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 NO. 79-23-603

A.M.F. HEAD DIVISION
BOULDER, COLORADO

JULY 1979

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at A.M.F. Head Division, Boulder, Colorado, on January 8, 1979, and January 30-31, 1979. (A previous health hazard evaluation (HE 73-84-119) was conducted at Head Ski during July and August 1973. Reference 1) At the time of this evaluation breathing zone and general room air samples were taken on workers for methyl ethyl ketone (MEK), toluene, xylene, methylene chloride, crystalline silica, total particulates, methylene bisphenyl isocyanate (MDI), chromium, nickel, asbestos, 1,1,1-trichloroethane, and naphtha.

All breathing zone air samples except one sample for chromium were well within the most recent evaluation criteria. Based on employee interviews and evaluation data, a health hazard is not believed to exist during the time of this survey.

II. DISTRIBUTION AND AVAILABILITY

Copies of this 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 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. A.M.F. Head Division
2. U.S. Department of Labor/OSHA - Region VIII
3. NIOSH - Region VIII

For the purpose of informing approximately 300 employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

III. INTRODUCTION

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.

NIOSH received such a request from the plant management of A.M.F. Head Division, Boulder, Colorado, to evaluate potential exposures associated with solvents, paints, particulates, metal electroplating solutions, and isocyanates.

IV. HEALTH HAZARD EVALUATION

A. Processes Evaluated

This plant manufactures snow skis and tennis rackets. Many processes in the plant are done by hand. The only assembly line process in the plant is in the paint rooms. Materials used throughout the plant include those mentioned above. Workers come into direct contact with many solvents, epoxies, and fibrousglass. Adequate personal protection is supplied in each of these areas, but the utilization of these protective measures is not strenously enforced. Areas investigated during this evaluation included the ski and tennis racket paint rooms, final ski inspection area, foam core mold area, tennis racket spray paint area, silk screen paint area, ski mold release and finishing area, tennis racket molding area, ski cleaning and finishing area, and ski mold and wrap area.

B. Evaluation Design

A significant number of workers were monitored for breathing zone air contaminants. These workers were also interviewed with questions directed at possible health effects from overexposure to the particular type of possible chemical exposures.

C. Evaluation Methods

Asbestos, chromium, nickel, and crystalline silica were collected on 37 mm filters using vacuum pumps operated at 1.5 liters per minute. Methylene chloride, MEK, toluene, xylene, and 1,1,1-trichloroethane samples were collected on charcoal

tubes using vacuum pumps operated at 50 to 100 cc's per minute. MDI samples were collected using impingers and Marcali solution using vacuum pumps at 1.5 liters per minute.

Asbestos fibers with a minimum length of 5 microns were counted on a Leitz phase contrast microscope. The microscope is equipped with a 40 X objective and a 10 X eyepiece containing a Patterson Globe and circle reticle.

Particulate weights of samples were determined by weighing the samples plus the filters on a Perkin-Elmer Model AD-2 electrobalance and subtracting the previously determined tare weights of the filters.

The crystalline silica samples were analyzed for quartz and cristobalite by X-ray diffraction using NIOSH P&CAM #109.

Chromium and nickel samples were analyzed according to the NIOSH procedure P&CAM #173.

MDI samples were prepared and analyzed according to NIOSH P&CAM #142.

Methylene chloride, MEK, toluene, xylene, and 1,1,1-trichloroethane samples were analyzed by gas chromatography utilizing a flame ionization detector according to NIOSH Method P&CAM #127.

D. Criteria for Assessing Concentrations of Air Contaminants

Three sources of criteria are generally used to assess workroom concentrations of air contaminants: (1) recommended Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1978; (2) Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910), January 1978; and (3) NIOSH criteria for recommended standards. NIOSH criteria and ACGIH TLVs represent the most recent and relevant recommendations and are given prominence in this evaluation.

Substances	TLV	Permissible Exposures 8-Hour Time-Weighted Exposures Basis (mg/M^3) Current OSHA Standard	NIOSH Criteria For Recommended Standard
MEK	590.0	590.0	590.0
Toluene	375.0	750.0	375.0
Xylene	435.0	435.0	435.0
Methylene Chloride	700.0	700.0	261.0
Crystalline Silica	0.10	$\frac{30\ mg/M^3}{\%\ Silica\ +2}$	0.05
Total Particulate	10.0	15.0	---
MDI	0.2	0.2	0.05
Chromium	0.5	0.5	0.001
Nickel	1.0	1.0	---
Asbestos	0.5*	2.0*	0.1*
1,1,1-Trichloroethane	1900.0	1900.0	1900.0
Naphtha	---	400.0	---

mg/M^3 = milligrams of substance per cubic meter of air.
* = fibers greater than 5 microns in length.

Occupational health standards are established at levels designed to protect individuals occupationally exposed to toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

E. Toxicology

Methyl Ethyl Ketone (MEK) -- MEK is a widely used industrial solvent. Prolonged exposures above the TLV of 590 mg/M^3 may cause mucous membrane irritation, nausea, vomiting, dermatitis, headache, and paresthesias. Workers strongly object to its odor. However, there have been very few reports of serious ill effects.

Toluene -- High concentrations, above TLV of 375 mg/M^3, may cause conjunctivitis and corneal burns, produces defatting dermatitis, causes fatigue and weakness, headache, dizziness and irritability. The level required to produce narcosis can exist without eye or respiratory tract irritation. (Reference 2)

Xylene -- Xylene has an irritant effect on the skin and mucous membranes and may also affect liver, kidneys, and gastrointestinal tract. Maintaining levels as low as found in this study and avoidance of skin contact should eliminate adverse effects.

Crystalline Silica -- Chronic crystalline silica exposures at levels above the recommended criteria can produce a fibrotic condition of the lungs (silicosis). This is a disabling disease that can lead to permanent disability and death. (Reference 3)

Total Particulate -- This is a term that is applied to the total dust in the air. It is very non-specific. However, at levels that exceed 10 mg/M^3, work conditions are very dusty and uncomfortable and can lead to coughing, sneezing, and respiratory irritation.

Methylene Chloride -- Methylene Chloride is an irritant to the eyes and upper respiratory tract. It is a depressant to the central nervous system (CNS). Exposures at or above 500 parts per million (ppm) may result in potentially harmful carboxyhemoglobin levels. (Reference 4)

Methylene Bisphenyl Isocyanate (MDI) - (Any exposure to MDI may produce irritation of the eyes, dehydration of tissues, corneal damage, irritation of skin and burns; darkening and hardening may occur after repeated exposures. MDI causes angioneurotic edema, irritation of pharynx, dyspnea, headache, cough, chest tightness, asthma, bronchitis, pulmonary edema, nausea and vomiting. (Reference 5) Allergic respiratory sensitization may occur.

Chromium -- Cr^3 is probably non-toxic. Hexavalent salts are most toxic and some are carcinogenic. Carcinogenic factor seems to be related to the manufacture of dichromates from the ore. Chrome does produce dermatitis most commonly of the hands at base of nails and over the knuckles and may cause ulcers which heal poorly and skin or the nasal sputum.

Nickel -- Nickel occurs as a silvery metal and in compounds, crystals, and powders. Nickel may cause "metal fume fever" and "nickel itch"--pink papular erythema of webs of fingers which may spread to other parts of the body; pustulation and ulceration may occur. (Reference 7) Cancer of the sinuses and lungs has been associated with some nickel refining processes.

Asbestos -- Chronic elevated exposures to asbestos may cause asbestosis. Any exposures to asbestos increases the worker's probability of developing an asbestos related cancer later in his life.

1,1,1-Trichloroethane -- 1,1,1-Trichloroethane vapors may produce narcosis. A five-minute exposure to 5000 ppm can be expected to produce marked incoordination and anesthesia. Exposure to concentrations in excess of 1000 ppm for 15 minutes, or 2000 ppm for 5 minutes, can be expected to produce a disturbance of equilibrium in the majority of adults. Above

1700 ppm minor disturbances of equilibrium have been observed, with complaints of headache and lassitude. In controlled human exposures to 500 ppm no effects other than slight transient eye irritation were noted; at 1000 ppm and above, mild eye irritation and some dizziness were noted. Following exposure, most of the compound is eliminated unchanged via the lungs, chiefly within 48 hours. Dermatitis may result from repeated skin contact with the liquid. Cardiac arrhythmias have been reported following ingestion. (Reference 8)

Naphtha -- Extremely high concentrations of naphtha (above 1000 ppm) will cause narcosis. It is a central nervous system depressant. The aliphatic naphthas are relatively non-toxic. The aromatic naphthas are more toxic. Naphtha is used to describe a variety of solvents. Therefore, it is always necessary to obtain bulk samples to identify the particular naphtha.

F. Environmental Results (Tables 1-8)

Breathing zone air samples were taken in all areas of the plant where potential exposures could occur. Results of these breathing zone air samples and confidential employee interviews indicated that there was not a health hazard at the time of this evaluation. This facility has improved its health and safety program since the NIOSH health hazard evaluation in 1973. Emphasis should be placed on the many safety violations noted during this survey such as ungrounded containers of paints and solvents, inadequate number of fire extinquishers, blocked aisles and passageways, and misuse of trash receptacles (for example, placing solvent soaked rags in a container where air could support combustion).

V. RECOMMENDATIONS

1. Immediate grounding of all the containers in the storage room.

2. Eating, drinking, and smoking should be prohibited in the work area. All cigarettes and food should be left in the cafeteria or some other clean area.

3. Periodic employee briefings describing the chemicals they work with should be instituted. This would help the employees understand and be more careful working with these chemicals and solvents.

VI. REFERENCES

1. Gunter, B.J. and Lucas, J.B., Health Hazard Evaluation Determination Report No. 73-84-119, NIOSH, Cincinnati, Ohio, March 1974.

2. Plunkett, E.R., Handbook of Industrial Toxicology, Chemical Publishing Company, New York, 1976, pp. 412-413.

3. NIOSH Criteria for a Recommended Standard...Occupational Exposure to Crystalline Silica. HEW Publication No. (NIOSH) 75-120, 1974.

4. Plunkett, E.R., Handbook of Industrial Toxicology, Chemical Publishing Company, New York, 1976, p. 267.

5. Ibid., p. 223.

6. Ibid., p. 108.

7. Ibid., p. 287.

8. NIOSH - 1,1,1-Trichloroethane Standards Completion Project.

VII. AUTHORSHIP AND ACKNOWLEDGMENTS

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Table 1

Atmospheric Breathing Zone Air Concentrations of
Methyl Ethyl Ketone (MEK), Toluene, Xylene, and Methylene Chloride

A.M.F. Head Division
Boulder, Colorado

January 30, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M^3 MEK	Toluene	Xylene	Methylene Chloride
1	Paint Room	Silk Screen	8:02 AM - 9:45 AM	125	28	8	*
2	Paint Room	Clear Coat	8:07 AM - 9:47 AM	100	*	12	*
3	Paint Room	Silk Screen	8:10 AM - 9:50 AM	155	13	10	*
4	Tennis Finish	Painter	8:15 AM - 1:00 PM	56	48	3	76
6	Tennis Finish	Painter	8:13 AM - 9:50 AM	70	60	3	270
7	Paint Room	Clear Coat	8:10 AM - 9:40 AM	220	*	23	*
8	Paint Room	Silk Screen	8:05 AM - 9:45 AM	180	48	14	*
9	Paint Room	Clear Coat	9:42 AM - 1:00 PM	305	6	60	*
10	Paint Room	Silk Screen	9:42 AM - 1:00 PM	120	133	19	*
11	Paint Room	Silk Screen	9:45 AM - 1:02 PM	128	158	22	*
12	Paint Room	Silk Screen	9:45 AM - 1:03 PM	170	58	26	*
13	Paint Room	Clear Coat	9:48 AM - 1:05 PM	152	*	26	3
14	Tennis Finish	Painter	9:50 AM - 1:00 PM	38	63	3	35
	EVALUATION CRITERIA			590	375	435	700
	LABORATORY LIMIT OF DETECTION mg/sample			0.01	0.01	0.01	0.01

* = below laboratory limit of detection

Table 2

Atmospheric Breathing Zone Air Concentrations of
Methylene Chloride and 1,1,1-Trichloroethane

A.M.F. Head Division
Boulder, Colorado

January 8, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M 3 Methylene Chloride	mg/M 3 1,1,1-Trichloroethane
01	Ski Mold	Mold Cleaner	8:16 AM - 10:10 AM	40	469
02	Ski Mold	Mold Cleaner	8:16 AM - 10:11 AM	*	303
03	Ski Mold	Wrapper	8:20 AM - 10:15 AM	*	122
04	Ski Mold	Mold Cleaner	8:21 AM - 10:16 AM	*	359
		EVALUATION CRITERIA		261	1900
		LABORATORY LIMIT OF DETECTION mg/sample		0.01	0.01

* = below laboratory limit of detection

Table 3

Atmospheric Breathing Zone Concentrations of
Quartz, Cristobalite, and Particulate Weight

A.M.F. Head Division
Boulder, Colorado

January 8, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M^3 Quartz	Cristobalite	Particulate
3254	Sand Blast	Sand Blaster	7:40 AM - 10:30 AM	*	*	0.35
3243	Sand Blast	Sand Blaster	7:43 AM - 2:00 PM	*	*	1.15
3252	Sand Blast	Sand Blaster	7:45 AM - 2:00 PM	*	*	0.77
3253	ICM Sand Blast	Sand Blaster	7:50 AM - 2:00 PM	*	*	0.79
3251	ICM Sand Blast	Sand Blaster	7:52 AM - 1:40 PM	*	*	7.4
3244	Tennis	Tennis Grind	7:58 AM - 1:30 PM	*	*	0.90
3241	Tennis	Tennis Grind	7:59 AM - 2:00 PM	*	*	4.87
3240	Tennis	Tennis Grind	8:00 AM - 1:40 PM	*	*	1.24
3245	Tennis	Tennis Grind	8:01 AM - 1:30 PM	*	*	11.0
3231	Tennis	Tennis Grind	8:02 AM - 2:00 PM	*	*	1.84
		EVALUATION CRITERIA		0.05	0.05	10.0
		LABORATORY LIMIT OF DETECTION mg/sample		0.03	0.03	
		PERCISION OF WEIGHING IN mg/sample				0.01

* = below laboratory limit of detection

Table 4

Atmospheric Breathing Zone and General Room Air Concentrations of Chromium and Nickel (Ni)

A.M.F. Head Division
Boulder, Colorado

January 30, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M^3 Cr	mg/M^3 Ni
19	Anodizing	General Room	8:25 AM - 1:45 PM	*	*
23	Anodizing	Anodizer	8:23 AM - 2:00 PM	*	*
100	Anodizing	Anodizer	8:40 AM - 2:00 PM	0.01	*
10	Anodizing	General Room	8:45 AM - 2:00 PM	*	*
		EVALUATION CRITERIA		0.001	1.0
		LABORATORY LIMIT OF DETECTION mg/sample		0.005	0.005

* = below laboratory limit of detection

Table 5

Atmospheric Breathing Zone and General Room Air Concentrations of Methylene Bisphenyl Isocyanate (MDI)

A.M.F. Head Division
Boulder, Colorado

January 8, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M^3 MDI
I-1	Foam Care	Power	8:10 AM - 10:30 AM	*
I-2	Foam Care	Power	8:12 AM - 10:30 AM	*
I-3	Foam Care	Power	10:30 AM - 1:10 PM	*
I-4	Foam Care	Power	10:30 AM - 1:10 PM	*
		EVALUATION CRITERIA		0.2
		LABORATORY LIMIT OF DETECTION mg/sample		0.001

* = below laboratory limit of detection

Table 6

Atmospheric Breathing Zone Air Concentrations of Asbestos

A.M.F. Head Division
Boulder, Colorado

January 30, 1979

Sample Number	Location	Job Classification	Sampling Time	Asbestos Fibers/cc*
13	Tennis Grind	Handle Sander	8:05 AM - 2:06 PM	**
3	Tennis Grind	Scratch Brush	8:07 AM - 2:10 PM	**
15	Tennis Grind	Drilling	8:09 AM - 2:08 PM	**
9	Tennis Grind	Grinding	8:11 AM - 2:13 PM	**
25	Tennis Grind	Grinding	8:14 AM - 1:40 PM	**
14	Tennis Grind	Grinding	8:16 AM - 2:05 PM	**
8	Tennis Grind	Grinding	8:18 AM - 10:50 AM	**
24	Tennis Grind	Grinding	8:20 AM - 1:40 PM	**
16	Tennis Grind	Grinding	8:30 AM - 2:10 PM	**
18	Tennis Grind	Grinding	8:18 AM - 2:15 PM	**
12	Tennis Grind	Grinding	8:14 AM - 2:30 PM	**
		EVALUATION CRITERIA		0.1 TWA 0.5 C
		LABORATORY LIMIT OF DETECTION fibers/field		0.03

* = fibers per cubic centimeter greater than 5 microns in length.
** = below laboratory limit of detection
TWA = time weighted average
C = Ceiling

Table 7

Atmospheric Breathing Zone Air Concentrations of
Naphtha

A.M.F. Head Division
Boulder, Colorado

January 30, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M^3 Naphtha
20	Ski Finishing	Clean and Paint	8:40 AM - 12:00 N	25
21	Ski Finishing	Clean and Paint	8:40 AM - 12:00 N	100
22	Ski Finishing	Inspection	8:50 AM - 12:00 N	7
23	Ski Finishing	Clean and Paint	8:50 AM - 12:00 N	13
24	Ski Quality Control	Inspector	8:50 AM - 12:00 N	14
		EVALUATION CRITERIA		400
		LABORATORY LIMIT OF DETECTION mg/sample		0.03

Table 8

Atmospheric Breathing Zone Air Concentrations of
Methylene Chloride, Methyl Ethyl Ketone (MEK), and 1,1,1-Trichloroethane

A.M.F. Head Division
Boulder, Colorado

January 8, 1979

Sample Number	Location	Job Classification	Sampling Time	mg/M^3 Methylene Chloride	MEK	1,1,1-Trichloroethane
30	Vapor Degreaser	Degreaser	7:58 AM - 1:00 PM	26	5	554
31	Tennis	Framer	8:30 AM - 11:00 AM	175	9	68
32	Tennis	Bonder	8:30 AM - 11:00 AM	171	14	1428
33	Tennis	Inspector	8:32 AM - 11:00 AM	100	6	94
34	Tennis	Wrapper	10:10 AM - 1:30 PM	27	44	110
35	Tennis	Wrapper	10:10 AM - 1:10 PM	20	25	101
		EVALUATION CRITERIA		261	590	1900
		LABORATORY LIMIT OF DETECTION mg/sample		0.03	0.2	0.03