Rat 1190 mgm/kg body wt.	Rabbit 1/4 dead; 3/4 normal; 2000 mgm/kg	Rabbit No response from powder	Rabbit 1/6 slight corneal necrosis 72 hrs. post	Rat No effect; 9.33 mgm dust/L air
Dowicide 1 Dowicide A	Rabbit 71000 mgm/kg	Not absorbed thru skin; LD_{50} N.A.	Rabbit Concentrate non-irritating	Rabbit Avoid contact; eye irritant	N.A.
XD-8254 DBNPA	Rat 126 mg/kg of acive material	Not absorbed thru skin in toxic levels	Repeated exposure can be irritating	Serious hazard; high doses at high pH Lachrymator	Rat Normally not an inhalation problem
Givgard DXN	Rat 2000 mg/kg	N.A.	Human 1% non-irritating	Rabbit 1% draize negative	Rat Vapor sat. 0.1% no visible toxicity
Proxel CRL	1100 mgm/kg	> 1 gm/kg	> 0.1% may be irritant	Draize avg. 65	N.A.
Bioban P-1487	Rat 380 mg/kg	Rabbit 1100 mgm/kg absorbed skin 24-hr. exposure (concen. used)	Rabbit 2-5% in petrolatum 1.1-1.5 rating mild irritant	Rabbit 0.1 ml concen. corneal damage; 2% — Draize 0 5% — Draize 40/110	Avoid breathing mists
Tris Nitro	Rat 995 mgm/kg (100% material)	Mouse 1850 mgm/kg	Rabbit Non-irritating at 1%	Rabbit Non-irritating· 50-100%	N.A.
Grotan HD2	Rat >5000 mgm/kg	> 2000 mgm/kg	Slight irritation on intact and abraded skin; gone in 72 hrs.	Mild to moderate irritation for 7 days	N.A.
Grotan BK†	Rat 580 mgm/kg	N.A.	Rabbit Index 1.25 (lowest)	Rabbit Transient irritation; gone 96 hrs. post	N.A.
Zinc Omadine	Rat 200 mgm/kg (based on 100%)	Rabbit Nothing 2%; 4-10 gm/kg	Rabbit 2% not irritating	Rabbit 2% no irritation	N.A.
Sodium Omadine	1100 mg/kg (based on 100%)	40%; 6.4 ml/kgm 2,500 mg/kgm	Rabbit irritation at 40% irritation at 10%	Rabbit 1-40% non-irritating; mild	N.A.
Triadine 10	Rat 734 mgm/kg	Rabbit 854 mg/kg	Concentrate is severe irritant	Concentrate is severe irritant. Immediate water wash prevents	LC_{50} > 7.44 mg/L1 hr; this is satur. concent.
Onyxide 200	Rat 860 mgm/kg	Rabbit No deaths at max. dose; 3.5 gm/kg 24-hr. exposure	N.A.	Rabbit Concen. irritant; H_2O wash prevents if immediate	Guinea Pig Exposure to 1.5% in 3% cutting fluid for 8 hrs., 5 days, 4 wks. — negative
Kathon 886 MW	457 mgm/kg	Rabbit 950 mgm/kg	See Table 3	See Table 3	Rat 1.5-2 mg/L 4 hr.
Vancide TH	Rat 280 mg/kg	Rabbit 499 mgm/kg	Rabbit 0.1 and 1.0% for 24 hrs. — slight irritation, abraded skin	Irritant	Rat 2660 mg/M^3/hr.
Vancide 51	Rat 3120 mgm/kg	N.A.	Irritation human-negative	Avoid contact with eyes	Avoid breathing mist

* Rossmoore H.W.: Antimicrobial Agents for Water-Based Metalworking Fluids. JOM 23:247-254, 1981.

TABLE IV

Participation Rates

March 13, 1980
HE 80-60

Core Department	n	%
Questionnaires sent	68	
Response to questionnaires		
White male	36	(52.9)
Black male	2	(2.9)
Women	2	(2.9)
		58.8

Tapping and Testing Departments	n	%
Questionnaires sent 125		
Response to questionnaires		
White male	49	(39.2)
Black or Oriental male	4	(3.2)
Women	8	(6.4)
		48.8

TABLE V

Age-Specific Frequencies of Heart Disease and Risk Factors

March 13, 1980
HE 80-60

	Heart Disease[1]		High Blood Pressure		Smoking[2]		Population At Risk	
Age	C	T	C	T	C	T	C	T
20-24	0	0	0	0	3	1	6	2
25-29	0	0	0	1	1	5	3	7
30-34	3	0	3	0	3	3	7	5
35-39	0	0	0	0	0	2	3	4
40-45	0	0	0	1	0	2	3	4
45-49	0	1	3	1	1	2	3	6
50-54	1	1	2	2	0	5	3	8
55-59	2	0	2	3	3	3	7	5
60-64	0	0	1	3	2	4	3	10
Total	6	2	11	11	13	27	36	49
Percent of total population at risk	16.6	4.0	30.5	22.4	36.1	55.1	100	100

1. Combined Heart Attack and Angina positive histories
2. Current Smokers
C = core department
T = tapping and testing departments