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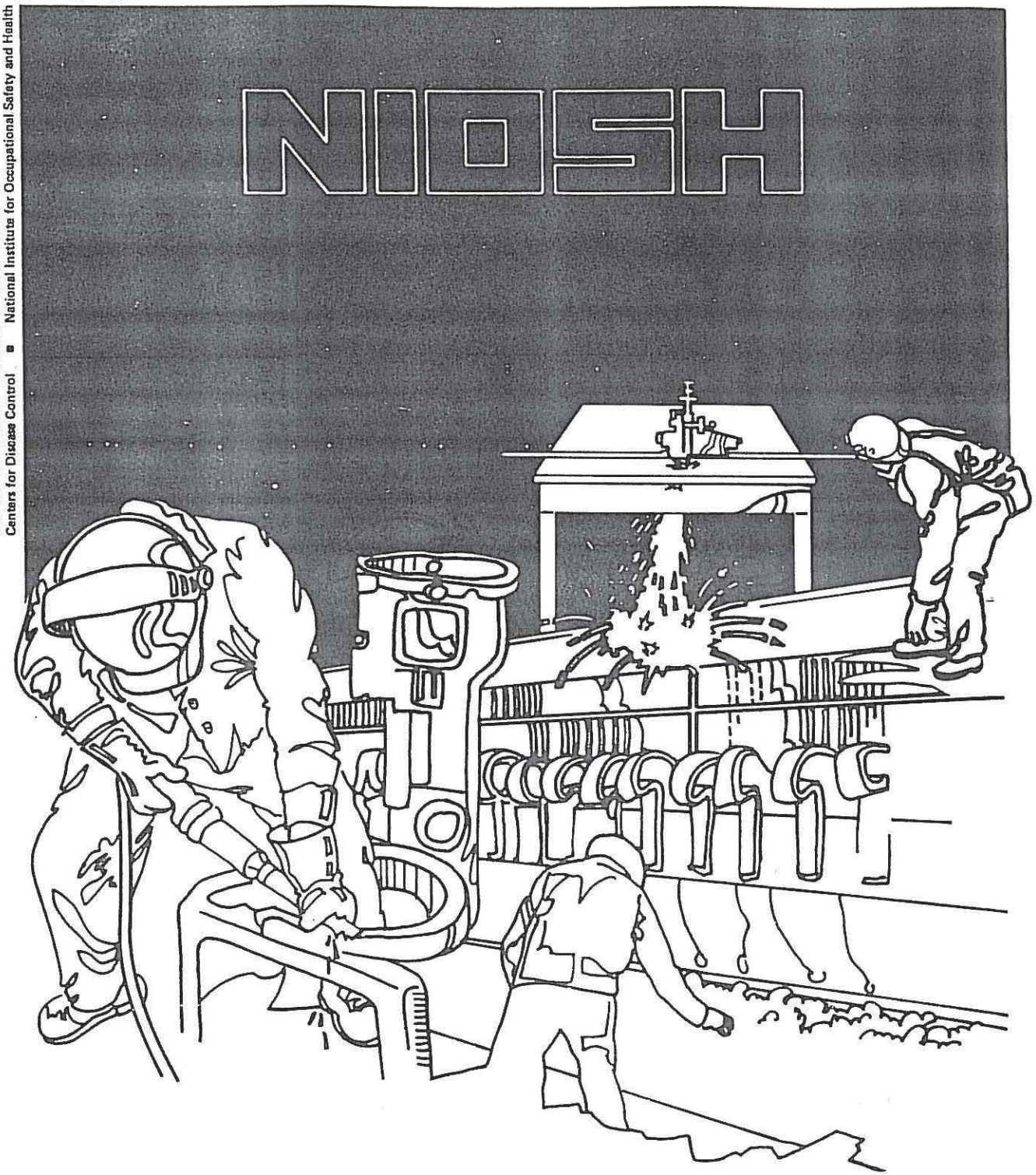

Health Hazard Evaluation Report

HETA 82-030-1184
MEDALIST-GLADIATOR ATHLETIC PRODUCTS COMPANY
LEESBURG, FLORIDA

PREFACE

The Hazard Evaluation 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.

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 82-030-1184
SEPTEMBER 1982
MEDALIST-GLADIATOR ATHLETIC PRODUCTS COMPANY
LEESBURG, FLORIDA

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I. SUMMARY

In November 1981, the National Institute for Occupational Safety and Health (NIOSH) was requested by employees at Medalist-Gladiator Athletic Company, Leesburg, Florida to evaluate the possible health hazards of exposure to organic solvents in the manufacturing of athletic equipment. At the time of the study, approximately 120 workers were employed at the plant.

On February 17-18, 1982, NIOSH investigators conducted environmental sampling and employee interviews at the plant. Personal breathing-zone and general area air samples for methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), toluene, tetrahydrofuran, cyclohexanone, cellosolve, and acetone were collected on activated charcoal. Analysis was by gas chromatography in accordance with NIOSH Method P&CAM 127. In addition, NIOSH field tested another type of organic vapor sorbent for MEK during the survey. The NIOSH medical epidemiologist interviewed 34 workers (13 exposed and 21 unexposed) to obtain information on past medical history, occupational history, and prevalence of symptoms known to be associated with solvent exposures.

Results of the 23 air samples collected by NIOSH showed that the two Dip Room workers were overexposed to total solvent vapor mixtures at concentrations 2.4 and 1.5 times the recommended limits. These exposures were to methyl ethyl ketone (MEK), at concentrations of 720 and 580 mg/M^3, to toluene at concentrations of 230 and 130 mg/M^3, and to methyl isobutyl ketone (MIBK) at concentrations of 110 and 60 mg/M^3. Mixtures of MEK, MIBK, and toluene vapors were also the major contaminants in the other work locations. However, all exposures were below NIOSH recommended standards in these areas. Combined solvent exposures ranged from 0.06 to 0.9 times the recommended standards with a mean of 0.4.

Analysis of the 32 completed questionnaires revealed 100% of those interviewed to report at least one symptom felt by them to be work-related. Forty-six percent complained of dryness, itching and irritation of skin (particularly the upper extremities), while 15% reported eye, nose, and throat irritation. Other complaints included those involving the central nervous system, such as headaches, fatigue, and lightheadedness and dizziness (23%).

Based on the results of this evaluation, NIOSH concluded that there was a health hazard from overexposure to mixtures of MEK, MIBK, and toluene among Dip Room workers at Medalist-Gladiator. Recommendations for controlling this hazard are found in Section VI of this report.

KEYWORDS: SIC 3949 (Sporting Goods Manufacturing) organic solvents, methyl ethyl ketone, MEK, methyl isobutyl ketone, MIBK, toluene, solvent mixtures, skin irritation, mucous membrane irritation, neurological effects

II. INTRODUCTION

In November 1981, NIOSH received a request for a health hazard evaluation at Medalist-Gladiator Athletic Company, Leesburg, Florida. The confidential request was submitted by employees at the plant who asked NIOSH to evaluate the possible health effects of organic solvent exposure among workers. The written request specified the dip room and vinyl areas as being the most problematic in terms of strong fumes, and somatic complaints including skin rashes, bronchitis, vomiting, nausea, memory loss, dizziness, incoordination and light-headedness.

Recommendations for reducing solvent exposures were submitted to Medalist-Gladiator following the NIOSH visit.

III. BACKGROUND

The Medalist-Gladiator plant was built in 1965 and employs about 120 workers for manufacturing a wide variety of athletic equipment such as skis, clothing, life jackets, football helmets, and athletic protective padding.

The major source of solvent vapor emissions in the plant is the Dip Room where life jackets are mechanically conveyed and dipped into a bright yellow vinyl bath whose solvent system consists of methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), and toluene. Additional solvent vapors are emitted during the use of various adhesives, cleaning solvents, lacquers, and thinners in other work areas. About 15 workers are involved in those operations.

The dip room was initially designed to be totally mechanized such that no employees would have to work inside. Solvent vapor concentrations are very high inside the room due to the presence of the open dip tank and the open ended ovens which help dry the jackets after they are dipped. The operator must occasionally enter the room to keep the conveyors running properly. The "tailer" removes tails of paint hanging from the bottom of the jackets as they emerge from the drying oven.

IV. DESIGN AND METHODS

A. Environmental

NIOSH collected personal breathing-zone and general area air samples on February 17-18, 1982, to evaluate workers° exposure to organic solvents. Four personal and two area samples were collected in the Dip Room. One personal and one area sample were taken in the Mixing Room. Five personal samples were collected on life-jacket gluing workers. Two personal samples were taken on protective-padding gluing workers.

Three personal samples were taken on helmet gluing workers, and two personal samples were collected on helmet spray-painters. The samples were collected using calibrated personal sampling pumps operating at 20 cm^3/min. Analysis was by gas chromatography in accordance with NIOSH Method P&CAM 127.[1] In view of recently observed problems with the use of activated charcoal for sampling MEK, NIOSH field tested another type of organic vapor sorbent during this survey. The sorbent tubes, "Ambersorb", are manufactured by SKC Corporation and contain small beads of a porous polymer with a carbonaceous coating. Sixteen pairs of charcoal/ambersorb samples for MEK were collected in a side-by-side manner using dual manifold sample holders.

B. Medical

The Medical Officer used several approaches including a walk-through and first-hand observation of the plant, distribution and collection of self-administered questionnaires, individual interviewing of workers, and review of personnel files - especially health and absentee records.

l. A walk-through of the entire facility was made with attention focused on the areas mentioned in the request. Odors were noticeably strong in several areas of the plant but most definitely in the "dip room." Steps involved in the work process were explained by employees in the area. Informal interviewing of workers was done during the walk-through.

2. Records of absenteeism for the period January 1, 1981 to January 31, 1982 were reviewed to determine whether there was any association between absenteeism and chemical exposure.

3. A self-administered questionnaire specific to the known chemical exposures at the plant was designed to obtain information on the health history, prevalence of symptoms known to be associated with various solvent exposures, and occupational history of selected employees. In addition, three questions were included to elicit comments on the measurement tool itself. The medical officer met with the selected workers in small groups to explain and distribute the questionnaire. Each member of the sample group was interviewed privately when he/she returned the completed questionnaire. No changes were made on questionnaire responses based on verbal discussion with the worker.

Of the 34 questionnaires distributed and returned, 32 were complete and usable, while 2 employees preferred not to participate in the study. The sample group of 13 exposed workers was chosen primarily from the areas of the plant which were specified in the health hazard evaluation request, i.e., the "Vinyl Area" including the dip room, the glue line, and the hanging and drying sections. In addition, workers from the "athletic products glueing area" were included due to their observed solvent-based glue exposures.

A sample of workers similar in age, sex and race was chosen by the medical investigator from the cutting departments, the warehouse, and the office staff to serve as a comparison group. Both groups were selected following a walk-through of the plant. The total number in the sample (exposed) was l3 while the comparison (unexposed) group had 2l workers (see Table III).

V. EVALUATION CRITERIA

A review of the literature (l,2,3) for the chemicals most frequently encountered by the work force at Medalist-Gladiator suggested an association between the specific solvents in use at the company and the reported somatic complaints, for example:

> *Methyl Ethyl Ketone (MEK), Methyl Isobutyl Ketone (MIBK), and Acetone are all members of the ketone family and as such enjoy a similar chemical structure with resultant similar adverse effects on the human organism. Local effects may include irritation of the cunjunctiva of the eyes, and mucous membrane of the nose and throat. Direct contact with solvents can also progress from a mild skin rash to a dry, scaly, fissured dermatitis. Higher concentrations of these chemicals affect the central nervous system and the exposed worker may complain of headache, nausea/vomiting, lightheadedness, dizziness and uncoordination. (4,5)
>
> Toluene may have all of the above mentioned effects on the exposed worker, but in addition, can also adversely affect the liver and kidney. If significantly contaminated with benzene, adverse effects on the hematopoetic system may be seen. (l,6)
>
> Other worker-reported solvent exposures included "Spartan Glue", glues #96283 and #2572 - all of which are approximately 95% MEK with small amounts of MIBK and toluene added. Standards for all of these chemicals have been established by OSHA and are reviewed elsewhere in this report. (7)

Environmental evaluation criteria and the principle effects of the substances sampled in this study can be found in Table I. Where available NIOSH recommended exposure limits were used as the evaluation criteria for this study. Current American Conference of Governmental Industrial Hygienist (ACGIH) recommended threshold limit values were used to evaluate those substances for which NIOSH has not yet developed recommended standards. Current OSHA standards are also listed in Table I.

When evaluating an exposure to substances, such as solvents, which affect the body in a similar fashion, their combined health effects should be given primary consideration. That is, if the sum of the following fractions,

$$\frac{\text{exposure level (1)}}{\text{evaluation criterion (1)}} + \frac{\text{exposure level (2)}}{\text{evaluation criterion (2)}} + .. + \frac{\text{exposure level (n)}}{\text{evaluation criterion (n)}}$$

exceeds 1.0, then exposure to the mixture is considered excessive.[7]

VI. RESULTS AND DISCUSSION

Environmental

A. Solvent Vapor Exposure

The vinyl solvent blend used in the dip room contains 63% MEK, 25% toluene, and 12% MIBK. Samples taken inside the two dip room workers respirators showed that they were exposed to 8-hour, TWA concentrations of MEK at 720 and 580 mg/M^3, toluene exposures were 230 and 130 mg/M^3, and MIBK exposures were 110 and 60 mg/M^3. Combined solvent exposures were 2.4 and 1.5 times the evaluation criterion (Table II).

MEK, MIBK, and toluene generally were the major contaminants in the other work areas because most of the adhesives also contained these compounds. In addition, MEK was frequently used as a cleaning solvent in the helmet gluing area. Small amounts of tetrahydrofuran and cyclohexanone were also present in a few of the glues. Combined solvent TWA exposure ratios in the gluing work areas ranged from 0.06 to 0.9 with a mean of 0.4.

Cellosolve and acetone were present in the lacquer used by the helmet spray painter. The spray painting booth was well exhausted with a face velocity of about 250 fpm. Thus, only small amounts of acetone were detected in the painter°s breathing zone.

B. Respiratory Protection

Each Dip Room worker is required to wear a positive-pressure, supplied-air respirator when working inside the dip room. The clear plastic hood ("StaSafe", Model No. SD5890) covers the head, neck, and upper chest. Hydrocarbon vapor levels inside the dip room averaged 2600 mg/M^3. Personal samples located outside the dip room workers° hoods contained about 1400 mg/M^3 of hydrocarbons and samples located so they would be inside the respirator hoods (when donned) averaged about 900 mg/M^3. The employees said that they could smell no contaminants in the supplied breathing air and expressed the opinion that fresh clean air was being supplied to their hoods. The fact that both workers were occasionally observed making short trips inside the dip room without donning respirators probably accounts for much of their high solvent exposure. Further evidence of this possibility was apparent from the considerably lower solvent exposure experienced by the tailer even though he spent more time inside the dip room.

It appeared that respirators were more likely to be donned when dip room tasks of longer duration were anticipated.

C. Ambersorb Results

The Ambersorb sorbent appeared to outperform activated charcoal for MEK sampling. An average of about 25% more MEK was quantitated from the Ambersorb samples. The compound 3-hydroxy, 2-butanone (acetoin) was also detected on seven of the charcoal tubes. Since acetoin was not found in the Ambersorb samples, there exists the strong possibility that this compound is an oxidative decomposition product of MEK on charcoal.

Symptomatology

Analysis of the questionnaire responses as well as personal interviewing revealed that "exposed" workers more frequently reported dry skin and, to a lesser degree, fatigue, lightheadedness/dizziness, and nausea/vomiting (Table IV). "Exposed" and "unexposed" workers reported comparably high prevalence of eye, nose, and throat irritation.

Based on both the questionnaire responses and observations made during the plant walk-through, it appears that some members of the presumed "unexposed" group do in fact experience moderate chemical exposure for one or more of the following reasons: (a) lack of enclosure of certain processes, for example, hanging wet jackets to air dry; (b) vapor contamination from chemical-using areas where exhaust ventilation is inadequate; or (c) movement by workers from an area of no chemical use into a chemical-using area, for example, a worker in the cutting area makes frequent daily trips carrying foam pieces from his area to the silk screening department. It was decided, therefore, to reclassify the interviewed workers into low, moderate, and high chemical exposure groups as follows:

a. High exposure - employees who work directly with one or more solvent-based glues on a regular basis; included are workers from the dip room, glue lines, and mixing room.

b. Moderate exposure - those who are exposed to any solvent-based glue which originates from a different work area - usually in vapor form; included are cutters, sewers, and utility men.

c. Low exposure - those who are isolated from solvent exposures such as warehouse employees and clerical staff.

Attempts to correlate environmental and questionnaire data were unsuccessful. Industrial hygiene measurements -- which focused on high exposure areas -- did confirm that dip room and mix room workers were correctly categorized as being at high risk (TWA exposure ratios of 2.4 and 1.5). However, workers from moderate and low exposure areas who had completed questionnaires, were not included in the environmental sampling and therefore a comparison of results was not possible.

Skin-related symptoms were most frequently reported by the high exposure group (55%) while the moderately exposed group experienced greatest difficulty with mucous membrane (eye, nose, and throat) irritation (50%). Central nervous system complaints were reported by almost half the workers (40%) (Tables IVa and IVb).

An association between degree of chemical exposure as reported on the questionnaire and frequency of related symptoms was found (Table IV), although there were some discrepancies seen between classification by exposure and actual industrial hygiene measurements.

Combining 4 symptoms (frequent headache, unusual tiredness, nausea/vomiting, and light-headedness/dizziness) into a general category of central nervous system effects, we found a consistent trend in frequency of symptoms with increasing chemical exposure, i.e., 27% for the high exposure group, l5% for moderate exposure, and 9% for the low exposure.

The highly exposed chemical group accrued a larger number of days absent during the winter months; but no seasonal pattern was found for the other two exposure groups.

Many of the original somatic complaints listed on the health hazard evaluation request continued to be reported on the completed questionnaires. Skin related conditions were reported primarily by workers who had direct daily contact with the various solvent-based glues, i.e., those in the dip room (mix room) and on the glue lines, while irritation of the mucous membranes was the most common among those employees who had indirect contact with solvents. This seems consistent with the fact that working directly with the glues would provide an opportunity for frequent skin exposure whereas, indirect exposure would be in the form of fumes and therefore primarily irritate the eyes, nose, and throat. A significant number in the highly exposed group, however, also complained of mucous membrane irritation (36%). As expected, those in the low exposure group reported minimal skin and mucous membrane problems (9%, l8%).

Informal interviewing of several workers who are currently employed and some who have left/layed off during the past year reported that production levels frequently exceed the level at the time of our study by almost double. Thus, while workers were turning out

approximately 350 jackets/day during our visit, at other times of the year a second line is opened and 600 jackets/day are produced. Frequency and severity of somatic complaints are said to increase as production rate increases.

Therefore, although the information obtained through questionnaire and environmental sampling show a hazardous situation to exist, the situation is potentially even worse at other times of the year. In addition, human studies have demonstrated irritation of eyes, nose, and/or throat to occur in some cases at lower concentrations than current NIOSH recommended standards (see Table V). Thus, workers with a greater sensitivity to these chemicals may experience some somatic effects.

A review of selected employee personnel records was made to determine the turn-over and absentee rates related to health reasons in several departments from l/l/8l through l/3l/82. This information, when analyzed, revealed that the number of days absent correlated with the reported amount of chemical exposure, i.e., the greater the reported chemical exposure, the more days absent in the past 12 months (see Table VI). In addition, the turn-over rate for the entire facility is quite high with monthly ranges from 8% to 28%. Although there are other factors which may explain these findings, the suggestion that working in certain areas of the plant is related to more frequent absences is an intriguing one.

VI. RECOMMENDATIONS

1. Engineering improvements in the Dipping Operation should be continued until employees no longer have to work inside the Dip Room.

2. Until the Dip Room becomes completely mechanized, the respirator program should be strictly enforced. Workers should not be allowed to enter the Dip Room, even for short durations, without first donning their positive-pressure, supplied-air respirators.

3. Air that is generated for use in air-supplied respirators should undergo the sampling and analytical requirements specified in ANSI 286.1 - 1973, "Commodity Specification for Air".

4. Local exhaust ventilation should be used to control exposure to MEK vapors when cleaning helmets. A small spray-painting booth such as the one used for painting helmits would be adequate.

5. Since dryness and redness of skin especially of the hands and arms are common problems among the workforce interviewed, it would be better if a barrier cream which would protect the hands from contact with solvents rather than just a moisturizer were used. There are several creams of this type available commercially.

6. The use of gloves would eliminate or at least reduce the frequency of contact between solvent and skin. It is important to realize that all gloves are not impervious to penetration by solvents, (8,9) therefore, the glove purchased must have this capability specifically for methyl ethyl ketone (MEK) and methyl isobutyl ketone (MIBK), which are the solvents encountered by the majority of the workers. In general, rubber or neoprene gloves work best for resisting MEK and MIBK. The use of any personal protective equipment should be accompanied by worker education which is an essential aspect of worker protection.

7. Regular monitoring of ambient chemical levels is recommended, especially during periods of increased production.

8. Workers on the vinyl glue line reported direct skin exposure to fibrous glass along the sides of the counter. This problem can be alleviated by covering the exposed fibrous glass with strips of tape or foam and thereby eliminate the skin contact.

VII. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. Medalist - Gladiator Company
2. NIOSH, Region IV
3. OSHA, Region IV

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 I

Demographic Characteristics of
Sample and Control Groups

Medalist-Gladiator Corporation
Leesburgh, Florida

		Gender	
	Mean Age	Males	Females
Exposed	32 years	7 (54%)	6 (46%)
Non-Exposed	31 years	10 (53%)	9 (47%)

TABLE II

Evaluation Criteria for Hazardous Substances

Medalist-Gladiator Athletic Products Company
Leesburg, Florida

Contaminant	OSHA Permissible Exposure Limit	ACGIH Threshold Limit Value	NIOSH Recommended Standard	Principle Health Effects
Toluene	750 mg/M^3	375 mg/M^3	375 mg/M^3	fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation (watering of the eyes), nervousness, muscular fatigue, insomnia paresthesias (abnormal sensations
Acetone	2400 mg/M^3	1780 mg/M^3	590 mg/M^3	irritation of the eyes, mucous membranes and skin; in high concentrations dizziness, excitement, drowsiness, incoordination, staggering gait.
Methyl Isobutyl Ketone	400 mg/M^3	400 mg/M^3	200 mg/M^3	dermatitis; irritation of the eyes, nose and throat; nausea; headache; in high concentrations drowsiness, weakness, dizziness, and staggering gait.
Methyl Ethyl Ketone	590 mg/M^3	590 mg/M^3	590 mg/M^3	dermatitis of exposed skin; irritation of the eyes, nose and throat at lower concentrations; headache, nausea, light headedness, vomiting, dizziness and incoordination at higher concentrations.
Tetrahydrofuran	590 mg/M^3	590 mg/M^3	---	irritation of eyes, nose and throat nausea, dizziness, headaches at high concentrations.
Cyclohexanone	200 mg/M^3	100 mg/M^3	100 mg/M^3	dermatitis; irritation to eyes, skin and respiratory tract; nausea, fatigue, weakness, sleepiness, lightheadedness.
Cellosolve	740 mg/M^3	185 mg/M^3	---	irritation to the eyes and mucous membranes; nausea, fatigue, weakness, lightheadedness.

Table III

Personal and Area Air Samples Collected for Organic Vapors
Medalist-Gladiator Corporation
Leesburgh, Florida
February 17-18, 1982

Job/Location	Sample Sorbent	Sample Period	Sample Volume (liters)	Methyl Ethyl Ketone (mg/M^3)	Methyl Isobutyl Ketone (mg/M^3)	Toluene (mg/M^3)	Tetra-hydrofuran (mg/M^3)	Acetoin (mg/M^3)	Cyclo-hexanone (mg/M^3)	Cellosolve	Acetone	Combined TWA Exposure Ratio
Dip Room operator (inside hood)	charcoal	7:10-14:00	4.8	565	108	231	ND*	150	ND	-**	-	2.4
	ambersorb		3.4	721	79	209	ND	ND	ND			
Dip Room operator (outside hood)	charcoal	7:10-10:52	1.3	815	192	423	ND	ND	ND	-	-	
	ambersorb		1.3	1262	123	392	ND	ND	ND			
Dip Room operator (outside hood)	charcoal	10:52-14:00	0.51	725	196	431	ND	ND	ND	-	-	
	ambersorb		0.53	1170	132	358	ND	ND	ND			
Dip Room tailer (inside hood)	charcoal	7:10-11:00	3.8	189	32	76	ND	ND	ND	-	-	
	ambersorb		3.6	306	31	78	ND	ND	ND			
Dip Room tailer (inside hood)	charcoal	11:00-14:00	4.1	502	98	210	ND	ND	ND	-	-	1.5
	ambersorb		3.9	613	69	187	ND	ND	ND			
Dip Room tailer (outside hood)	charcoal	7:10-11:00	4.1	749	185	383	ND	329	ND	-	-	
	ambersorb		3.9	500	67	177	ND	ND	ND			
Dip Room tailer (outside hood)	charcoal	11:00-14:00	2.7	1015	222	470	ND	359	ND	-	-	
Mixing Room and Glue Line Helper	charcoal	7:30-14:00	6.8	40	10	29	ND	ND	ND	-	-	0.4
	ambersorb		6.8	165	13	41	ND	ND	ND			
Dip Room Area Sample	ambersorb (A)	9:51-10:30	6.8	1672	178	471	ND	ND	ND	-	-	
	ambersorb (B)			157	ND	ND	ND	ND	ND			
Dip Room Area Sample	ambersorb (A)	9:52-10:30	6.3	1778	229	667	ND	ND	ND	-	-	
	ambersorb (B)			472	19	ND	ND	ND	ND			
Mixing Room Area Sample	charcoal	7:40-14:00	6.5	617	63	163	ND	308	ND	-	-	
	ambersorb		6.5	1123	52	171	ND	ND	ND			
Glue Line	charcoal	7:05-14:00	8.4	35	12	26	3.6	ND	ND	-	-	0.3
	ambersorb		3.9	87	10	31	ND	ND	ND			

Table III - continued

Glue	charcoal	7:10-14:00	7.3	18	9.6	21	ND	ND	ND	-	-	0.2
Line	ambersorb		7.0	24	4.3	11	ND	ND	ND			
Glue	charcoal (A)	11:00-14:00	32.5	234	32	61	44	50	0.9	-	-	0.5
Line	charcoal (B)			38	ND	ND	23	ND	ND			
Glue	ambersorb (A)	11:00-14:00	34.4	309	17	37.5	28	ND	4.1	-	-	0.4
Line	ambersorb (B)			7.8	ND	ND	7.3	ND	ND			
Glue	ambersorb (A)	11:00-14:00	35.9	133	15	31	11	ND	2.2	-	-	0.2
Line	ambersorb (B)			0.8	ND	ND	ND	ND	ND			
Gladiator Prework	charcoal	7:30-14:00	7.3	30	ND	2.7	ND	ND	ND	-	-	0.06
Gluing	ambersorb		6.0	3.3	ND	ND	ND	ND	ND			
Gladiator Prework	charcoal	7:20-14:00	6.9	128	ND	4.4	23	ND	ND	-	-	0.3
Gluing	ambersorb		6.9	133	ND	2.9	13	ND	ND			
Helmet	charcoal	7:20-14:00	7.4	304	5.4	11	ND	162	ND	-	-	0.9
Gluing	ambersorb		3.4	532	ND	12	ND	ND	ND			
Helmet	charcoal	7:25-14:00	6.9	191	2.9	8.7	ND	117	ND	-	-	0.7
Gluing	ambersorb		6.6	385	ND	9.1	ND	ND	ND			
Helmet	charcoal	7:15-14:00	3.6	183	5.6	14	ND	ND	ND	-	-	0.6
Gluing	ambersorb		5.0	362	4.0	14	ND	ND	ND			
Helmet	charcoal	7:40-14:00	7.3	-	-	-	-	-	-	ND	11	0.02
Spray Painting	ambersorb		6.0								17	
Helmet	charcoal	7:15-14:00	6.8	-	-	-	-	-	-	ND	ND	0
Spray Painting	ambersorb		6.6									
Evaluation Criteria				590	200	375	590	not applicable		100	185	590	1.0

*ND = No Contaminant Detected
**- = Not Analyzed

TABLE IV(a)

Prevalence of Reported Symptoms by Level of Exposure

Medalist-Gladiator Corporation
Leesburgh, Florida

SYMPTOMS	Exposure Group HIGH (%) (11 workers)		MODERATE (%) (10 workers)		LOW (%) (11 workers)	
Skin dryness	45	avg.=27%	10	avg.=10%	9	avg.=3%
Skin redness	18		10		0	
Skin itching	18		10		0	
Eye irritation	36	avg.=36%	50	avg.=45%	18	avg.=14%
Nose/throat irritation	36		40		9	
Unusual fatigue	27	avg.=27%	20	avg.=15%	9	avg.=9%
Frequent headache	27		20		9	
Lightheaded/dizzy	27		10		9	
Nausea & vomiting	27		10		9	
Feel edgy	0		0		0	
Act differently	9		0		0	
Reduced muscle strength	0		0		0	

TABLE IV(b)

Grouping of Reported Symptoms by Exposure Group

Medalist-Gladiator Corporation
Leesburgh, Florida

SYMPTOM	Exposure Group HIGH (%)	Moderate(%)	Low(%)
Skin	27	10	3
Mucous membrane irritation	36	45	14
Central nervous system	27	15	9

TABLE V

SENSORY THRESHOLDS IN HUMANS FOR KETONES

Ketone	Highest Satisfactory Concentration* (ppm)	Irritating Concentration** (ppm)			NIOSH Recommended Standard (ppm)
		Eyes	Nose	Throat	
Acetone	200	500	500	500	250
Methyl ethyl ketone	200	350	350	350	200
Methyl isobutyl ketone	100	200	>200	>200	50
Diisobutyl ketone	25	50	>50	>50	
Cyclohexanone	25	75	75	75	
Mesityl oxide	25	25	50	>50	
Diacetone alcohol	50	100	>100	100	
Isophorone	10	25	25	25	

* Concentration judged by majority of exposed volunteers to be satisfactory for an 8-hour exposure
** Concentration that caused irritation in the majority of subjects

Source: Reference 3, p. 30.

TABLE VI

Association Between Reported Chemical Exposure and Absenteeism

Medalist-Gladiator Corporation
Leesburgh, Florida

EXPOSURE CATEGORY	Total No. Days Absent for Group*	Average No. Days Absent per Worker
High	202	18.3 days
Moderate	83	8.3 days
Low	56	5.0 days

* From January 1981 through January 1982

DEPARTMENT OF HEALTH AND HUMAN SERVICES
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