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

HEALTH HAZARD EVALUATION DETERMINATION
REPORTS 76-67 and 77-30-405
FISCHER AND PORTER COMPANY
WARMINSTER, PA

JULY 1977

I. TOXICITY DETERMINATION

It has been determined that employees were not exposed to toxic concentrations of organic vapors in the force motor assembly area. Potentially toxic exposures of ozone were noted at the automatic MIG/TIG welding operation in the welding department. These determinations are based on analysis of air sampling results both laboratory and direct-reading, non-directed interviews of employees and observations of working conditions.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this hazard evaluation determination report are 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:

a) Fischer and Porter Company, Warminster, PA
b) Authorized Representative of Employees
c) U.S. Department of Labor, Region III
d) NIOSH, Region III

For the purpose of informing the approximately 20 affected employees, this report shall be posted for a period of at least 30 days in a prominent place readily accessible to workers.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S. Code 669 (a)(6), authorizes the Secretary of Health, Education and Welfare, following a written request by an employer or authorized representative of the 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 two such requests from an authorized representative of the Fischer and Porter Company to evaluate: 1) dizziness and nausea at the force motor assembly and gluing operations, and 2) drying of nostrils in the area of "Heliweld Automatic, MIG/TIG welder."

IV. HEALTH HAZARD EVALUATION

A. Plant process - Conditions of use

As part of the "force motor" assembly, machined magnetic frame parts are placed into a jig and the top coated with Loctite 312® accelerator using a cotton swab. The part is allowed to dry for two minutes before the adhesive is applied. A top plate or cover is placed on the frame and clamped into a jig to set.

Prior to the initial visit to the area, local exhaust ventilation was installed on the work bench near the drying jig to control vapors.

The second area of investigation involved the manufacturer of evaporators used for metering systems. Mild steel parts are welded together using alternate M.I.G. and T.I.G. welds. Conventional stick welding and silver sodering are also performed in other areas of the welding shop.

B. Evaluation Design

An initial survey was conducted on June 14 and 15, 1976. Air samples were collected on activated charcoal tubes to evaluate employee exposures to acetone, the most volatile component of the Loctite accelerator.

Past and present employees who had performed the adhesive work, were interviewed using a non-directed questioning technique.

Air samples were subsequently analyzed for the most volatile and major constituent. When little meaningful data was obtained from these samples, bulk samples of the adhesive and accelerator were examined using gas chromatography for additional vaporization products.

The only material that appeared to merit additional air sampling was a butyl amine/butyl aldehyde complex. This decision was based primarily on the noted odor properties of amines and trace amounts being detected in air above bulk samples. Efforts were then made to collect the additional samples for the amine/aldehyde complex, however, due to the sporadic nature of the operation, efforts were unsuccessful.

When the request regarding the welding area was received, an effort was made to coordinate the two surveys. This resulted in a delay of the initial visit for the welding shop evaluation.

A second survey was conducted on March 10, 1977, this time in the

welding shop to review operations and controls. Direct-reading detector tubes were used to evaluate the Automatic MIG/TIG welder for ozone while running M.I.G. When discrepancies were noted between different manufacturers' ozone tubes, the decision was made to return and repeat the ozone determination using a more sensitive method of evaluation for comparison with detector tube results. Upon returning to conduct the environmental sampling, detector tube results no longer indicated a problem. Since symptoms noted during initial visit were also absent, the decision was made to forego the time consuming wet chemistry laboratory samples.

C. Methods of Evaluation

Employees exposure to acetone during accelerator application were evaluated by collecting air samples on activated charcoal. Samples were subsequently analyzed for acetone by gas chromatography using P & CAM #127[1]. The limit of sensitivity for this method was 0.01 mg acetone per sample.

Bulk samples of Loctite 312® accelerator and adhesive were analyzed three different ways for possible volatile components. Each bulk was put into several solvents (water carbon disulfide, methanol) and run by gas chromatography and gas chromatography-mass spectrometry (GC/MS). Thirty minute charcoal tube and silica gel tube samples were collected above each bulk desorbed and analyzed. In addition, 60-minute samples were also generated and run by GC/MS.

Employee exposures were evaluated at the welding operation using both MSA and Drager ozone tubes. It should be noted that detector tubes provide only a semi-quantitative method for estimating the concentrations of ozone in air. NIOSH requires an accuracy of ±35% at 1/2 the exposure limit and 25% at 1 to 5 times the exposure limit, for detector tubes to be certified. While these tubes may meet this criteria to date neither type of tube has been certified.

The range of operation for the Drager tubes is 0.05 to 14.0 ppm while the MSA tube can detect between 0.05 and 5.0 ppm.

D. Evaluation Criteria

The primary source of criteria used in this evaluation was the American Conference of Governmental Industrial Hgyienists (ACGIH): Threshold Limit Values for Chemical Substances for 1976 are as follows:

	TWA
Acetone	1,000 ppm
Ozone	0.1 ppm

The 1976 TLV list also included a new listing referred to as the Threshold Limit Value - Short Term Exposure Limit (TLV - STEL) which is defined as the maximal concentration to which workers can be exposed for

a period up to 15 minutes continuously without suffering from: 1) intolerable irritation, 2) chronic or irreversible tissue change, or 3) narcosis of sufficient degree to increase accident proneness. The STEL should be considered a maximal allowable concentration or absolute ceiling not to be exceeded at any time during the 15 minute excursion.

E. Results and Discussion

Force Motor Assembly

Environmental air samples collected at the time of the initial visit and analyzed for acetone ranged from 5 ppm to less than 0.04 ppm with 14 out of 19 samples being less than the limit of detection, which is generally less than 1.0 ppm acetone.

Since results indicated that levels were less than the odor threshold[2] for acetone and since employees complained about the odors of both halves of the adhesive efforts were made to identify additional adhesive vaporization products. A summary for analyses is as follows:

Accelerator

(1) Direct Solution - By far the major component was acetone, identified by GC/MS. A possible trace of butyl amine also was indicated. The solution also run by colorimetric procedure gave a positive indication for an amine.

(2) Silica gel - desorbed with acid-base, and run by colorimetric procedure, gave a positive indication for amine.

(3) Charcoal tubes - desorbed with CS_2 and run by GC/MS. The only peak detected and identified was acetone.

Adhesive

(1) Direct Solution - Put into both CS_2 and methanol and run by GC/MS using two different columns. Major component was identified as hydroxypropyl methacrylate. A small amount of cumene hydroperoxide and derivatives were indicated.

(2) Silica Gel Tube - desorbed in methanol and run by GC. No. peaks detected in high enough concentration to be identified by GC/MS.

(3) Charcoal Tube - desorbed in CS_2 and run by GC. 30-minute sample displayed no detectable peaks. 60-minute sample had only one major peak. GC/MS identified this peak to be cumene (isopropyl benzene). No hydroxypropyl methacrylate was found in the CS_2 desorbed samples.

Subsequent efforts to collect air samples for butyl amine/butyl aldehyde were unsuccessful due to the limited and sporadic nature of this operation.

A summary of results of non-directed employee interviews conducted during the initial visit in the forcemotor assembly area can be found in Table II. The responses were subjective in nature and no attempt was made to diagnose any symptoms. While symptoms did appear to be related to working with the adhesive in question, no apparent trend that aided in resolving the question at hand was noted.

Evaporator Welding

Environmental samples collected on March 10, 1977, using MSA detector tubes, indicated that ozone concentrations present were in the range of 0.4 to 0.5 ppm. A discrepancy existed, however, between the MSA and Drager tubes which indicated little or minimal ozone in the area, (Table III). One possible explanation for the discrepancy was that the Drager tubes had been redated for expiration from October, 1975 to October, 1977, and thus might be expected to read low.

Symptomatic responses of workers and the investigator included: eye irritation and drying of the nose and throat, while in the area where MIG welding was being done. This correlates well with the expected respiratory irritation with excessive exposure to ozone[3] which included: dryness of upper respiratory passages; irritation of mucous membranes of nose and throat. Higher concentrations may result in: choking, coughing, severe fatique, impaired lung function lasting up to 24 hours, bronchial irritation, substernal soreness, cough.

It should be noted that while sampling with detector tubes, the investigator received a "sunburn" on the side of the face, which developed later in the day from the intensity of the welding flash or light of the arc.

Verbal recommendations were made regarding contacting the manufacturer of the welding equipment to insure its proper operation, which was subsequently done.

A re-evaluation was made on March 31, 1977 at which time readings using MSA detector tubes gave no detectable reponse for ozone. In addition, no irritation was noted in the area of the welder during either MIG or TIG Automatic Welding. Based on this information the decision was made not to sample for ozone using the time consuming and awkward wet chemistry method.

A review of operating conditions noted on March 10th as compared to those on the 31st, although varied slightly, were basically the same. In the opinion of both the equipment manufacturer and management officials present, the variations noted were normal and would not have caused the conditions previously noted.

V. CONCLUSIONS & RECOMMENDATIONS

Environmental data collected at the adhesive operation indicate that

exposures are within the environmental criteria for acetone, the most volatile component of the adhesive and activator systems.

Further examination of bulk samples of both the activator and the adhesive confirmed that acetone would be the major air contaminant expected. Should the level of actone be maintained within acceptable levels then the risk of exposure to the remaining volatization products should be minimal.

This minimal risk factor and the decrease in complaints indicate that mechanical exhaust ventilation in the work area is adequate to control exposures. It is recommended, however, that the present ventilation system be slightly modified to improve its effectiveness. These modifications include:

1) Installing a flange around the table slot exhaust similar to the one shown in Attachment "A". (4)

2) Positioning the exhaust as close to the work area as possible. If the distance can not be reduced, then the rate of exhaust must be increased according to the distance from the work area (see also Attachment "A").

Environmental data collected at the automatic MIG/TIG welding equipment during MIG Welding exceeded the tentative ACGIH short term exposure limit for ozone. Although there was some question regarding the detector tube results, symptoms associated with excessive exposures to ozone confirmed the higher readings. The existence of ozone especially in the area of high energy welding has previously been recognized(5) and more recently charcoal "ozone filters" have been advocated for exhaust systems used during T.I.G. welding by some manufacturers. Why ozone levels of this magnitude were encountered on March 10, 1977 yet not present under similar conditions on March 31, 1977 can not be explained at this time. As a result of the initial findings, the following recommendations are made:

1) Institute a program of periodic ozone monitoring to insure continuing exposures are within acceptable levels.

2) Institute a program of preplacement and periodic medical monitoring of employees exposed to ozone. Pre-employment physical examinations should identify persons with significant respiratory diseases who should not be exposed to ozone. Periodic examinations should be directed at respiratory changes and eye problems and include chest x-rays and pulmonary function tests.(3)

During the initial visit to look at the welding shop a question regarding odors from scrap areas was discussed. In particular, questions were asked about a chlorinated solvent storage tank leakage. Although no specific monitoring was done for this problem after reviewing the area, the possibility of phosgene generation was discussed. Whenever chlorinated hydrocarbon vapors are in the area of welding equipment,

there is the potential for the chlorinated hydrocarbon to be decomposed with one of the products being the highly toxic gas phosgene. The complete elimination of these conditions appears remote, however, if workers are aware of the presence of the chlorinated hydrocarbons, welding can be and should be curtailed until the condition is corrected. One possible way of achieving this recognition would be through the installation of a continuous Halide monitoring system. Systems of this nature with audible alarms are available from numerous equipment manufacturers.

VI. REFERENCES

1) NIOSH Manual of Analytical Methods, HEW Publication No. 75-121, P & CAM 127 Characterization of Odor Properties of 101 Petrochemicals Using Sensory Methods Hellman, TM, Small, FH

2) Journal of the Air Pollution Control Association, Vol. 24, No. 10. October, 1974.

3) Unpublished data from upcoming revision of Occupational Diseases, A Guide to Their Recognition. To be published September, 1977

4) Industrial Ventilation. A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists, 14th Edition, Page 5 - 53, 1976.

5) Patty, F. A.. Industrial Hygiene and Toxicology, Second Revised Edition, Vol. II, Page 938, 1967

VII. ACKNOWLEDGMENTS

Report Prepared by	Wesley E. Straub Regional Industrial Hygienist Philadelphia, PA
Originating Office	Jerome P. Flesch, Acting Chief Hazard Evaluation and Technical Assistance Branch Cincinnati, Ohio
Laboratory Analysis-Acetone	Steven Hudson. Chemist Utah Biomedical Test Laboratory Salt Lake City Utah
Qualitative Work for Accelerator and Adhesive	Ardith Grote, Chemist NIOSH Measurement and Support Branch Cincinnati, Ohio

Table I
Fischer and Porter Company
Warminster, PA
Acetone Concentrations

Location	Time	Sample	PPM*	Comments
Force Motor Assembly	10:30-12:30	C-1	<0.4	Operator's Exposure, gluing frame, fan on
	10:00-12:30	C-6	<0.6	
	10:00-15:00	C-9	<0.4	
	10:30-15:30	C-10	<0.04	
	10:30-12:30	C-11	<0.04	Operator's Exposure, gluing frames, fan off
	10:30-15:30	C-2	5.7	Operator's Exposure, gluing frames, all day sample
	10:00-15:20	C-17	1.1	
	10:00-12:30	C-16	1.2	Operator's Exposure, gluing frames, AM sample
	1:30-15:30	C-18	<0.5	Operator's Exposure, gluing frames, PM sample
	10:30-12:15	C-3	<0.4	General air, right side of work bench
	10:05-15:30	C-12	<0.2	
	10:35-12:10	C-4	<0.4	General air, left side of work bench
	10:30-12:00	C-5	<0.5	
	10:00-15:30	C-13	1.3	
	10:30-12:00	C-7	<0.8	General air, center of work bench
	10:30-12:00	C-9	<0.4	
	10:00-12:30	C-14	<0.2	
	10:00-12:30	C-15	0.4	
	13:15-15:00	C-19	<0.8	

* Denotes parts per million - Threshold Limit Value^{R} based on a time-weighted average exposures for an eight-hour working day 1,000 ppm.

< Denotes less than.

Table II
Fischer and Porter Company
Warminster, PA

SUMMARY OF RESPONSES DURING
NON-DIRECTED INTERVIEWS

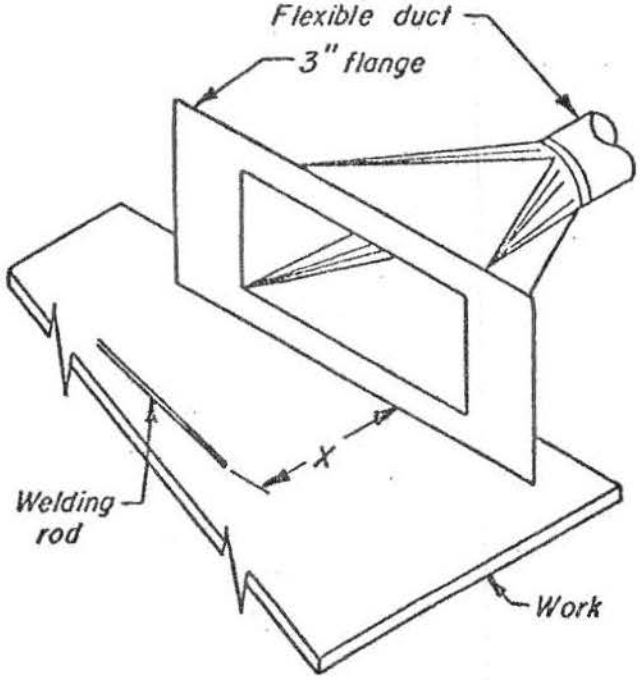
COMPOUND	OCCURRENCE*	COMPLAINT	FREQUENCY
Loctite Minute Bond Adhesive	16	Lightheaded or Dizziness	7
		Ear Ache	1
		Eye Irritation	3
		Nose Irritation	7
		Sore Throat	3
		Headache	9
		Breathing Difficulty	2
		Coughing	2
		Dermatitis	3
		Listless-Drowsiness	3
		Nausea	2
Resiweld[R]	5	Breathing Problems	1
		Dermatitis	3
		Irritating Odor	2
Vacuum Grease	2	Dermatitis	1
		Eye Irritation	1
Solder Flux Vapors	2	Tired	1
		Headache	1
		Odor Strong	1
Lubri Plate[R]	2	Dermatitis	1
		Odor Strong	1

*Number of workers with complaint(s) related to indicated compound.

Table III
Fischer and Porter Company
Warminster, PA
Ozone Concentrations

Location	PPM* March 10	March 31	Comments
Welding Shop	0.5	0.05	General Air, MSA Detector tube by transformer
	0.05 0.05		General Air, Drager Detector tubes transformer
	0.4 0.5	0.05 0.05	Operator's Exposure, MSA Detector tubes, during MIG welding
		0.05	Operator's Exposure, MSA Detector tubes, during TIG welding

* Denotes parts of ozone per million parts of Air. Threshold Limit Value based on an 8-hour time weighted average is 0.1 ppm. Short term exposure limit not to be exceeded at any time during the 15 minute excursion period is 0.3 ppm.



PORTABLE EXHAUST

X, inches	Plain duct cfm	Flange or cone cfm
up to 6	335	250
6 - 9	755	560
9 -12	1335	1000

Face velocity = 1500 fpm
Duct velocity = 3000 fpm minimum
Entry loss = 0.25 duct VP
Also see "Granite Cutting" VS-909

GENERAL VENTILATION, where local exhaust cannot be used:

Rod, diam	cfm/welder
5/32	1000
3/16	1500
1/4	3500
3/8	4500

OR

A. For open areas, where welding fume can rise away from the breathing zone:
cfm required = 800x lb/hour rod used
B. For enclosed areas or positions where fume does not readily escape breathing zone:
cfm required = 1600 x lb/hour rod used

For toxic materials higher airflows are necessary and operator may require respiratory protection equipment.

OTHER TYPES OF HOODS
Bench: See VS-416
Booth: For design See VS-415, VS-604
Q=100 cfm/sq ft of face opening

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

WELDING BENCH

DATE 1-76 | VS-413.1