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

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HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 78-110-585

PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

APRIL 1979

I. TOXICITY DETERMINATION

It has been determined, based on environmental evidence, that a hazard to the health of some workers exposed to styrene, existed at the Piper Aircraft Plant, Vero Beach, Florida, during the period of a Health Hazard Evaluation conducted by NIOSH on August 3-5, 1978.

The evaluation revealed short-term concentrations of styrene in some lay-up operations which were above the OSHA ceiling value of 200 ppm and the ACGIH STEL of 125 ppm. In addition, the nose cone lay-up man was exposed to styrene on an 8-hour time-weighted average basis in excess of the OSHA and ACGIH criteria of 100 ppm.

Within three months of the evaluation, and prior to notification by NIOSH that these exposures existed, Piper reported having installed local exhaust ventilation to control emissions in the nose cone lay-up operation.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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, Publication Office at the Cincinnati address.

Copies of this report have been sent to:

a) Piper Aircraft Company
b) Requestor
c) U.S. Department of Labor, Region IV
d) NIOSH, Region IV

For the purpose of informing the approximately 150 "affected employees", the employer shall promptly "post" for a period of 30 calendar days the determination report in a prominent place near where exposed employees work.

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 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees at Piper Aircraft Corp., Vero Beach, Florida, to investigate substances used in Building 8 of that plant.

Subsequent to the on-site portion of this investigation, there were several written and verbal communications with the company and employee representatives. Both parties were sent a report on August 22, 1978, summarizing the work that had been done, along with a summary of detector tube and ventilation measurements. A more detailed report was submitted to both parties on November 8, 1978, containing the results of the environmental sampling and a discussion of samples which indicated toxic exposures. On December 28, 1978, a letter was sent to the requestor in response to his request for clarification of specific items.

IV. HEALTH HAZARD EVALUATION

A. Process Description

The two departments of interest to this evaluation produced molded fibrous glass and plastic components used in the production of various aircraft manufactured by Piper. Department 2731 works primarily with acrylonitrile-butadiene-styrene (ABS) plastic in molding, finishing and subassembly operations. Department 2732 produces molded fibrous glass components using a resin-fibrous glass buildup technique. These two departments occupy Building 8.

In Department 2731, ABS sheets are heated and molded to produce the desired product in one of three molding ovens located in a room at one end of Building 8, and provided with local exhaust ventilation. Potential environmental contaminants released during this operation include acrylonitrile, butadiene, and styrene. Finishing operations such as sawing, drilling and abrading are potential dust sources. Subassembly operations use glues which contain methylene chloride and other solvents.

The molded fibrous glass components are produced in Department 2732 by alternately brushing a layer of resin onto a mold and applying a layer of fibrous glass over that. The component is built up to the desired thickness by repeatedly adding layers of resin and fibrous glass. The employee performing this operation, called "lay-up", would first coat the mold with a layer of wax to assure release of the finished component. Then a layer of paint is applied and allowed to dry. Then a paintbrush is used to apply the resin to the mold. A sheet of fiberglass, cut to fit, is then put in place and smoothed out by hand and various tools. More resin and fibrous glass layers are "laid-up" to produce the desired thickness. The most likely contaminant from this operation is styrene from the resin. Methyl alcohol, acetone, and trichloroethylene are also used as solvents and are potential exposures, both airborne and to the skin. Fibrous glass exposure is not expected in the lay-up operation, but is a potential problem during cutting.

B. Evaluation Design

On August 2, 1978, a walk-through survey was conducted with representatives of the company. The requestor and other employees were interviewed confidentially later in the evaluation.

On August 3 and 4, 1978, personal and area environmental samples were collected during the day shift in both Departments 2731 and 2732 for styrene, methyl alcohol, butadiene, acrylonitrile, acetone, trichloroethylene, particulate, methylene chloride and methyl ethyl ketone. Both long-term (4 to 8 hours) and short-term (less than 1 hour) personal breathing zone samples as well as detector tube samples were taken for styrene to determine time-weighted average and peak exposures. Most of these samples were in the lay-up area. Battery-powered personal sampling pumps were used to collect the samples by adsorption onto activated charcoal. These pumps were clipped to the employee's belt and attached by plastic tubing to the collection media placed in his breathing zone. Some sampling devices were not carried by employees, but instead were placed in an area where an employee spent a large part of his workshift. In the case of some of the short-term samples, the pumps were carried by a NIOSH investigator and the collection media was held in the breathing zone of the employee while he was working.

Methyl alcohol, acetone, and trichloroethylene samples were taken throughout both departments of Building 8 to determine time-weighted average concentrations for those compounds. These samples were also taken using personal sampling pumps and charcoal adsorbent tubes, and the samples were worn by the employees while performing their normal work operations.

Acrylonitrile and butadiene samples were taken in the oven room of Department 2731 to determine the concentrations of those compounds on a time-weighted average basis. Again, personal samplers and charcoal were used to collect the samples from either the general work area or an employee's breathing zone.

Total particulate or "nuisance dust" concentrations were measured in the areas that appeared to be the most dusty. These samples were collected on filters, placed in the employee's breathing zone and connected to personal sampling pumps worn on the employee's belt.

Ventilation measurements were made using a thermal anemometer. Sixteen point traverses were made of the grinding booths to determine face velocities. Measurements were also made at the exhaust duct in the mixing room and resin room with doors open and closed.

Employees in all areas of both sections were informally interviewed regarding working and smoking histories, working conditions and health problems. Recent process and equipment modifications, as well as current working conditions, were discussed with company representatives, foremen, and the requestor.

C. Evaluation Criteria

Table VII lists various criteria used in the evaluation of the toxicity of the substances under study. Listed in this table are OSHA Standards[1], NIOSH Criteria Document Recommendations[2-6], A Special Occupational Hazard Review [7] and the Threshold Limit Values (TLV's) of the American Conference of Governmental Industrial Hygienists (ACGIH)[8], along with health effects of each substance.

The effects of exposure to acrylonitrile are currently being reviewed as a result of recent information regarding association with an excess of lung and colon cancer. NIOSH suggests[9] that acrylonitrile be handled in the workplace as if it were carcinogenic, although their recommendations are aimed primarily at the manufacture and polymerization of acrylonitrile. The criteria established by the ACGIH[8], namely no exposure or contact with acrylonitrile as detected by the most sensitive method, is more practical in the situation where ABS is being molded.

In addition to the recommendations presented in Table VII, a new criteria document is about to be released by NIOSH which in all probability will recommend a time-weighted average styrene standard of 25 ppm with a 15 minute ceiling of 100 ppm. It also appears that this document will place an increased emphasis on protection against skin exposure to styrene since it can be absorbed through the skin and cause toxic effects.

D. Evaluation Results

The attached Tables I through VI show workplace concentrations of styrene, methyl alcohol, acetone, trichloroethylene, acrylonitrile, butadiene, and total particulates on the days of this evaluation. In addition to these samples, there was one sample taken for methylene chloride and methyl ethyl ketone (MEK), and one sample taken for asbestos. Concentrations of 23 ppm methylene chloride and 0.6 ppm MEK were found in Department 2731 near where some parts were being glued. The asbestos sample is inconclusive due to the nature of the filter used to collect that sample. Visual observation of the process and inspection of the asbestos-containing material, however, indicated very little probability of personal exposure.

These sample results indicate that the most prevalent overexposures are the short-term styrene levels (see Table II), although one long-term styrene exposure was above the recommended maximum concentration (see Table IV). Company representatives spoke during the evaluation of planned control measures for these areas, and NIOSH has been informed that additional local exhaust ventilation has been installed to control exposures in the nose cone lay-up operation.

All other environmental contaminants, including acrylonitrile, were below the recommended levels. The current OSHA standard for acrylonitrile is 20 ppm, but the ACGIH recommends reducing exposure below the lowest level detectable by the most sensitive methods, and this is the situation as shown in Table V.

Detector tube samples were taken for styrene and carbon monoxide. Those for styrene confirm the results shown by the short-term personal and hand held samples, namely high concentrations during lay-up of some molds. Styrene concentration in some areas was much greater than could be measured by detector tubes (200 ppm). No carbon monoxide was found using detector tubes. The limit of detection was approximately 2 ppm, and below the 9 ppm at which methylene chloride toxicity is affected.

Measurements of airflow at grinding booths indicate sufficient flow to prevent toxic exposure of employees to dust created by grinding operations. This was confirmed by measurements of particulate concentrations as shown in Table VI. Average face velocities for the five booths ranged from approximately 300 to 400 feet per minute(fpm). Minimum recommended velocities for grinding operations[10] range from 150 to 250 fpm.

Airflow into the common exhaust for the mixing and resin rooms was minimal (less than 50 fpm) when the door to the mixing room was open. Flow was 150 to 200 fpm when that door was closed. There is no recommended flow published for this type of system, but it was not adequate to eliminate strong odors in these rooms. However, employees did not spend much time in these areas and therefore probably were not exposed to toxic concentrations from this situation.

Sixteen employees were informally interviewed regarding health problems. Most stated they at one time or another had minor problems, but they did not feel in most cases that these were work-related. Complaints included sinus problems, respiratory irritation and difficulty breathing (5); dry skin (7); watery eyes (1); and headache (1). All said their problems were transient and not present on the days of the evaluation.

E. Summary and Conclusions

Results of this evaluation indicate that some employees working in Building 8 (Departments 2731 and 2732) were exposed to potentially toxic concentrations of styrene on the days during which the atmospheric samples were taken. All but one of these potentially toxic exposures were short-term and were generally the result of emissions during lay-up of large molds. No toxic exposures were found to methyl alcohol, butadiene, acrylonitrile, acetone, trichloroethylene, particulate, methylene chloride, or methyl ethyl ketone. The response to questions asked during employee interviews indicated that, other than occasional overexposures to irritant vapors, there were few job-related complaints.

V. RECOMMENDATIONS

The addition of local exhaust ventilation appears to be the most feasible method for eliminating toxic exposures of employees to styrene in the lay-up process. The use of respirators is acceptable as an interim measure while ventilation is being designed and installed, but not as a permanent solution. According to a company spokesman, local exhaust ventilation was installed to control emissions from the nose cone lay-up operation subsequent to the on-site sampling conducted by NIOSH. As a result, the resin fumes could no longer be detected by smell in this operation. It is recommended, however, that short-term detector tube or charcoal tube samples be used to measure styrene concentrations during this operation since olfactory fatigue might be decreasing a person's ability to detect styrene.

It is also recommended that the effectiveness of ventilation in the mixing and resin rooms be reviewed. While employees did not appear to spend enough time in these rooms to be exposed to toxic doses of the substances used or stored there, vapor concentrations were strong enough to cause upper respiratory irritation and lacrimation to NIOSH investigators while taking ventilation measurements. The exhaust duct was located in such a way that in most instances the employee was positioned between the duct and the substance with which he was working, and the vapors from that substance were being drawn through his breathing zone. Simply relocating containers and mixers could minimize this problem. Also, there did not appear to be sufficient makeup air to supply the needs of the exhaust system. When the door to either room was open, there was a strong draft into the room. This air, however, went in almost a straight line to the exhaust vent and did not effectively sweep vapors from most of the room. This indicates that the makeup air supply is neither adequate nor properly distributed.

The effectiveness of the grinding booth ventilation system might also warrant re-evaluation. While ventilation measurements indicated adequate airflow at the face of these booths, the results of particulate samples were higher than would be expected. (The particulate concentrations were not, however, above the evaluation criteria.) This could be due possibly to the grinder throwing the particles away from the exhaust system, or the size of the particles being too large to be effectively captured by the face velocity. Either situation might be improved by increasing the face velocity. This could be done by installing a door on each booth which could be lowered to decrease the open area of the face of each booth which in turn would increase the velocity of the air through the opening. When larger pieces were being finished, this door could be raised to accomodate them.

Recommended work practices include the use of gloves when possible to reduce absorbtion of styrene through the skin and also to reduce skin dryness and irritation due to exposure primarily of hands to resins and acetone. The continued use of skin lotion or moisturizer is recommended. The use of air hoses to blow dust off of clothing and equipment as a means of cleaning should be discontinued.

VI. REFERENCES

1. U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Safety and Health Standards, 29 CFR 1910, Revised January, 1978.

2. Criteria for a Recommended Standard ... Occupational Exposure to Methyl Alcohol, DHEW (NIOSH) Publication No. 76-148, Cincinnati, Ohio 1976.

3. Criteria for a Recommended Standard ... Occupational Exposure to Acetone, DHEW (NIOSH) Publication No. 78-173, Cincinnati, Ohio 1978.

4. Criteria for a Recommended Standard ... Occupational Exposure to Trichloroethylene, DHEW (NIOSH) Publication No. 73-11025, Cincinnati, Ohio 1973.

5. Criteria for a Recommended Standard ... Occupational Exposure to Methylene Chloride, DHEW (NIOSH) Publication No. 76-178, Cincinnati, Ohio 1976.

6. Criteria for a Recommended Standard ... Occupational Exposure to Methyl Ethyl Ketone, DHEW (NIOSH) Publication No. 78-173, Cincinnati, Ohio 1978.

7. Special Occupational Hazard Review With Control Recommendations - Trichloroethylene, DHEW (NIOSH) Publication No. 78-130, Cincinnati, Ohio 1978.

8. American Conference of Governmental Industrial Hygienists, Documentation of the Threshold Limit Values for Substances in Workroom Air, 1977.

9. Current Intelligence Bulletin 18, Acrylonitrile, U.S. Department of Health, Education, and Welfare, NIOSH, July 1, 1977.

10. Industrial Ventilation, A Manual of Recommended Practice, 13th Ed., 1974, American Conference of Governmental Industrial Hygienists.

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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TABLE I

Long-Term Styrene Concentrations

August 3 & 4, 1978

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

Department	Description	Type*	Day	Time	Concentration
2732	Lay-up Person, Small Parts	P	8/3	8:10 am- 3:05 pm	37 ppm
2732	Gluing in Assembly Area	P	"	7:45 am- 3:10 pm	22 ppm
2732	Assembly Person	P	"	7:50 am-12:10 pm	53 ppm
2732	Lay-up Person	P	"	7:50 am- 3:45 pm	49 ppm
2732	" "	P	"	7:55 am- 3:05 pm	60 ppm
2732	Nose Cone Lay-up	P	"	7:55 am-11:56 am	25 ppm
2732	Patch and Grind	P	"	7:30 am- 3:00 pm	29 ppm
2732	Patch and Grind	P	"	7:25 am- 3:10 pm	13 ppm
2732	Gluing in Assembly Area	P	"	7:35 am- 3:45 pm	12 ppm
2732	Patch and Grind	P	"	7:10 am- 3:10 pm	8 ppm
2732	Assembly Person	P	"	7:40 am- 3:10 pm	8 ppm
2732	Lay-up Person	P	"	8:10 am- 3:10 pm	29 ppm
2732	Patch and Grind	P	"	9:10 am- 3:05 pm	18 ppm
2732	Lay-up, Small Parts	P	"	12:35 pm- 3:00 pm	67 ppm
2732	Patch and Grind	P	"	12:40 pm- 3:05 pm	23 ppm
2732	Assembly	P	"	12:40 pm- 3:45 pm	11 ppm
2732	Lay-up Person, Large Molds	P	8/4	7:15 am-11:35 am	35 ppm
2732	Patch and Grind	P	"	7:10 am- 3:50 pm	13 ppm
2732	" " "	P	"	7:10 am- 2:50 pm	15 ppm
2732	" " "	P	"	7:10 am- 3:55 pm	29 ppm
2732	" " "	P	"	7:10 am- 3:55 pm	12 ppm
2732	Lay-up Person	P	"	7:20 am- 3:50 pm	52 ppm
2732	" " , Large Molds	P	"	7:30 am- 2:45 pm	67 ppm
2732	" "	P	"	7:35 am- 2:50 pm	44 ppm
2732	" "	P	"	7:35 am- 3:50 pm	52 ppm
2732	Assembly	P	"	7:55 am- 1:30 pm	10 ppm
	Environmental Criteria				100 ppm

* "P" Indicates Personal Breathing Zone Sample

TABLE II

Short-Term Styrene Concentrations

August 3 & 4, 1978

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

Department	Description	Type*	Day	Time	Concentration
2732	Lay-up Person, Making Nose Cone	P	8/3	11:05 am-11:25 am	162 ppm
"	" " " "	H	"	11:08 am-11:23 am	174 ppm
"	" " " Part 161 Top	P	"	1:28 pm- 1:49 pm	129 ppm
"	4 Ft. Behind 161 Top Mold	A	"	1:32 pm- 1:49 pm	39 ppm
"	3 Ft. in Front of 161 Top Mold	A	"	1:32 pm- 1:49 pm	45 ppm
"	6 Ft. to Left of " " "	A	"	1:32 pm- 1:45 pm	43 ppm
"	Lay-up Person Making Part 161 Top	H	"	1:32 pm- 1:47 pm	122 ppm
"	" " " Top 180	P	8/4	8:50 am- 9:20 am	189 ppm
"	" " " " "	H	"	8:50 am- 9:05 am	178 ppm
"	" " " Part 300	H	"	10:09 am-10:24 am	372 ppm
"	" " " " "	H	"	10:09 am-10:24 am	177 ppm
"	" " " " "	P	"	10:08 am-10:36 am	209 ppm
"	" " " Nose Cone	H	"	9:00 am- 9:15 am	1040 ppm
"	" " " " "	P	"	12:44 pm- 1:29 pm	440 ppm
"	" " " " "	H	"	12:45 pm- 1:00 pm	1080 ppm
"	" " " " "	H	"	12:45 pm- 1:05 pm	966 ppm
"	" " " " "	H	"	1:05 pm- 1:10 pm	508 ppm
"	" " " " "	H	"	1:11 pm- 1:16 pm	759 ppm
Environmental Criteria					125 ppm

* "P" Indicates Personal Breathing Zone Sample
"A" Indicates Sample in Area of Work Process
"H" Indicates Sample Held Near Breathing Zone of Employee by Investigator

TABLE III

Methyl Alcohol Concentrations

August 3 & 4, 1978

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

Department	Description	Type*	Day	Time	Concentrations
2732	Assembly Area Worker	P	8/3	7:40 am-3:45 pm	<0.3 ppm
2731	Gluing Small Parts	P	8/3	9:05 am-3:05 pm	<0.4 ppm
2731	Gluing Small Parts	P	8/3	9:10 am-3:05 pm	0.7 ppm
2732	Lay-up Area Worker	P	8/3	9:15 am-3:05 pm	0.3 ppm
2731	Gluing Small Parts	P	8/4	7:40 am-3:50 pm	<0.5 ppm
2731	Gluing Small Parts	P	8/4	7:40 am-3:50 pm	<0.5 ppm
Environmental Criteria					200 ppm

* "P" Indicates Personal Breathing Zone Sample

TABLE IV

Styrene, Acetone and Trichloroethylene Concentrations
August 3 & 4, 1978

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA
HE 78-110

Department	Description	Type*	Day	Time	Concentration, ppm		
					Styrene	Acetone	Trichloroethylene
2732	Lay-Up Person	P	8/3	8:50 am- 3:05 pm	17	15**	2.8
2732	Lay-Up Person, Nose Cone	P	8/4	7:15 am-11:45 am	74	88**	1.8
2732	Lay-Up Person, Small Parts	P	8/3	8:05 am-10:00 am	35	71**	1.6
2732	Lay-Up Person, Small Parts	P	8/3	10:00 am-11:50 am	76	117**	1.2
2732	Mixer	P	8/3	8:15 am- 3:10 pm	19	18**	1.5
2732	Lay-Up Person, Nose Cone	P	8/4	11:45 am- 3:50 pm	293	15**	3.0
2732	Lay-Up Person	P	8/3	8:10 am-11:50 am	29	109**	-
2732	Lay-Up Person	P	8/3	12:40 pm- 3:10 pm	26	36	-
2732	Lay-Up Person, Door	P	8/4	7:25 am- 2:50 pm	61	13**	-
2732	Patch & Grind Person	P	8/3	7:15 am-10:00 am	47	39**	-
2732	Patch & Grind Person	P	8/3	10:00 am-11:50 am	46	58**	-
2732	Assembly Person	P	8/3	8:35 am-10:05 am	6	7	-
2732	Assembly Person	P	8/3	10:05 am-11:50 am	8	12	-
Environmental Criteria					100	250	25

* "P" Indicates Personal Breathing Zone Sample

** A significant amount of acetone was found on the backup section of these charcoal tube samples, and it should be assumed that these are minimum values as reported here

TABLE V

Styrene, Acrylonitrile and Butadiene Concentrations

August 3 & 4, 1978

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

Department	Description	Type*	Day	Time	Concentration, ppm		
					Styrene	Acrylo-Nitrile	Butadiene
2731	Oven man	P	8/4	7:45am- 2:15pm	4.0	<0.8	<0.7
2731	Attached to oven frame	A	8/4	7:50am-11:45am	1.5	<1.0	<1.0
2731	Attached to oven frame	A	8/4	11:45am- 2:55pm	2.5	<1.4	<1.3
2731	Oven man	P	8/3	8:25am- 3:05pm	5.4	<0.8	<0.8
Evaluation Criteria					100	**	1000

* "P" Indicates Personal Breathing Zone Sample

"A" Indicates sample in area of workplace

** See Text

TABLE VI

Total Particulate Concentrations

August 3 & 4, 1978

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

Department	Description	Type*	Day	Time	Concentration
2732	Patch & grind, grinding at a booth	P	8/3	7:20am-11:50am	7.3 mg/M^3
2732	Patch & grind, grinding at a booth	P	8/3	7:25am-11:50am	2.9 mg/M^3
2732	Assembly area person	P	8/3	8:30am-11:50am	0.5 mg/M^3
2732	Cutting fiberglass cloth	P	8/3	8:40am-11:55am	0.4 mg/M^3
2731	Rough saw operator	P	8/3	12:45pm- 3:15pm	0.5 mg/M^3
2732	Patch & grind, not at a booth	P	8/3	12:40pm- 3:00pm	5.0 mg/M^3
2732	Patch & grind, not at a booth	P	8/3	12:50pm- 3:10pm	4.4 mg/M^3
Environmental Criteria					10 mg/M^3

* "P" Indicates Personal Breathing Zone Sample

TABLE VII

Evaluation Criteria

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

Substance	OSHA Standard	NIOSH Recommendation	Threshold Limit Value	Health Effects[a]
Styrene	100 ppm[b] 200 ppm ceiling[c]	NA[d]	100 ppm 125 ppm STEL[e]	irritation of eyes, nose & skin, neurologic impairment
Methyl Alcohol	200 ppm	200 ppm (10 hour TWA) 800 ppm ceiling	200 ppm 250 ppm STEL	narcosis, blindness, metabolic acidosis
Butadiene	1000 ppm	NA	1000 ppm 1250 ppm STEL	eye, nose & throat irritation, narcosis
Acrylonitrile	20 ppm	Carcinogen [f]	NE[g]	lung and bowel cancer
Acetone	1000 ppm	250 ppm (10 hour TWA)	1000 ppm 1250 ppm STEL	CNS depressant, irritation of eyes, nose & throat
Trichloroethylene	100 ppm [h] 200 ppm ceiling	25 ppm [i]	100 ppm 150 ppm STEL	central nervous system depressant
Total Particulate	15 mg/M^3	NA	10 mg/M^3	irritation of eyes and upper respiratory tract, reduced visability, skin damage
Methylene Chloride	500 ppm 1000 ppm ceiling[j]	75 ppm [k] (10 hour TWA)	100 ppm 500 ppm STEL	CNS effects, increased carboxyhemoblobin
Methyl Ethyl Ketone	200 ppm	200 ppm (10 hour TWA)	200 ppm 300 ppm STEL	irritation of eyes, nose and throat

TABLE VII (Continued)

Evaluation Criteria

PIPER AIRCRAFT COMPANY
VERO BEACH, FLORIDA

HE 78-110

(a) Primary effects considered in establishing NIOSH Recommended Standards when available, otherwise effects described by ACGIH

(b) Criteria are 8-hour time-weighted averages except as noted

(c) Standard includes provision for acceptable maximum peak of 600 ppm above ceiling value for 5 minutes in any 3 hours

(d) Recommended exposure limits not available for these substances

(e) Short-term exposure limit

(f) This substance should be treated as a carcinogen during its manufacturing and polymerization

(g) No exposure as detected by the most sensitive methods

(h) Standard includes provision for acceptance maximum peak of 300 ppm above ceiling value for 5 minutes in any 2 hours

(i) The previous Recommended Standard of 100 ppm with a 10-minute ceiling of 150 ppm appears adequate to prevent CNS effects. Technology is available, however, to control exposure to below 25 ppm, and due to the question of carcinogenic potential of trichloroethylene this limit is recommended by NIOSH.

(j) Standard includes provision for acceptable maximum peak of 2000 ppm above ceiling value for 5 minutes in any 2 hours

(k) This value becomes smaller if carbon monoxide concentrations are greater than 9 ppm