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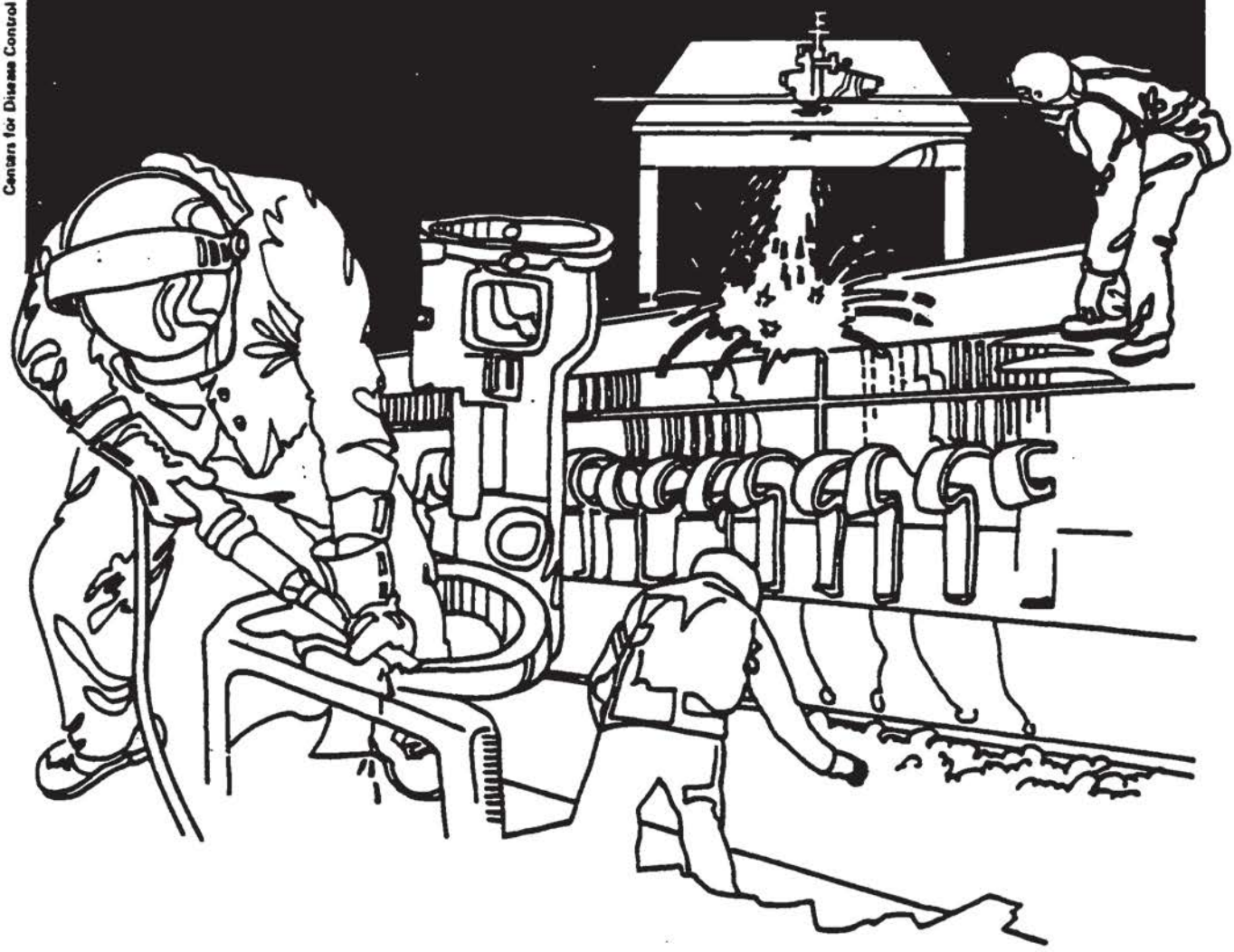
NIOSH



Health Hazard Evaluation Report

HETA 84-222-1715
TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, N.Y.

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 84-222-1715
JULY 1986
TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, N.Y.

NIOSH INVESTIGATORS:
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I. SUMMARY

On March 2, 1984 the National Institute for Occupational Safety and Health (NIOSH) received a request from United Automobile Workers Local 338 to evaluate respiratory and skin problems among workers at TRW Bearings Division plants in Jamestown and Falconer, New York. The problems were thought to be due to coolant system additives. The two plants employed 277 and 419 hourly workers, respectively.

NIOSH investigators conducted a walk-through inspection April 18-19, 1984, and conducted an environmental and medical survey the week of May 14, 1984. The environmental survey included air sampling for oil mist, C_8-C_{13} aliphatic hydrocarbons (naphtha), 1,1,1-trichloroethane, butyl cellosolve, methyl amyl alcohol and metals. All oil mist concentrations were within the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 5 milligrams per cubic meter (mg/m^3) for mineral oils (there are no authoritative occupational exposure criteria for synthetic machining fluids). Oil mist concentrations in two samples from the Falconer plant, and in none from the Jamestown plant, exceeded 2 mg/m^3. Naphtha concentrations ranged from 8 to 65 mg/m^3 (median 25) at the Jamestown plant, and 3-51 mg/m^3 (median 4) at the Falconer plant (NIOSH recommended exposure limit for a comparable mixture of aliphatic hydrocarbons: 350 mg/m^3). None of 11 samples at the Jamestown plant had more than trace amounts of 1,1,1-trichloroethane; 2 of 9 at the Falconer plant had quantifiable amounts, 4.5 and 1.2 mg/m^3, both for grinder operators (ACGIH TLV: 1900 mg/m^3). Butyl cellosolve was present only in trace amounts (less than 0.01 mg/m^3) at the Falconer plant and in concentrations up to 0.39 mg/m^3 at the Jamestown plant (ACGIH TLV 120 mg/m^3). Methyl amyl alcohol was not present at either plant at more than trace concentrations (less than 0.1 mg/m^3). No air concentrations of any metal at either plant exceeded 0.03 mg/m^3, and except for sodium, all were below 0.01 mg/m^3.

Sixty-one Jamestown workers and 79 Falconer Main building workers participated in the survey. Jamestown and Falconer workers did not differ significantly with respect to prevalence of skin or pulmonary problems over the preceding year or prevalence of irritative or respiratory symptoms in the preceding three days. Jamestown workers were 3.1 times [51% vs. 16%, 95% confidence interval (CI) about the rate ratio (RR): 1.8-5.4] more likely than Falconer workers to have had a skin problem in the preceding three days. Jamestown workers were

more likely than Falconer workers to wear gloves (20% vs. 6%, RR = 3.1, 95% CI: 1.2-8.4) and to use barrier creams (52% vs. 30%, RR = 1.7, 95% CI: 1.2-2.6). Geometric mean oil mist exposure was not associated with irritative symptoms, respiratory symptoms, or headache.

This study did not document airborne exposures to oil mist or other substances in excess of current occupational health criteria. The reason for the higher prevalence of recent skin problems at the Jamestown plant is not apparent from our data. Section VIII of this report contains recommendations for reducing skin exposure to machining fluids and for proper care of oil-exposed skin.

KEYWORDS: SIC 3562 (ball and roller bearings), machining fluids, oil mist, dermatitis.

II. INTRODUCTION

On March 2, 1984, NIOSH received a request from the United Automobile Workers Local 338 to evaluate respiratory and skin problems among workers at TRW Bearings Division plants in Jamestown and Falconer, New York. The problems were thought to be due to exposure to coolant system additives.

NIOSH medical and industrial hygiene investigators made an initial visit to the plant April 18-19, 1984, to conduct a walk-through inspection, interview workers, and obtain bulk samples of coolants. The NIOSH investigators returned the week of May 14, 1984, to conduct air sampling and a medical questionnaire survey. Air sampling results were sent to the company and union on October 16, 1984.

III. BACKGROUND

A. Process Description

TRW Bearings Division grinds and mills roller bearings of various sizes for the automotive and aircraft industry at its Jamestown and Falconer, New York, facilities. The majority of the bearings consist of a circular inner and outer race which contain the roller bearings, and all exposed surfaces including the lateral edge must undergo a grinding operation to meet size and surface preparation specifications. Grinding is conducted on various types of automated and semi-automated machines, which use a free-running synthetic coolant (usually a 1:25 coolant:water mixture) to reduce heat build-up within the bearing and the grinding wheel. Following is a description of the production processes monitored during our evaluation.

1. Jamestown facility

The Jamestown plant employed 277 hourly workers at the time of our investigation. The plant can be categorized into four areas, distinguished by type of grinding. Although there are six different coolant systems within the facility, the four main grinding areas are serviced by one 50,000-gallon main system.

Centerless grinding:

Historically, the centerless grinding operation had the highest incidence of health complaints, according to union and company representatives. Fifteen to 20 operators and helpers are employeed in this area. While some of the machines are essentially automated, others require labor- intensive service, involving loading and hand operation of the grinding activity. Oil mist is generated and becomes dispersed by the physical contact of the oil with the high-speed grinding wheels. Creation of the mist is partially controlled, especially on the automated systems, by draping cloth near the points of the grinding wheel-to- bearing contacts. While some machines are designed for the use of extensions for loading and feeding of bearings (to increase the distance between the worker and these contact points) we observed that they were usually not used because the operators claimed that they could not run "spec" parts if they could not actually see and feel the grinding. They also gave this reason for not using gloves.

Intermediate area:

This area consists of six partially automated lines employing 12-14 operators and helpers. A typical "line" consists of three grinding operations: an inner and outer race grind, an inner and outer bore grind, and an inner finish race grind with an outer hone. The outer hone process uses mineral oil instead of the usual coolant. Finally, the parts are washed in a Solv-o-solvT lubricant, then pressed and packed for shipment.

Miscellaneous area:

This area consists of seven bore grinders requiring three operators, five OD (outside diameter) grinders requiring three operators, and two large-bore grinders requiring two operators.

Duplex area:

This area employs seven operators on Brown & Sharp and Duplex grinding machines. These operations are very skilled and labor-intensive due to the rigid specifications required of the product. Therefore, compared to the other areas of the plant, there was relatively little through-put. A Rust-BanT product (petroleum naphtha) was sprayed on parts stored in this area.

2. Falconer facility

The Falconer plant employed 419 hourly workers at the time of our investigation. The plant is involved in the same type of production process as the Jamestown plant, except that greater tolerances are required and more stainless and higher grade steels are used. The majority of the bearings processed at this facility are used in the aircraft industry. A new, 10,000-gallon coolant system was installed in the plant in January 1984.

The facility is serviced by roof-mounted airconditioning units operated in the summer months, and local exhaust ventilation is located on several of the grinding machines. No ventilation is present during the winter months.

The facility can be categorized by the type of grinding operation or by the type of grinding machine. Following is a description of the production processes monitored during our evaluation.

Building #1 (Main building):

Lathes: Four (Lodge & Shipely) lathes require three operators per shift. Due to the nature of the process, the potential for exposure to oil mist is low in this area.

C.F. (Controlled Force) Grinders and Micro Matic Grinders: This area of the plant has generated the most health complaints. There are 12 C.F. grinders and 16 Micro Matics, which require a total of 18 operators.

Bryant 214: Four machines of this type are present, requiring one operator each. The actual grinding process is enclosed behind Plexiglas, which substantially reduces oil mist exposures for these operators.

Bryant 3216, 1124(2), and 1130: Two operators are required for these four machines. Although a visible oil mist was observed in this area, the operation is not labor-intensive.

Grand Rapids (Slotting operation): Seven operators are required for these seven slotting machines. Oil mist exposures appeared to be minimal.

Brown & Sharp: This skilled, labor-intensive operation required five operators on eight machines.

All of the above grinding operations are supplied by the main coolant system.

Building #2 (New building)

Operations in Building #2 include the Roll Line (3 operators), End Grinding (one operator), Separator Department (5-6 operators), and the Broach Area (one operator). All these operations are supplied by different, smaller coolant systems.

The coolant systems in the two buildings are essentially the same, except that a fragrance/dye was added to the starting oil by the manufacture of the synthetic oil in building #1. Currently, the same starting coolants are used at both the Jamestown and Falconer plants.

B. History of Coolant System Problems

Historically, according to documents and verbal information provided by the company and union, the initial problems with the coolant systems appeared to occur in the mid-1970's at the Falconer plant and were related to production difficulties: excessive foaming, dirty coolant, rapid clogging of settling tanks, and scrapped parts due to grinding wheel "load-up" and thin coolant. A bacterial build-up problem was addressed in the Falconer facility in May 1982. It was determined that the high-phosphate cleaners/detergents used in the coolants were providing nutrients for bacteria. These cleaners were also used to clean floors in the facility and got into the coolant system through the floor-level coolant returns. The high-phosphate cleaners were subsequently removed from both facilities.

In December 1982, company officials identified several deficiencies in the Falconer plant's coolant system. Items noted were a general lack of capacity, which forced a high-volume through-put to meet

production demands. This situation led to a breakdown in the capacity of the filtering screens. Screens were subsequently replaced with larger screen openings. Also, a "positive" type filtration mechanism was suggested.

In March 1983, the coolant in the Falconer plant was changed to TRW #1 (a Cincinnati Milacron semi-synthetic, oil-based, water-soluble coolant), which had been used at the Jamestown facility. The change was made because of continued excessive bacterial growth in the Falconer plant coolant. Even with the change, however, bacterial growth persisted, requiring additional dosages of biocide (Additive RY). It was noted by the company at that time that the use of additional biocide apparently resulted in the increased occurrence of "operator skin irritation and sensitization." It was thought at the time that the use of well water could be contributing to the bacterial problem. The coolant units were then switched to city water.

In April 1983, an evaluation of the irritability of various coolant solutions was undertaken because of continued skin irritation experienced by several operators. Various concentrations of the coolant and a rust inhibitor (added to the coolant) were tested by Cincinnati Milacron using guinea pig patch testing. Results from the Milacron CimcoolT Customer Laboratory Services showed that "...Rustban at 1%, 3%, and 5% significantly increases the irritability of TRW-1 mixes. Because of the increased irritability when Rustban is mixed with the TRW-1 mixes, the Rustban should be kept out of the TRW-1 mixes." The company obtained a second opinion from an independent laboratory which stated that only minimal irritability should be realized with the low amount of Rustban used in the coolant solutions.

In June 1983, a grievance was filed by several employees questioning the integrity of the grinding coolants. The employees stated that the coolant caused respiratory problems for them on certain dates. They stated that the problems coincided with the addition of biocide to the coolant system. This initiated a system of (1) adding biocide over a longer period of time rather than "slugging" the system with the entire recommended quantity, and (2) having laboratory personnel, rather than a coolant operator, control biocide addition.

On November 13, 1983, several employees experienced burning eyes, throats, and noses following a coolant change. An investigation by the company revealed that the rust inhibitor had been added without authority and was probably responsible for the health effects. It was subsequently determined that the health effects were experienced 3-4 days after a coolant change and that the rust

inhibitor product (Additive 12 - sodium nitrite) was normally added at each change. It was theorized that the additive could be attacked by bacteria and yeast, and at lower pH values the oxidized additive could release ammonia-like fumes. Since bacteria/yeast counts were fairly low in freshly prepared coolants, the breakdown of the additive would not take place until the microbial concentration increased sufficiently (approximately the 3rd or 4th day of the operation). At that time, a replacement for the additive was suggested.

In December 1983, bulk samples of the coolant were submitted to an independent testing laboratory for analysis of possible irritants. Laboratory results did not identify any irritants, but the samples did not contain either the biocide or rust inhibitor.

In January 1984, a new "hydromation" filtration system was installed in the Falconer facility in anticipation that many of the production problems and health effects would be alleviated.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

As an initial step toward characterization of the potential airborne exposures experienced by the grinding operators, bulk samples of the coolant starting materials and existing coolant streams, plus additives such as the biocide and rust inhibitor, were obtained during the initial site visit and analyzed in preparation of the environmental sampling protocol for the follow-up evaluation. For this analysis, the coolant systems were grouped into three categories: 1) the main coolant system at the Jamestown facility, 2) the coolant system in building #1 at the Falconer facility, and 3) one sample representing the smaller, mostly individual coolant systems in building #2 at the Falconer plant. Also submitted for analysis was the rust inhibitor applied to finished parts (Rust Ban), plus possible contaminants of the coolant systems, such as honing, spindle, hydraulic, and cutting oils.

Employee oil mist exposures were measured to determine whether there was a relationship between exposures and symptom prevalance by department and/or operation. In addition, a portion of employees from each of the major production areas was monitored for exposures to total particulate, naphtha, 1,1,1-trichloroethane, methyl amyl alcohol, and metals. Finally, exposure levels were determined for specific metals (present as contaminants in the cooling oil as a result of the grinding operations), and bulk air

samples were collected on silica gel and charcoal and submitted for qualitative analysis to determine the presence of other airborne contaminants. Table I presents a summary of the sampling and analytical methods used for the sampled substances.

B. Medical

All production and maintenance employees were invited to participate in the medical survey, which consisted of an interviewer-administered medical and occupational history questionnaire.

V. EVALUATION CRITERIA

A. Environmental 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 Governme'tal 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 exposure limits, 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 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.

B. Specific Substances

1. Grinding and cutting fluids[2,3]

Grinding and cutting fluids can be "straight" (insoluble) oils, soluble (water-miscible) oils, or aqueous solutions. Straight oils are mineral oils, sometimes blended with vegetable or animal oils, and may contain biocides and other additives. Soluble oils are mineral oils to which emulsifiers, corrosion inhibitors, anti-foaming agents, dyes, and water conditioners have been added and which may also contain biocides and other additives. Synthetic (water-soluble) fluids contain corrosion inhibitors and surfactants and may also contain blending agents, biocides, water conditioners, anti-foaming agents, and dyes. Semi-synthetic fluids contain oils in additon to the other constituents of synthetic fluids.

Mineral oils can cause oil acne, but eczematous contact dermatitis is the most common skin problem resulting from exposure to water-based (synthetic) cutting and grinding fluids. This condition can be manifested by redness, scaling, fissuring, and thickening of the skin. Swelling, papules (small, solid bumps), and vesicles (small, fluid-filled bumps) can result if the fluid contains strong irritants or sensitizers. Although water-based fluids are more likely than insoluble oils to be contaminated with bacteria, they are less likely to be associated with bacterial infections of the skin. Operations in which cutting fluids are used generate metallic swarf or splinters, which can cause foreign body granulomas (chronic, localized inflamation) if imbedded in tissue and not removed. Skin cancer has resulted from contact with European oil but apparently not from North American oil. Respiratory

disorders, including lipid pneumonia, resulting from occupational exposure to cutting and grinding fluids are apparently rare. Lung cancer has not been associated with exposure to cutting and grinding fluids, but nitrosamines (which are carcinogenic) can form in fluids containing nitrites and secondary or tertiary amine additives.

The OSHA standard and the current ACGIH TLV for mineral oil mist are both an 8-hour TWA of 5 mg/m^3. The ACGIH also has a short-term exposure limit of 10 mg/m^3. There are no NIOSH, OSHA, or ACGIH exposure criteria for synthetic machining fluids.

2. Other substances

Table 2 presents the evaluation criteria for naphtha, 1,1,1-trichloroethane, butyl cellosolve, and several metallic substances.

VI. RESULTS AND DISCUSSION

A. Environmental

Gas chromatographic/mass spectroscopic (GC/MS) analysis of bulk samples collected during the initial site visit from the product streams indicated that the main coolant systems in both the Jamestown and Falconer plants consisted of essentially the same compounds, primarily oil patterns of aliphatic hydrocarbons, phenols, and nitrogen compounds. The pH's ranged from 7 to 8.5. The sample representing the smaller coolant systems in building #2 at the Falconer plant showed simply an oil pattern with a pH of 6. The starting material concentrate (TRW #1) indicated an oil pattern with several nitrogen-containing compounds such as aliphatic amines or amides, but no positive indentification could be made.

The microbiocide (additive RY) was shown to contain several isothiazolin and chloro-nitrogen compounds. The rust inhibitor (Additive 12) showed no major peaks under GC/MS analysis.

The three bulk samples collected from the coolant system streams were also analyzed for nitrosamines and screened for the presence of the bactericide and rust inhibitor. No nitrosamines were detected in any of the three coolant system samples (limit of detection 500 mg/ml) or in the bulk air samples submitted for qualitative analysis. No peaks matching the retention times of those found in the bactericide or rust inhibitor were seen in any of the three bulk coolant samples, indicating that if present, nitrosamine concentrations were relatively low. Results of

charcoal and silica gel bulk air samples submitted for qualitative analysis indicated the presence of naphtha, 1,1,1-trichloroethane, methyl amyl alcohol, and butyl cellosolve. Twenty-six personal breathing zone air samples for oil mist were collected at each plant (Tables 3a and 3b). Following is a summary of airborne exposures by facility and specific locations or operations within each facility.

Jamestown Facility

Area	Number of samples	Oil mist concentration (mg/m^3) Range	Mean	Median
Centerless	8	0.47 - 1.55	0.91	0.89
Duplex	4	0.43 - 1.12	0.71	0.65
Intermediate	9	trace - 1.59	0.79	0.90
Miscellaneous	5	trace - 1.13	0.63	0.60
Total	26	trace - 1.59	0.78	0.78

Falconer Facility

Area	Number of samples	Oil mist concentration (mg/m^3) Range	Mean	Median
Lathes, CFs, Micros	16	0.44 - 1.96	1.71	1.02
B, GR, B&S	6	0.27 - 4.44	1.49	0.94
New Building	4	trace - 0.56	0.33	0.39
Total	26	trace - 4.44	1.11	0.81

Airborne aliphatic hydrocarbons were measured at both TRW facilities based upon analysis of the charcoal tube bulk air samples. These samples indicated airborne aliphatics in the C_9-C_{13} range. Analysis of the Rust Ban product, used quite liberally in the Jamestown plant and to a lesser extent in the Falconer facility, showed it to be comprised of C_8-C_{12} aliphatics. The discrepency between the bulk Rust Ban analysis and the bulk air analysis is probably due to the contribution of the oil-based coolant to the airborne aliphatics. For analysis of the breathing zone charcoal tube samples, Stoddard solvent was used as the reference standard since its retention time and peak patterns under GC analysis matched those of the airborne aliphatics. Following is a summary of "naphtha" exposures at the two facilities (Table 4).

		Naphtha concentration (mg/m^3)		
Location	Number of samples	Range	Mean	Median
Jamestown				
Centerless	2	11 - 58	35	35
Duplex	3	25 - 32	29	30
Intermediate	3	16 - 49	28	19
Miscellaneous	3	8 - 65	28	10
Total	11	8 - 65	29	25
Falconer				
Main building	6	3 - 9	4	3
New building	3	9 - 51	34	42
Total	9	3 - 51	14	4

Eight of 11 breathing zone samples collected from the major production areas at the Jamestown plant had no detectable 1,1,1-trichloroethane, and the remaining three had amounts below the limit of quantitation (trace quantities of less than 0.4 mg/m^3). Two breathing zone samples collected in the New building at the Falconer plant had 4.5 and 1.2 mg/m^3 (from the Unison grind and Centerless grind operators, respectively). The other seven samples, collected in Building #1, had less than the limit of quantitation (less than 1 mg/m^3).

Employee exposures to butyl cellosolve at the Falconer plant were at trace quantities (less than 0.01 mg/m^3, eight samples), and none of eight samples had detectable amounts of methyl amyl alcohol. Twelve samples collected for methyl amyl alcohol at the Jamestown facility had trace amounts (less than 0.1 mg/m^3). Results for 4 of 12 samples analyzed for butyl cellosolve ranged from 0.24 to 0.39 mg/m^3, with the remaining eight having trace amounts (less than 0.3 mg/m^3).

No significant exposures to airborne metals were found at either facility (Table 5).

B. Medical

One hundred forty-eight workers participated in the medical survey, 61 from the Jamestown plant and 87 from the Falconer plant. All were men, and all but four (one Black and 3 Hispanics) were non-Hispanic Whites. They had worked at TRW from 4 to 42 years (median 28). The 130 workers who were grinders at the time of the survey had worked as grinders for 1 month to 42 years (median 19 years). Eight of the Falconer plant employees were from the New building. Because this number is small, all Falconer plant data and analyses presented below refer only to the Main building, even though New building data are presented in Table 6 along with the Main building and Jamestown plant data.

The age distributions at the two plants were similar, as were smoking status and history of allergy (Table 6). A similar proportion of Jamestown and Falconer participants reported bronchitis, asthma, or emphysema in the preceding year. Also, similar proportions reported skin problems in the preceding year. In the three workdays preceding the questionnaire interview, however, Jamestown workers were 3.1 times [51% vs. 16%, (95% confidence interval (CI) about the rate ratio (RR): 1.8-5.4] more likely to have had a skin problem than Falconer workers. The prevalence of other symptoms during the preceding three days did not differ significantly between the two plants. Jamestown workers were more likely than Falconer workers to wear gloves on the job (20% vs. 6%, RR = 3.1, 95% CI: 1.2-8.4) and to use barrier cream (52% vs. 30%, RR = 1.7, 95% CI: 1.2-2.6), but were not more likely to have ever changed jobs because of skin problems associated with grinding (3% vs. 5%). Geometric mean oil mist concentrations were not associated with irritative symptoms, respiratory symptoms, or headache (Table 7).

VII. CONCLUSIONS

This study did not document airborne exposures to oil mist or other substances in excess of current occupational health criteria. The reason for the higher prevalence of recent skin problems at the Jamestown plant is not apparent from our data. The greater use of gloves and barrier creams could be a response to a greater dermatological hazard at the Jamestown plant. Alternatively, inadequate gloves and/or improper use of gloves or barrier cream could exacerabate the adverse dermatologic effects of machining fluids.

VIII. RECOMMENDATIONS

1. Workers should wear clean work clothes because oil-soaked clothing may hold the oil in contact with the skin. This recommendation applies particularly to underclothes, which should be changed frequently and washed thoroughly before re-use. There should be separate lockers for work clothes and street clothes.

2. Short-sleeved overalls, rather than long-sleeved garments, should be worn because friction from cuffs saturated with oil and swarf can contribute to skin problems.

3. Oil should be removed from the skin as soon as possible. This requires easily accessible wash basins and the provision of mild soap and clean towels in adequate supply. Strong soaps, detergents, and abrasive-type cleaners should be avoided. Warm water, mild soap, and a soft brush should be sufficient.

4. Workers should shower at the end of a day's work in order to remove all traces of oil from the skin.

5. Solvents should not be used for cleansing the skin.

6. A skin reconditioning cream should be used at the end of the shift after washing hands. This very important part of a skin conservation program helps to replace the natural oils removed from the skin by exposure to machining fluids and solvents and by washing.

7. All cuts and scratches should be washed and covered by an appropriate dressing, which should be changed as often as necessary to keep the injury free of oil and dirt. Any cut or scratch that appears to be infected, that is suspected to contain a piece of metal or other foreign body, or that does not seem to be healing properly should be brought to medical attention.

8. Eating at the worksite should not be allowed. Food should only be consumed at designated break or lunch areas away from the production processes and the airborne contaminants generated by these processes.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. TRW Bearings Division
2. UAW Local 338
3. UAW International Union
4. NIOSH, Region I
5. OSHA, Region I

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
SAMPLING AND ANALYTICAL METHODODLGY

TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, NEW YORK
MAY 14-17, 1984
HETA 84-222

Substance	Collection Device	Analysis	Detection Limit	Reference
Oil Mist	Tared FWSB	IR Spectroscopy	0.12 mg	P&CAM 283*
Metals	Millipore "AA"	ICP-AES	0.001 mg	----------
Naphtha	Charcoal tube	GC/FID	0.05 mg	----------
1,1,1-trichloroethane	Charcoal tube	GC/FID	0.02 mg	----------
Butyl cellosolve	Silica gel tube	GC/FID	0.005 mg	----------
Methyl amyl alcohol	Silica gel tube	GC/FID	0.005 mg	----------

1 - See reference 1 in Section IX.

TABLE 2
ENVIRONMENTAL EVALUATION CRITERIA

TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, NEW YORK
MAY 14-17, 1984
HETA 84-222

Substance	Evaluation Criteria (mg/m^3)[1] NIOSH[2]	OSHA[3]	ACGIH[4]	Health Effects[5]
Aluminum	-----	-----	10	Pulmonary fibrosis ("scarring" of lungs) following massive exposure to fine powder.
Butyl cellosolve (2-butoxyethanol, ethylene glycol monobutyl ether)	-----	240	120	Eye, nose, and throat irritation. Hemolysis (destruction of red blood cells) in experimental animals. (Other glycol ethers cause reproductive abnormalities in experimental animals.[6])
Calcium (oxide)	-----	5	2	Eye, nose, throat, skin, and lung irritation.
Iron (oxide fume)	-----	10	5	X ray abnormality that appears to be pneumoconiosis (dust disease), but without fibrosis.
Magnesium (oxide fume)	-----	15	10	Eye and nose irritation.
Naphtha (petroleum distillates)	350[7]	2000	1350	Dizziness, drowsiness, headache, nausea, shortness of breath; eye nose, and throat irritation; drying and cracking of skin. May contain benzene, which can cause leukemia.
Sodium	-----	-----	-----	Depends on compound it is part of.
Tin (inorganic compounds)	-----	2	2	Eye and skin irritation.
1,1,1-trichloroethane	1900[8]	1900	1900	Eye and skin irritation, light-headedness, incoordination, disturbance of equilibrium, confusion.
Zinc (oxide fume)	5[9]	5	5	Metal fume fever from freshly formed fume. Symptoms include throat and chest discomfort, cough, fever, chills, muscle discomfort, and fatigue.

1. Eight-hour time-weighted average unless otherwise specified.
2. See reference 4 in Section IX.
3. 29 CFR 1910.1000.
4. See reference 5 in Section IX.
5. See reference 3 in Section IX.
6. See reference 6 in Section IX.
7. 10-hour TWA; 15-minute ceiling: 1800 mg/m^3.
8. 15-minute ceiling.
9. 10-hour TWA; 15-minute ceiling: 15 mg/m^3.

TABLE 3a
OIL MIST EXPOSURES

TRW BEARINGS, INC.
JAMESTOWN, NEW YORK
MAY 14-15, 1984
HETA 84-222

Sample #	Duration	Location/Operation	Exposure Concentration (mg/m^3) Total Weight	Oil Mist
546	0704-1503	Centerless/OD Grinder	1.53	0.95
545	0655-1459	Centerless/OD Grinder	1.67	0.82
553	0704-1144	Centerless/OD Grinder	1.76	1.55
556	0656-1500	Centerless/OD Grinder	1.67	1.26
548	0710-1449	Centerless/OD Grinder	0.63	0.47
552	0720-1452	Centerless/OD Grinder	1.04	0.47
493	0712-1450	Centerless/OD Grinder	0.84	0.66
492	0708-1457	Centerless/OD Grinder	1.06	1.09
491	0729-1454	Duplex/Brown & Sharp	3.91	1.12
540	0758-1454	Duplex/Surface Grinder	0.71	0.43
551	0726-1453	Duplex/Surface Grinder	0.71	0.74
559	0814-1455	Duplex/Surface Grinder	0.65	0.55
557	0751-1501	Intermediate Ln. 2/Grinder	0.33	<0.22*
549	0732-1450	Intermediate Ln. 3/Grinder	1.95	1.15
550	0729-1449	Intermediate Ln. 4/Grinder	2.24	1.59
562	0746-1459	Intermediate Ln. 4/Grinder	2.17	1.50
558	0747-1459	Intermediate Ln. 4/Grinder	0.49	0.23
544	0724-1447	Intermediate Ln. 6/Grinder	0.97	0.70
547	0721-1447	Intermediate Ln. 7/Grinder	1.17	1.05
541	0718-1444	Intermediate Ln. 8/Grinder	1.35	0.90
554	0739-1458	Intermediate Ln. 8/Grinder	0.27	<0.22
539	0740-1456	Misc./OD & Inner Grinder	1.61	1.03
542	0743-1457	Misc./Inner-Race Grinder	1.35	1.13
543	0750-1458	Misc./Race Grinder	0.44	<0.19
560	0802-1505	Misc./Race & OD Grinder	0.73	0.60
561	0800-1505	Misc./Bore Grinder	0.33	0.38

* < = Less than. These values do not represent exposures, but rather the highest possible value considering the analytical limit of detection for the sample and the sampled air volume.

TABLE 3b
OIL MIST EXPOSURES

TRW BEARINGS, INC.
FALCONER, NEW YORK
MAY 16-17, 1984
HETA 84-222

Sample #	Duration	Location/Operation	Exposure Concentration (mg/m^3) Total Weight	Oil Mist
513	0753-1455	Lathes, CF's, Micros/CF Op.	1.75	0.88
503	0741-1459	Lathes, CF's, Micros/CF Op.	1.28	0.53
507	0745-1500	Lathes, CF's, Micros/CF Op.	2.36	1.96
497	0714-1442	Lathes, CF's, Micros/CF Op.	2.04	1.46
500	0716-1445	Lathes, CF's, Micros/CF Op.	1.08	0.74
494	0719-1448	Lathes, CF's, Micros/CF Op.	1.58	1.31
504	0725-1450	Lathes, CF's, Micros/Micro Op.	1.64	1.38
505	0721-1451	Lathes, CF's, Micros/Micro Op.	1.75	1.48
510	0733-1451	Lathes, CF's, Micros/Micro Op.	1.84	1.13
860	0709-1442	Lathes, CF's, Micros/Micro Op.	2.43	1.91
495	0713-1428	Lathes, CF's, Micros/Micro Op.	3.28	2.45
496	0711-1447	Lathes, CF's, Micros/Micro Op.	1.23	0.73
859	0706-1440	Lathes, CF's, Micros/Lathe Op.	1.34	0.90
498	0707-1441	Lathes, CF's, Micros/Lathe Op.	1.19	0.73
499	0715-1513	Lathes, CF's, Micros/Lathe Op.	1.12	0.44
514	0713-1502	Lathes, CF's, Micros/Lathe Op.	1.03	0.62
512	0809-1455	B-GR-B&S*/Grand Rapids Op.	1.08	0.64
861	0737-1450	B-GR-B&S/Grand Rapids Op.	0.48	0.27
511	0803-1456	B-GR-B&S/Brown & Sharp Op.	0.68	0.37
501	0734-1449	B-GR-B&S/Brown & Sharp Op.	4.75	4.44
858	0724-1445	B-GR-B&S/Bryant Op.	2.43	1.96
509	0812-1453	B-GR-B&S/Landis Op.	1.77	1.24
506	0832-1505	New Bldng/Roll Line Grinder	1.11	0.56
508	0842-1508	New Bldng/Bryant Op.	0.50	0.33
502	0747-1456	New Bldng/Unison Corner Grind	0.12	<0.18*
854	0754-1452	New Bldng/Micro Op.	0.95	0.44

*Bryants, Grand Rapids, Brown & Sharp

* < = Less than. These values do not represent exposures, but rather the highest possible value considering the analytical limit of detection for the sample and the sampled air volume.

TABLE 4
NAPHTHA

TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, NEW YORK
MAY 14-15, 1984
HETA 84-222

Sample #	Duration	Location/Operation	Exposure Concentration (mg/m^3)
Jamestown			
CT-14	0704-1447	Centerless/OD Grinder	57.5
CT-8	0700-1500	Centerless/OD Grinder	10.9
CT-9	0803-1453	Duplex/Form Grinder	24.8
CT-10	0804-1453	Duplex/Form Grinder	29.8
CT-18	0727-1455	Duplex/Surface Grinder	31.7
CT-3	0729-1449	Intermediate Ln. 4/Grinder	48.8
CT-5	0720-1446	Intermediate Ln. 8/Grinder	18.9
CT-19	0749-1459	Intermediate Ln. 3/Grinder	16.2
CT-17	0747-1457	Misc./Bore Grind	9.8
CT-4	0753-1456	Misc./Outer Race Grind	7.8
CT-13	0806-1505	Misc./Bore Grinder	65.3
Falconer			
CT-27	0707-1513	Lathes, CF's, Micros/Lathe Op.	2.9
CT-26	0743-1458	Lathes, CF's, Micros/CF Op.	2.5
CT-21	0750-1458	Lathes, CF's, Micros/CF Op.	9.3
CT-29	0716-1445	Lathes, CF's Micros/CF Op.	3.8
CT-22	0818-1454	B-G B&S*/Bryant Op.	3.4
CT-20	0805-1455	B-G B&S/B&S Op.	3.3
CT-11	0831-1505	New Bldng/Roll Ln Grinder	42.3
CT-16	0849-1505	New Bldng/Unison Grind	9.0
CT-28	0744-1456	New Bldng/Centerless Grind	50.5

*Bryants, Grand Rapids, Brown & Sharp

TABLE 5
METAL EXPOSURES

TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, NEW YORK
MAY 14-17, 1984
HETA 84-222

Sample #	Location	Concentration (mg/m^3)					
		Aluminum	Calcium	Iron	Magnesium	Sodium	Zinc
Jamestown:							
AA-01	Intermediate	0.003	0.003	0.023	ND*	0.012	0.003
AA-02	Duplex	ND	0.001	0.012	ND	0.005	0.003
AA-03	Miscellaneous	0.006	0.002	0.016	ND	0.013	0.005
AA-04	Miscellaneous	0.006	0.002	0.021	ND	0.008	0.015
AA-05	Intermediate	0.004	0.002	0.018	ND	0.015	0.006
AA-06	Centerless	ND	0.001	0.011	ND	0.007	0.002
AA-07	Intermediate	ND	0.002	0.012	ND	0.005	0.003
AA-08	Centerless	0.004	0.005	0.022	ND	0.028	0.004
Falconer							
AA-10	Brown & Sharp	0.003	0.001	0.008	ND	0.003	0.002
AA-11	Grand Rapids	ND	ND	0.038	ND	0.016	ND
AA-12	C.F.	ND	0.001	0.010	0.003	0.028	ND
AA-14	MicroMatic	ND	0.001	0.007	ND	0.018	0.001
AA-15	Landis	0.006	0.001	0.006	ND	0.010	ND
AA-16	C.F.	0.003	0.001	0.007	ND	0.012	ND
AA-17	Bryant (Bldng #1)	0.007	0.002	0.019	ND	0.001	ND
AA-18	Lathe	ND	0.001	0.003	ND	0.005	ND
AA-20	MicroMatic	ND	0.001	0.006	ND	0.003	ND
AA-21	Roll Line (Bldng #1)	ND	0.005	0.005	ND	0.011	ND

* ND = none detected

TABLE 6
DEMOGRAPHIC CHARACTERISTICS, MEDICAL HISTORIES, AND SKIN PROTECTION PRACTICES AMONG SURVEY PARTICIPANTS

TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, NEW YORK
MAY 14-17, 1984
HETA 84-222

	Jamestown plant	Main building	New building
Number of participants	61	79	8
Age (years)			
Range	25-64	30-31	28-60
Mean (± s.d.)	47(±10.5)	50(±6.0)	48(±9.2)
Smoking Status			
Current smokers	29 (48)[A]	33 (42)	2 (25)
Former smokers	19 (31)	30 (38)	3 (38)
Never smoked	13 (21)	16 (20)	3 (38)
History of allergy	26 (43)	30 (38)	0
Bronchitis, asthma, or emphysema in past year	4 (7)	4 (6)	1 (13)
Skin problem in past year	17 (29)	22 (28)	1 (13)
Skin problem in past 3 days	31 (51)[B]	13 (16)[B]	0
Other symptoms in past 3 days			
Eye irritation	11 (18)[C]	21 (27)[C]	1 (13)
Nose or throat irritation	15 (25)[D]	29 (37)[D]	3 (38)
Sore throat	5 (8)	8 (10)	2 (25)
Nosebleed	1 (2)	0	0
Cough	10 (16)	6 (20)	1 (13)
Shortness of breath	10 (17)[E,F]	7 (9)[F]	0
Wheezing	3 (5)	6 (8)	0
Chest pain	4 (7)[E]	3 (4)	0
Dizziness	2 (3)	3 (4)	0
Headache	12 (20)[G]	28 (35)[G]	1 (13)
Use of gloves	12 (20)[H]	5 (6)[H]	0
Use of barrier cream	32 (52)[I]	24 (30)[I]	3 (38)
Job change because of skin problem	2 (3)	4 (5)	0

A - Number and (%) of participants from the plant (Jamestown) or building (Falconer).
B - Rate ratio (RR) = 3.1, 95% confidence interval (CI): 1.77-5.38.
C - RR = 0.68, 95% CI: 0.35-1.3
D - RR = 0.67, 95% CI: 0.40-1.1
E - Information not available for one Jamestown participant.
F - RR = 1.9, 95% CI: 0.76-4.7
G - RR = 0.56, 95% CI: 0.31-1.0
H - RR = 3.1, 95% CI: 1.2-8.4
I - RR = 1.7, 95% CI: 1.2-2.6

TABLE 7
SYMPTOMS ACCORDING TO OIL MIST EXPOSURE
(PERSONAL BREATHING ZONE AIR CONCENTRATION, mg/m^3)

TRW BEARINGS, INC.
JAMESTOWN AND FALCONER, NEW YORK
MAY 14-17, 1986
HETA 84-222

Symptom(s)	Number of participants sampled	Oil mist exposure		p, Wilcoxon 2-sample test
		Geometric mean and (s.d.)	95% confidence interval	
Eye, nose, or throat irritation				
Yes	21	0.80 (2.07)	0.57-1.11	0.30
No	22	0.73 (1.99)	0.54-0.99	
Cough, shortness of breath, wheezing or chest tightness				
Among current smokers				
Yes	4	0.65 (2.43)	0.19-2.23	0.41
No	9	0.88 (1.84)	0.56-1.80	
Among non-smokers				
Yes	10	0.84 (1.82)	0.55-1.82	0.30
No	20	0.70 (2.19)	0.49-1.01	
Headache				
Yes	14	0.81 (1.94)	0.56-1.19	0.90
No	29	0.74 (2.08)	0.56-0.97	

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